GOVERNMENT OF ODISHA
DEPARTMENT OF WATER RESOURCES

BIDDING DOCUMENT (PRESSURISED UGPL) FOR

EPC CONTRACT

Bid Identification No.: CEBM-RBVN-(GID -01)/2026-27

NAME OF WORK

Construction of distribution system of Nuagaon Barrage Project through UGPL(Pressure Flow) system for CCA of 1979Ha in Gajapati District of state of Odisha including electro-mechanical work, power connectivity, Staff quarter and including survey, investigation, planning, design and estimate of all components with operation and maintenance of the project for a period of five years or five flood seasons whichever is more after successful commissioning of the project

VOLUME –II

TECHNICAL SPECIFICATION

(EPC CONTRACT)

Chief Engineer & Basin Manager,
RBVN Basin,Brahmapur

VOLUME-II

TECHNICALSPECIFICATIONS

VOLUME-II
TECHNICALSPECIFICATIONS

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SECTION-I

GENERAL

SECTION–I

GENERAL

THE SPECIFICATIONS CONTAINED UNDER DIFFERENT SECTIONS IN THIS DOCUMENT ARE FOR GENERAL GUIDANCE. IN CASE OF DISAGREEMENT BETWEEN THE SPECIFICATION OF THE DEPARTMENT AND STANDARD PRACTICES BEING FOLLOWED AND/OR SPECIFICATIONS NOT PROVIDED SPECIFICALLY, THEN RELEVANT SPECIFICATIONS UNDER LATEST INDIAN STANDARDS, CWC GUIDELINES & "MANUAL ON WATER SUPPLY AND TREATMENT" PUBLISHED BY CENTRAL PUBLIC HEALTH AND ENVIRONMENTAL ENGINEERING ORGANISATION (CPHEEO), MINISTRY OF URBAN DEVELOPMENT, GOVERNMENT OF INDIA, RELEVANT REGULATIONS OF CEA/CERC/OERC AND APPROVED MANUFACTURER SPECIFICATIONS SHALL PREVAIL.

Section–I

General

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A. EXTENTOF WORK

1.0 GENERAL

This Technical Specification relates to "Planning, Design, Construction & Commissioning of Under Ground Pipe Line Irrigation System (Pressure Flow as Site Condition) for 1979 ha.of CCA and Command Area Developmentof Nuagaon Barrage Project in Gajapati district of Odisha including micro irrigation within the total CCA of1979Ha and O&M for five years onEPC-mode ; comprising work of Detailed Planning, Design, Drawing, Estimation, Preparation of ROW/ROU schedules and commissioning of the UGPL irrigation system along with CAD works and Operation & Maintenance of completed commissioned system for five years or five Kharif crop seasons whichever is later.''

TheBasicProjectProfileandscopeofworkofexecutionofthePressurizedUGPL Irrigation Network system has been detailed in volume –I of the bidding document.

DetailsofworkscoveredintheScopeofWorkforPressurizedUGPLirrigation system is as below :

(A) Detailed Engineering of the whole system along with Micro Irrigation compatible System and for power connectivity of the system conducting Survey, Investigation, Planning and component designs and preparation of estimates.

(B) CivilWorks

I.Construction of RCC Intake works in the reservoir with RCC Duct/pipe up to the Pump house, Filtration System including all river protection works. II.

Constructing Pump House with Panel Room & Operating rooms

III. Approach roads to Pump House

IV. MS/DI Pipeline for Transmission of Water up to delivery chamber (optional) / Pressure main, Surge Control Devices / Water Hammer Control Devices, other appurtenances,

V. Delivery Chamber (optional)and the Irrigation Distribution Network such that Micro Irrigation System can be adopted at later stage through pipes

(C) Mechanical Works

Pumping Machinery &all related mechanical equipment

(D) Electrical Works

Electrical Equipment

(E) Instrumentation Works

Instrumentation Equipment

(F) O&MforCivil,Mechanical&ElectricalWorksfor5years

O & M for Civil, Mechanical, Electrical & Instrumentation Works for 5 yrs. Mandatory Spares,Tools&TacklesrequiredforafterOperation&Maintenance period of 5 yrs.

(G) MiscellaneousWorks

ROU(Righto Fuse)/ROW,Landacquisitionprocessing,forest&environment & other statutory clearances.

II. DetailsofworkscoveredintheScopeofWorkforPowerSystemConnectivityas below :

a) PowerSystemconnectivityfromtheidentifiedlocalGridStationsasdefined under the "Basic Project Profile in Volume-I.

b) O&M for "User's Installation" for period of 05 yrs and 132 kV Sub-Transmission Line shall be with concerned DISCOM.

1.0 PUMPINGSTATIONCOMPLEX

(A) Intakewell/Intakesystem

I. Water shall be drawn from the river for providing Kharif water supply to the command area and Rabi water supply in case of water availability in the river and as decided by Government.

II. The Intake works shall be constructed to draw required quantum of water with provision of arrangement for trash racks, gates and hoists for operation &maintenance. The maximum velocity in the intake works should be limited for minimising losses and silt entry.

III. Necessaryearthwork&Protectionworksintheriveristobe constructed.

IV. All RCC construction of Intake Works will be with M-25 grade concrete as per detailed specification narrated in this document. TMT reinforcement bars and all other ancillary civil work shall be as per the detailed specification in the same volume. However latest IS codal provisions to be followed.

V. Any suitable type of intake system can be chosen by the EPC contractor depending upon site conditionwithproper justification and detailed design to be approvedby the CE&BM, RBVN Basin , Brahmapur.

VI. Necessary temporary arrangements to be made by the EPC contractor by constructing low height check structures for sourcing of water in to the intake system during khariff operation.

(B) **ConstructionofPump House Building**

The Pumping Stations shall be adequate to accommodate required no. of pumps , valves, accessories, panel board, Filtration System, working area for maintenance of pump sets, facilities for proper O&M, cable ducting, pump foundation, pipes support, valve supports, floor drainage arrangementfordrainingthewaterfromoutsidethePumpHouse,deliverypipelineconnections, provision is to be made for sufficient ventilation, lighting to Pump House with exhaust arrangement. Access between floors shall be provided through RCC stair case / ladders. Pump House shall also have sufficient head room for electrically operated over head crane for loading and unloading the equipment. The Pump House shall be designed so as to maintain the noise level inside the Pump House within the permissible limit and to absorb vibration of pump sets while running. The P.H. bottom level is to be provided considering bottom of suction pit of RCC sump for positive suction. Further as the Pump House, Panel Room shall be adjoining to sump, necessary RCC retaining wall shall be provided to withstand the loads as per the design requirement. The minimum inner width of operating floor of pump house shall be 7.5 m and the control room floor width be 8 m.

Construction of an isolated 3 storied building for watch man and operator with plinth area ofabout650sq. ft. In each floor in the pumping station is within the scope of the Contract.

ThecomponentswillincludebutnotlimitedtoPumpingStations

Requirednos.ofPumps(workingandonestandby)andassociatedmotorsatPumping Stations.

b) Power,controlandinstrumentationsystems,associatedaccessoriesandcabling.

c) Pump bowl assembly & Pump discharge pipe work, Non-Return Valves, Expansion Bellows, electrically operated butter fly Valves, etc. onpump suction and delivery. The delivery of each pump shall be connected to a common designed dia. MS pipemanifold header line.

d) Surge&WaterHammerprotectiondevices.

e) NecessaryRCCblockstosupportpipelinewiththrustblocksasperrequirement.

f) Rawwatersumpwithwaterlevelindicators&control panel.

g) Rawwater/suctionchamberwaterlevelindicator(Physical)

h) EmergencypushbuttonsneartoHTmotors

i) Switchgearandaccessories

j) CapacitorsformainpumpmotorsandforAuxiliaryLTload

k) Arrangementsfor receiving power from OPTCL and stepping down to requiredvoltage, power distribution etc.

l) Arrangements of HT overhead line/ cabling from new MSDSS power supply to 6.6kV switch yard incomer.

m) Lighting,earthlingandlightningprotectionsystem,fire

extinguisher

n) DC system

o) Any other equipment like EOT Crane / system not mentioned above but required for satisfactory operation of the Pump House.

DesignConsiderations

TheSumpwellcum PumpHouseshallbeofRCCstructuresquare/circularshapedependingon hydraulic performance of pumping constructed in minimum M-25 grade concrete. The gradeof reinforcing steel in the sump / suction chamber structure shall be of TMT steel. It shall be a R.C.C. vertical wall for P.H. up to plinth level and RCC framed structure with brick masonry wallsabovetheroofofthePumpHouseshallbeofRCCslabwithwaterproofing.Thedesignof the Pump House and its foundation shall take into account the worst combination of loadsand forces such as service loads, wind load, uplift forces, seismic loads for the zone, dynamic forces due to vibration of pumps, ensuring total structural safety.

2.0 WATER TRANSMISSION MAINS

2.1 General arrangement of lifting raw water and also necessary filtration system for Micro Irrigation System at later stage for the desired command area and designated maximum discharge from project has been detailed in Volume – I & under the Vol-II.

2.2 The contractor has to Survey, plan, design most economical transmission line MS Rising main/Pressure main with MS Pipe with External Coating and Internal Epoxy Painting 406 Micron as per detail specification Or Ductile Iron Pipe Line of K9/K7 as per design and external & internal coatings as per the detailed specification.

2.3 **DesignconsiderationsforMSPipelineSystem**

2.3.1 Submerged Arc welded Hot finished Mild Steel bevelled pipes manufactured from MS plate confirming to IS 2062-1999 or hot rolled steel coilsconfirming to IS 10748 and fabricated pipes procured from manufacturer shall bear ISI mark as per IS 3589 / 2001, and pipes with inside 406 microns food grade epoxy coating as per detailed specification and outside 4 mm thick coal tar tape coating as per IS 15337:2003 or latest revision / amendments if any shall be used. The pipeline shall be buried.

2.3.2 Appropriate bedding / concrete encasement in accordance with loading on pipeline, anchor / thrust blocks, saddle supports for pipeline above ground level and other accessories shall also be considered for design.

2.3.3 The pipeline shall be provided with required number of Double Orifice Tamper Proof Air Valves with Isolation Valves at a distance, not more than 500 M along the length and at humps.

2.3.4 Isolating / Butterfly Valves in main line shall be provided with at a distance not more than 5 Km along the pipeline with manhole arrangement.

2.3.5 The pipeline shall be provided with required sizes & type of scour valve / Sluice Valves as per requirements.

2.3.6 The pipeline shall also be provided with Surge Control Devices / System as per the design at required chainage / length.

2.3.7 The technical requirements of different type of valves are as per the technical specifications – under Indian Standards or International Standards for the related items of the valves and appurtenances.

3.0 OPERATION&MAINTENANCESTAFFINGFORUGPLSYSTEM

The contractor shall provide all the necessary operating staff and maintenance personnel to operate and maintain the works forFive years Operation and Maintenance contract period under the contract. Contractor will train local personnel of PaniPanchayat and engage them in the O&M so that the capacity of Beneficiaries are enhanced and they become capable to effectively manage the Scheme.The contractor shall provide a detailed proposed staffing schedule covering all categories of his staff with duties, responsibilities, qualification, experience and their salaries, etc. The staffing schedule shall be prepared on assumption that thesystemwillbeoperatedona24hoursperdaybasiswiththreeequalshiftsof8hourseach for the crop calendar period. The inspection vehicles and staff required for the maintenance and operation of the pipeline shall also be considered for three equal shifts of 8 hours.

4.0 EQUIPMENT&OTHERANCILLIARYWORKSFORRAWWATERPUMPINGSYSTEMFOR PUMPING STATIONS

Theequipmentsshallincludebutnotlimitedto:

a) Piping, valves, fitting and all accessories within or in connection with system units and ancillary structures.

b) Mechanical and other equipments such as trolleys, pallets and hoists for handling, storing and lifting of plant items concerned.

c) All pipelines including connections, interconnecting pipe works including making connections, tapping where necessary, procurement of all materials, fabrication of pipes, bends, tapers, flanges, manholes, fittings, valves, flushing connections, washouts, flexible couplings, dismantling / expansion joints, linking, finishes, pipe protection, supports, anchor block, thrust block etc.

d) Painting, lining, finishing after erection of all plants required for water pumping plant, commissioning tests and performance tests, operation and maintenance of raw water pumping plant during entire O & M period of 05 years.

e) The surge control devices are to be provided as per contractor's own design and approved by Department.

5.0 PUMPINGPLANTSANDDESIGNPARAMETERS

Theplantshallbedesigned,selectedandinstalledtakingintoaccountlocalsiteambient conditions.

6.0 LIFEEXPECTANCYOFWORKS

Thecontractorshalldesigntheworksforalifeexpectancyasfollows:

Concrete Structures	:	60 Years
MechanicalPlants	:	20Years
Electrical Plants	:	25 Years
Buried Earth Electrical System:		50Years
Control Panels	:	25 Years
External Instrumentation Systems:		15 Years
MSPipeLine	:	30Years
DistributionPipeLine	:	30Years

7.0 ELECTRICALSYSTEMS

Allsupplyandinstallationworksrequiredforappropriatefunctioningoftheplant.

8.0 SUPERVISORY/ANNUNCIATIONSYSTEMS

Instruments, indicators, measuring and transmitting devices, meters (flow meters) at entry, gauges, gauge plates, consoles, annunciation panels / cubicles, stands, connections, cabling andwiringandotherequipments,materialandaccessoriesnecessaryforinterconnectionof earthing and lighting with starter grids.

9.0 SERVICEWATERINSTALLATIONS

Pumps,motors,valves,stationpipeworksandallaccessoriesnecessaryforservicewater systems for water supply for plants.

10.0 GENERALUTILITIES

Otherutilitiesnecessaryfortheproperfunctioningoftheproposedworkswhichshallbe included under this Contract but not limited to the following for Pumping Stations are:

a) Fire Fighting arrangement in the Pump House shall be provided as per the Indian Standards

b) Site development includesecological development, boundary wall with suitablegates. Site development also includes raising GL at Pumping Station by selected excavated earth including proper ramming, watering, consolidation of earth work, etc. The finished ground levelof the plot shall be brought toLevel atleast onemeter above the local Flood Level.The filling shall be done in uniform layers of 15 cm. to 20 cm. thick and shall be well watered and well compacted with suitable power roller.

c) Internalroads&approachroadrequiredtoHeadWorksfromexistingroad, etc.

d) Electricsubstationanddistributionofpowersupplytoallnecessarypoints.

11.0 APPLICABLESTANDARDS

Reference to all the standards shall be meant for the latest revision of that standard and allthe equipments shall be of approved make only.

SUBMISSIONSTOBEMADEONDETAILEDENGINEERINGOFTHE PRESSURIZED UGPL SYSTEM

DRAWINGS,DOCUMENTS,CERTIFICATES,MANUALS

The envisaged Pressurized UGPL Irrigation System is independent catering to commandareas of 1979 Ha. Hence the Detailed Survey & Investigation works, Planning andDesign Works can be taken up simultaneously. All the components have to be done for thesystem. The detailed scope of services for Survey& Investigation and Design & Engineering has been explained in Volume – I.

1.1 SubmissionandreviewofEngineeringDocuments

1.1.1 The contractor will submit **within 180 days**from award of contract, the following designs and drawings for review and approval of the Engineer In-charge generally in the sequence given below:

(a) Generallayoutplanoftheentire LiftIrrigationSchemeonvillagemaps

(b) Designsanddrawingsforallelectrical,instrumentationandmechanical equipment

(c) Generalarrangementdrawingsforallunitsofworks

(d) Structural design calculations and drawings for all units of work shall be prepared and signed by registered structural engineer. As far as possible all structural drawings shall be drawn with the appropriate scale, neatly giving

allthesectionsanddetailsnecessaryfortheeasyunderstandingof structural details and smooth execution of the work.

(e) Architectural drawings for all buildings and landscaping for entire plant plumbing and electrical drawings.

1.1.2 After review by the department/consultant of the department, Engineer–in-Charge will convey comments, within 30 days from receipt of details from contractor, which the contractor shall incorporate by modifying designs and drawings accordingly.

1.1.3 Inno casewilldesign,calculations/ drawings beconsideredcompleteoracceptable, if

(a) They are not duly signed by respective Architect/ Civil/ Stuctural/ Electrical/ Mechanical Design Engineer(s).

(b) They are not thoroughly checked and duly signed in the appropriate places by contractor and Sub Contractor (if any).

(c) Design calculations are not accompanied by supporting engineering, drawings or appropriate sketches.

(d) Design calculations are incomplete or not fulfilling the design requirements or are shabbily done or are without adequate reference, or other necessary back-up data.

(e) Anycommentspreviouslymadearenotincorporatedonreviseddrawings /calculations.

1.1.4 Suchunacceptеddrawings/designsasdescribedaboveshallbesummarilyrejected andcontractorwillbeinformed.Contractorshall arrangetoresubmitthesameduly checked, revised and signed within 15 days. No claim from contractor for extension of time or for extra cost on this account will be entertained under any circumstances.

1.1.5 The review of civil design calculations and drawings shall be carried out only in respect of correctness of centre-to-centre distances, elevations, important / typical details, orientation and sizes of important members, general design principles and approach, adherence to requirements of the relevant IS or other statutory codes, compliance with the Technical Specifications, general or specific notes and with the requirements of good engineering practice and whether the details shown on drawings conform to design calculations. Check for any interference and taking remedial action is the responsibility of the Contractor.

1.1.6 No check will be specifically carried out by the Engineer–in-Charge to verify arithmetical / numerical accuracy of the calculations, which shall remain entirely the Contractor's responsibility, irrespective of any approval that may have been accorded thereto by the Engineer–in-Charge.

1.1.7 All values / dimensions / elevations, etc. without supporting back-up data adopted / assumed by the contractor in his calculations / drawings shall be taken by the Department to be incorrect unless they are specified.

1.2 Formof Drawings

1.2.1 All drawings submitted for approval shall be ISO standard size sheets, prepared on computerwithAutoCAD2012&above.Everydrawingshallhaveatitleblockinthe bottom right corner showing:

DrawingTitle:

Job:

Client: DEPARTMENTOFWATERRESOURCES,ODISHA

PROJECTDIRECTOR-CUM-CHIEFENGINEER,PMU,MEGALIFTPROJECTS

Consultant:

Contractor:

DrawingNumber:

RevisionNumber:

Date:

1.2.2 Drawings/Documents

Drawings&DocumentstobesubmittedhavebeenoutlinedunderAppendix-Design & Drawing of Volume-I. In addition the following documents areto be furnished.

a) Preliminaryoutlinedrawingsindicatingdetailsofpump,motor,civil foundation, clearances etc.

b) Crosssectionaldrawingsofallequipmentsshowingbillofmaterial&relevant standards.

c) TestreportsforchemicalanalysisofMajorcomponentslikeimpeller,shaft, casing etc.

d) Allperformancetestreports.

e) O&MManual&sparepartlist

f) Qualityassuranceplantobesubmittedforapproval.

g) Start/Stop instructions.

h) Dimensionalsimilarity/interchangeabilitycertificates.

1.2.3 Each pump shall be provided with stainless steel name plate indicating following detail as minimum requirements.

a) Ratedcapacity :M^3/hr.

b) TotalHead :MWC

c) Speed :RPM

d) Ratedpower :KWat50 Hz

e) Testpressure : Kg/cm^2orKg/m^2

f) Make& Model

g) ManufacturerSr.No. :

h) Weightofpump :

i) Materialofcasingandimpeller:

j) Detailofbearingwithgradeoflubricants:

1.2.4 Each drawing shall bear the signature of the Authorised Project Manager on behalf of the contractor to the effect that the drawing (whether his own or from any other source) has been checked by the contractor before submission to the Engineer-in-Charge.

1.2.5 Each revision shall be properly recorded to show the number, date, specific description of revision/s carried out, and signature of the Project Manager in the revision block. The contractor shall be responsible forincorporating all the comments issued by the Engineer–in-Charge/ Consultant in the subsequent revision.

1.3 ProgrammeofSubmission

1.3.1 The contractor shall furnish a programme for submitting all designs, drawings, and documents to Engineer-in- Charge within three weeks of award of Contract for pre - construction review. The program shall make reasonable provision for resubmission of unapproved designs, drawings and documents and for the time needed to review and transmit such designs, drawings and documents. No designs, drawings and documentswillbeacceptedforreviewuntiltheprogrammeforsubmissionhasbeen approved by Engineer–in-Charge**.** The Engineer In-charge will approve / convey his comments on the submitted programme within one week from receipt of programme by him.

1.3.2 The contractor shall provide six copies of all submissions for review / approval. One copy will be returned to the contractor with comments / approval.

1.3.3 The review period of pre-construction documents shall be as per conditions of contract.

1.3.4 Afterapproval, the contractor shall submit to Engineer-in-Charge one tracing, soft copy of design & drawings and minimum six copies of all approved drawings withthe date of approval marked. Depending requirement of use in the project the contractor shall provide additional copies as requested.

1.4 ApprovalofDesignsandDrawings

1.4.1 EPC contractor shall ask manufacturer to submit the Quality Assurance Plan(QAP) for the equipment manufactured by them. The QAP will indicate clearly the tests to be carried out at manufacturer's works which will be as per I.S. and as specified in technical specifications of the tender documents. The QAP shall be approved by Employer. The Engineer-in-charge can depute third party inspector /consultant's representative / Client representative to witness the tests as per approval given for quality assurance Plan and technical specifications of the equipment given in the tender.

1.4.2 Approval from Engineer–in-Charge to the Contractor's design or drawings shall not relieve the contractor of any of his contractual obligations or liabilities under the Contract or his responsibilities for correctness of dimensions, materials of construction, weights, quantities, design details, assembly fits, performance particulars and conformity of the suppliers with the Indian statutory laws as may be applicable, nor does it limit the Engineer–in-Charge's rights under the Contract.

1.4.3 Should it be found at any time after approval has been given by Engineer–in-Charge that any designs, drawings or documents submitted by the contractor are not consistent withany design,drawings ordocumentssubmittedorapprovedpreviously or deviate from any major aspect of the Contract Document, then such alternationsor additions as may be deemed necessary by the Engineer–in-Charge shall be made therein by the contractor and the works carried out accordingly for which no extra payment shall be made.

1.4.4 Norevision shall be made by the contractor after design, drawings or documents are "approved" by the Engineer–in-Charge. In case the contractor desires to incorporate any minor amendments in the "approved" drawing, he shall resubmit the same for formal approval. Contractor shall not make any revision in design / drawings, which is not related to the comments conveyed by Engineer–in-Charge.

1.4.5 Thedesignwouldhaveto begotapprovedfrom department& authorizedagencies.All compliance of technical requirements is to be fulfilled.

1.5 Certificates

1.5.1 Where certificates are required by the Specification or relevant Reference standard, the original and one copy of each such certificate shall be provided by the Contractor.

1.5.2 Manufacturer's and supplier's test certificates shall be submitted as soon as the tests havebeencompletedandinanycasenotlessthansevencalendardayspriortothe

time that the materials represented by such certificate are needed for incorporation into the Works.

1.5.3 Certificatesoftestcarriedoutduringtheconstructionoroncompletionofpartsof the Works shall be submitted within 7 days of the completion of the test.

1.6 SchemeWiseInstructionManuals

1.6.1 The contractor shall submit to the Engineer–in-Charge prior to the delivery of allmajor items of Plant to Site, five copies of instructions appropriate to the erection, commissioning, testing, operation and maintenance of that item of plant. These instructionsshall form adraftof the relevant partsofthe InstructionManualand their submission and approval by the Engineer–in-Charge shall be a condition precedent to the issue of a Taking over Certificate for that section of the Plant. During erection, commissioning and testing, draft instructions and associated diagrams shall be checked against the plant, and amended as necessary to relate accurately to the Plant as installed.

1.6.2 The manuals shall cover the setting to work, commissioning, testing, Operation and Maintenance of the works. The greatest importance is attached to completeness and clarity of presentation.

1.6.3 Information supplied by sub-Contractors and manufacturers employed by the contractor shall be co-ordinated into the comprehensive manual. The instruction manuals shall describe the installation as a whole and shall give a step-by-step procedure for any operation likely to be carried out during the life of each item of Plant, including erection, commissioning, testing, operating, maintaining, dismantling and repair.

1.6.4 Maintenance instructions shall include charts showing lubrication, checking, testing and replacement procedures to be carried out daily, weekly, monthly and at longer intervals to ensure trouble-free operation. Where applicable, fault location chartsshall be included to facilitate tracing the cause of malfunction or breakdown.

1.6.5 Asectiondealingwithproceduresfororderingspareshallalsobeincludedinthe manual.

1.6.6 Six draft copies of the manual shall be submitted to the Engineer–in-Charge prior to commissioningtheworks.Tenfinalcopiesoftheamendedandcorrectedmanualsand drawings shall be provided by the contractor at the commencement of the Period of Maintenance.

1.7 OperatingInstructions

The instructions shall be written in a simple language. Wherever possible, instructions shall be presented in a tabular form easy to understand.

1.7.1 GeneralInstructions

(a) Listof Plant alarms, giving possible causes for alarm initiation and sequence of remedial actions to be taken.

(b) Instructionson monitoring of Plant performance and sample log sheets for each plant item, to be filled by Operators on a routine basis.

(c) Safety precautions to be taken in the handling of equipments, action to be taken in case of accidents, including first aid instructions.

(d) Basicmaintenance procedures such as flushing of pumps, cleaning of tanks after use and washing down of spillage.

(e) Do'sand don'ts in Plant operations. Operators' attention shall be drawn to all operations considered to be dangerous to operators or likely to cause damage to the Plant.

(f) Adetailed description of Plant start-up and shutdown procedures supported by Process and Instrumentation Drawings.

(g) AdetaileddescriptionofdaytodayPlantoperationprocedures.

1.7.2 MaintenanceInstructions

A maintenance manual in four copies shall be provided as a supporting document to the equipment manufacturer's instructions.

(a) **MaintenanceManual**

i) Checking, testing and replacement procedures to be carried out on all Mechanical and Electrical plant items on a daily, weekly and monthly basis or at longer intervals to ensure trouble free operations.

ii) Faultlocation and remedy charts to facilitate tracing the cause ofmalfunctions or breakdown and correcting faults.

iii) Acompletelistofrecommendedlubricants,oilsandtheircharts.

iv) Aspares schedule which shall consist of a complete list of itemized spares for all Electrical and Mechanical items with ordering reference and part numbers.

v) A complete list of manufacturer's instructions for operation and maintenance of all bought out equipment.

vi) Preventivemaintenancedetails.

(b) **Manufacturer'sInstructions**

Manufacturer's instructions for Operation and Maintenance of all bought out equipments shall be provided. The instructions shall be supplied complete with Electrical / Mechanical drawings

CRITERIAFORDESIGNOFCIVILSTRUCTURES

1.0 INTRODUCTION

This section forms the engineering design basis for structural design. The content of these documents is to form the guidelines for engineering design of Structures and to provide information about other disciplines concerned.

ThisistechnicalspecificationsummarizestheconceptandrelevantIScodes(Latest

Revision) to be followed for buildings and water retaining structures.

2.0 GEO-TECHNICALINVESTIGATION

The contractor will be responsible for the geo-technical exploratory survey to obtain accurate information about soil condition at the site. The depth, thickness, extent, composition of each stratum and the depth of ground water shall be determined. Provide a geo-technical report based on survey data which includes boring logs, field and laboratory test results, interpretation of data, building foundation and earthwork recommendations.

3.0 BASICENGINEERINGDATA:DATUMANDSITELEVELS.

The Plinth Level of the Pump House and other Building and Electrical works shall be fixed depending on Local maximum flood level with a minimum Plinth Height above Finished Ground Level - 0.6m or otherwise specified

4.0 LISTOFDESIGNCODESANDSTANDARDS

All designs shall be based on the latest International or Indian Standard (IS) Specifications or CodesofPractice.The designstandards adoptedshallfollowthebestengineeringpracticein the field based on any other international standard or specialist literature subject to such standardreferenceorextractofsuchliteratureintheEnglishlanguagebeingsuppliedtoand approved by the Employer's Representative. In case of any variation or contradiction between the provision of the IS Standards or Code and the specifications given with the submitted tender document, the provision given in the Specification shall be followed.

DesignofvariousstructuresshallbecarriedoutasperTechnicalspecificationandrelevantIS Codes (Latest Version). List given below is indicative. Appropriate Codes & Manuals can be followed subjected to approval of Chief Engineer.

(i) FoundationEngineering

IS1080:Designandconstructionofshallowfoundationonsoils.

IS6403:Determinationofbearingcapacityonshallowfoundations. IS

8009 : Part I & Part II Calculation of settlement of foundations.

IS2974:Codeofpracticefordesignandconstructionofmachinefoundations (part1 to

4)

IS:13301:Guidelinesforvibrationisolationformachinefoundations

(ii) LoadingstandardcodesandDesignAids:

IS456-2000CodeofPracticeforplainandreinforcedconcrete

IS875-1987CodeofPracticefordesignloadsforbuildingsandstructures Part I – dead loads.

Part-II–Liveloads.

PartIII–Windloads

PartV-SpecialLoadsandLoad combinations

IS3370-CodeofPracticeforconcretestructuresforthestorageofliquids Part-I - General Requirement (2009)

Part- II - Reinforces concrete structures (2009)

Part-III-Pre-stressedconcretestructures(1967)

Part-IV-Designtables(1967)

IS1893-2002Criteriaforearthquakeresistantdesignofstructures

IS4326-Earthquakedesignandconstructionofbuildings -CodeofPractice. IS 13920 - Ductile detailing of Reinforced Concrete Structures subjected to Seismicforces.

IS1911-Scheduleofunitweightsofbuildingmaterials

(iii) Reinforcement

IS1786:Highstrengthdeformedsteelbars

IS2502:Bendingandfixingofbarsforconcrete reinforcement

IS5525:Recommendationfordetailingofreinforcementinconcreteworks

(iv) BrickworkandHollow block

IS–1077Commonburntclaybuildingbricks IS - 2212 Brick work

IS-2185CementConcreteBlock.Part-I,Part-II-Hollowcementconcrete blocks.

(v) CementandFine&CoarseAggregates:

IS-455Portlandslagcement

IS-1489Part1PortlandPozzolanaCement(PPC)flyashbased IS-

1489 Part 2 PPC Calcined clay based

IS-8112 43 grade Ordinary Portland Cement

IS-12330SulphateResistingPortlandCement

IS-12269 53 grade ordinary Portland cement

IS-383 Coarse and Fine aggregate

(vi) Allstructuralsteeldesignshallgenerallyconformtothefollowingpublicationsof the Indian Standards Institution:

I.S.800CodeofPracticeforgeneralconstructioninsteel

I.S.806CodeofPracticeforuseofsteeltubesingeneralbuildingconstruction

I.S.807CodeOfPracticeForDesign,Manufacture,ErectionAndTesting Structural

Portion Of Cranes And Hosts

I.S.808Dimensionsforhotrolledsteelbeam,columnchannelandanglesection

I.S.813Schemeofsymbolsforwelding

I.S.816CodeofPracticeforuseofmetalarcweldingforgeneralconstructioninmild steel

(vii) Miscellaneous

IS:1172Codeofbasicrequirementsforwatersupply,drainageandsanitation IS:1742

Code of Practice for building drainage

IS:3067CodeofPracticeforgeneraldesigndetailsandpreparatoryworksfor damp

proofing and water proofing of buildings

SP:16 Design Aids for reinforced concrete to IS:456

SP:20Handbookonmasonrydesignandconstruction

SP:22Explanatoryhandbookoncodesforearthquakeengineering

SP:24ExplanatoryhandbookonIndianStandardCodeofPracticeforplainand reinforced concrete

SP:25Handbookoncausesandpreventionofcracksinbuildings

SP:31Handbookofconcretereinforcement&detailing(SCIP)

IRC:37:2012Guidelines for design of flexible pavements

IRC:73:1983Geometric design of roads

5.0 METHODOFANALYSIS

TheanalysisforallstructuresRCCaswellasSteelStructuresistobecarriedoutbySTAAD-pro or Employer's approved software and designs of the same for the worst/governing combination as per latest International or Indian Standards.

6.0 METHODOFDESIGN

Designshallbedoneasperfollowing:

RCCfootings:	Limitstatemethodofdesign
RCC columns:	Limitstatemethodofdesign
RCC column in pumping station: & Water Retaining Structure	limit state method of design
RCCbeamsandslabs:	Limitstatemethodofdesign
Retaining wall:	Workingstress/Limitstatemethodofdesign
RCC water retaining structures:	Working stress method of design
SteelStructures:	LimitState/WorkingStressmethodofdesign

6.1 AlsoprovidetheseismicdesigncalculationofR.C.CWaterretainingstructuresasper IS:– 1893 (Part II ,2014/latest Revision).

7.0 DESIGNBASIS

a) Foundation shall be designed to carry all the loads from equipment or super structure, which they support in accordance with the relevant codes.

Netsafebearingcapacityofsoilshallbeconsideredaspergeo-technicalreport. Type of

foundation is to be decided based on above data and report.

b) Forbuildingsandstructures:Aspergeo-technicalreport

c) Allowableincreaseinsoilbearingcapacityineventofstorm(wind)25%,Earthquake 25%,factorofsafetyasperIS1904againstoverturning1.5,Sliding1.5,andbuoyancy 1.2unlessotherwisehighervaluesarespecifiedinthelatestcode.

d) As a general rule following features will be adopted, unless decided otherwise in a specific or exceptional case:

e) Topoffootingwillbehorizontalandflat/Trapezoidalascase.

f) Minimum depth of footingis considered as per geotechnical report for various locations of the proposed structure.

g) Foundation plinth for structural columns and equipment supports shall extend not less than 5 mm from the edge of base plate.

h) The clear distance between a standard mild-steel anchor bolt or anchor sleeve and the face of the foundation shall be not less than 75 mm.

i) Minimum thickness of lean concrete layer shall be 75 mm and shall extend 75 mm beyond the foundation edge.

j) For heavier loads and restricted settlements pile foundation may be considered as an alternative as per IS 2911.

k) Where ever columns are very near, pedestals of footing are considered combined to take care of unbalance loading. Sufficient reinforcement is provided to take care of unbalance load. Centre of footing and combined loading is to match to nullify eccentricity in load.

l) Where stresses due to wind (or seismic) and temperature are combined with those due to other loads, the allowable stresses in concrete and reinforcement steel shall be increased by 33.33% in case of working stress design.

m) All building shall have a minimum 1.0 m wide, 100 mm thick plinth protection paving in M15 grade concreteor stone slabs/tiles. All plinth protection shall be supported on well compacted strata.

DESIGNCONDITIONSFORUNDERGROUNDORPARTLYUNDERGROUNDLIQUIDRETAINING STRUCTURES

Allundergroundorpartlyundergroundliquidcontainingstructuresshallbedesignedforthe following conditions:

(i) Liquid depth to be considered up to full height of wall and no relief due to soil pressure from the other side to be considered.

(ii) RCC water retaining structures like storage tanks shall be leak proof and designed as uncracked section.

(iii) Structure empty condition (i.e., empty of liquid, any material, etc.) **:**full earth pressure with saturation and surcharge pressure wherever applicable, to be considered.

(iv) Partition wall between dry sump and wet sump: to be designed for full liquid depth up to full height of wall.

(v) Partitionwall between two compartments: to be designed as one compartment empty and the other full for both the directions.

(vi) Structuresshall be designed for uplift in empty conditions with no live load withthe water table indicated in the geotechnical report or high flood level, whichever is maximum. No reduction factor for the uplift forces shall be considered. Use of pressure relief valves to reduce uplift pressure due to ground water table shall not be allowed.

(vii) Walls shall be designed under operating conditions to resist earthquake forces from earth pressure mobilization and dynamic water loads.

(viii) Underground or partially underground structures shall also be checked against stresses developed due to any combination of full and empty compartments with appropriate ground/uplift pressures from below to base slab. A minimum factor of 1.2 shall be ensured against uplift or floatation and due to other loads shall be 1.5 unless otherwise higher values are specified in the latest codes.

(ix) Soilbearingcapacityistobeconsideredaspersoilinvestigationreport.

8.0 DESIGNLIFE

Thedesignlifeofallstructuresandbuildingsshallbe60years.

9.0 DESIGNLOADING

All buildings and structures shall be designed to resist the worst combination of thefollowing loads / stresses under test and working conditions; these include dead load, live load, wind load, seismic load, Equipment load, Piping Anchor and Restraint loads, Crane, Monorail & Elevator loads, Earth Pressure load, Hydrostatic Pressure load, stresses due to temperature changes, shrinkage and creep in materials, dynamic loads, impact load and other specific loads.

a. DeadLoad

This shall comprise all permanent construction including walls, floors, roofs, partitions, stairways, fixed service equipment and other items of machinery.

Openings(doors,windows,ventilatorsetc.)inthemasonryareignored.

i. MaterialDensities

(i) Weightofwater :10.00kN/m^3

(ii) Weightofsoil :Asperfieldtestresults

(iii) Weightofplainconcrete :24.00kN/m^3

(iv) Weightofreinforcedconcrete :25.00kN/m^3

(v) Weightofbrickwork(exclusiveofplaster) :19 kN/m^3per

(vi) Weight of plaster to masonry surface :18.00N/m^2permm thickness

(vii) Weight of granolithic terrazzo finish or. rendering screed, etc :24.00N/m^2permm thickness

(viii) WeightofFillinginSunkSlabetc. :10KN/m^3

(Ix)Weightofceilingplaster6/8mmthick :20 KN/m^3

(x) Lightweightconcretewithaggregates :10 kN/m^3

(xi) RubbleMasonry :22.00kN/m^3

(xii) ElectricalPanelLoad,InstrumentationPanelLoad,

BatterybackupLoad etc. :AsperActualPanelLoads

ii. Slabs

Floor Finished on working floors – 1.0 KN/m^2

FloorFinishedonTerrace –1.0 KN/m^2

iii. Beams

Self weight/ :-Weightdensityxwidthxtotal depth

Brick masonry :-Weightdensityxwallthicknessxwall height

b. LiveLoad

Liveloadsshallbeingeneralasper I.S.875.However,thefollowingminimumloadsshall be considered in the design of structures:

(i) Live load on roofs (accessible)

:1.50kN/m^2(

Non-accessible) :0.75 kN/m^2

(ii) Live load on floors supporting

Equipmentsuchaspumps,blowers,

Compressors,valves,etcorasrequiredby

equipmentsupplierwhicheverisgreater. :10.00kN/m^2

(iii) Liveloadonallotherfloors

Walkways,stairwaysandplatforms. :5.00 kN/m^2

(iii) Liveloadonallresidentialfloors :3KN/m^2

(iv) LiveloadonToilets :2.5 KN/m^2

Liveloadreductionshallbeinaccordancewiththeprovisionsof IS: 875andIS:1893 incase ofseismicanalysis. Intheabsenceofany suitableprovisionsforliveloadsinI.S.Codesoras given above for any particular type of floor or structure, assumptions made must receive the approval of owner prior to starting the design work. Apart from the specified live loads orany otherloadduetomaterialstored,anyotherequipmentloadorpossibleoverloading during maintenance or erection / construction shall be considered and shall be partial or full whichever causes the most critical condition.

c. WindLoad

Windloadsshallbeasper I.S.875.

Indesignofstructures,windforceonequipmentssupportedonframeincludingall fixtures, piping, staircases, ladders, handrails etc. shall also be considered.

d. EarthquakeLoad

ThisshallbecomputedasperI.S.1893.Animportancefactorappropriatetothetypeof structure shall be considered for design of all the structures.

ForallstructuresandbuildingsResponseSpectrumMethodofdesignshallbeused.The importance factor for all buildings and structures shall be taken as 1.5

e. DynamicLoad

Dynamic loads due to working of items such as pumps, blowers, compressors, switch gears, travelling cranes, etc. shall be considered in the design of structures as per manufacturer's data.

f. EarthPressureLoad

Earth pressure for all underground structures shall be calculated using coefficients ofearth pressure at rest or coefficient of active earth pressure (whichever is applicable). In addition to earth pressure a minimum surcharge load of 20 kN/sqm shall also be consideredforthedesignofallundergroundstructuresorrailwayload(incasetherailway track is located nearby) whichever is critical. The underground structures shall be subjected to sub surface water pressure. Calculations shall be based on the weight of the soil plus full hydrostatic pressure. The full upward pressure of water below base raft shall be taken over the entire area.

g. HydrostaticPressureLoad

Groundwaterlevelforcalculationofloadshallbeconsideredasindictedinthe geotechnical report or high flood level whichever is maximum / at Finished Ground Level.

h. ImpactFactor

Loads for cranes, hoists and elevators shall be taken as per IS: 875(Part 2). The minimum impact factors to be used in design shall be as follows:

i. CraneLoads

a. Forverticalforce,animpactfactorof25%ofthemaximumstatic loads.

b. A lateral crane surge of 10% of the weight of the crab plus lifted load applied at the topofcranerailactingonanyonecranetrackrail.Forframeanalysis,thisforceshall be applied on one side of the frame at a time in either direction.

c. Alongitudinalsurgeof5%ofthemaximumstaticwheelloadsofthecraneapplied at the top of the rail.

j. MonorailLoads

a. Impactfactorof10%ofliftedloadofhoistformonorailandsupport design

b. Impactfactorof25%ofliftedloadforelectricalpulleyandsupport design.

k. TemperatureLoad

Expansion and contraction due to changes of temperature of materials of a structure shall be considered and adequate provisions shall be made for the effects produced (as per provision in relevant IS codes). Suitable expansion joints shall be provided in the longitudinal direction wherever necessary. The maximum distance of the expansion joint shall be as per the provisions of IS: 800 and IS: 456 for steel and concrete structures respectively.

Coefficient of thermal expansion of steel shall be taken as per IS: 800. Coefficient of thermal expansion for concrete shall be taken as per IS: 456.

l. VibrationLoads

Vibration Loads shall mean the vibration forces caused by heavy vibrating equipment or machinery and dynamic forces caused by fluids in the normal operation. Frames, structures and foundations for machinery or equipment causing vibration shall be designedtolimitvibrationstoanacceptablelevel.Itshallbedesignedsuchthatwhether they are independent or part of the building, it shall not only safely carry the loads for such items but also prevent resonance. Natural frequencies of frames, structures and foundations must differ by more than 20% from that of the machinery under operating conditions. While carrying out dynamic analysis of foundations/structures supporting dynamically loadedequipments, the loads indicatedby vendorin his documents shall be used.

m. LoadCombination

Loadcombinationforcheckingofbearingcapacityofsoilanddesignofsteelstructures (working stress)

- DL+1.0LL
- DL+/-1.0WL (1.0EQ)
- DL+1.0LL+/-1.0WL (1.0 EQ)
- LoadcombinationfordesignofRCCstructuresandSteelStructures (Limit state)
- 1.5DL+1.5LL
- 1.5DL+/-1.5WL(1.5EQ)
- 0.9DL+1.5WL/EQshallbeusedforstabilityagainstoverturningis critical.
- 1.2DL+1.2LL+/1.2 WL (1.2EQ)
- Loadcombinationforwaterretainingstructures
- 1.0DL+1.0LL
- 1.0DL+1.0LL+1.0uplift
- 1.0DL+1.0LL+1.0 uplift+1.0Waterload

AppropriatefactorofliveloadshallbetakenasperIS1893forseismicload calculation.

The load combinations giving the most critical conditions on foundations, structuresor individual members shall be taken in to account.

10.0 RCCDETAILING

MinimumCovertomainReinforcement

TheminimumclearcovertoreinforcementinallR.C.CstructuresshallbeasperIS:456/IS: 3370 (Part –II), except as mentioned for following:

ThefollowingminimumclearcovershallbeprovidedforRCCworks.

-	Slab(roof&floors,Canopies,chajjas,waistslabinstairetc.)	25mm
-	Beams,lintels	40mm
-	Gradebeams	40mm
-	Columns,pedestals	40mm

- Drypits/retaining walls

  i. Faceincontactwithearth- 50mm

  ii. Freeface- 50mm

  - Water/Liquidretainingstructures

  i. Faceincontactwithliquid 50mm

  ii. Awayfromliquidbutincontactwith earth 50mm

- Footing

  i. Sidesandtop 50mm

  ii. Bottom 60mm

Increasedcoverthicknessmay beprovidedwhensurfacesofconcretemembersareexposed to the action of harmful chemicals (as in case of concrete in contact with earth faces contaminated with such chemicals, acid vapour, saline atmosphere, sulphurous smoke (as in case of steam operated railways) etc. and such increase of cover may be between 15 mmand 40 mm beyond the figures given above as may be specified by the engineer-in-charge.

Concrete cover blocks of different and necessary sizes and shall use as and when requiredfor providing the adequate and specified cover to thereinforcement. Such coverblocks shall be made so in advance and properly cured to take the load of reinforcement. Cementmortar blocks in CM (1:1) shall be used for making cover blocks.

Minimumdiameterof bars

Mainsteelin foundation : 10mm

Mainsteelincolumn : 12mm

Mainsteelinbeam : 10mm

Mainsteelinslab : 8mm

Stirrups&Ties : 8mm

Mainsteelinwall&Wallfooting: 10mm**

Mainsteelforwaterretainingstructure:10mm**

**8mm,ifrequirementfallstominimumsteelcriteria

MinimumthicknessofPCC

1) For all RCC building foundation : 75mmThick–M15
And Trenches etc

2) ForBrickmasonrywallfoundation : 100mmThick–M15

3) Forallwaterretainingstructures : 100mmThick–M 15

Minimumpercentageof steel

1) For buildings :AsperIS456-2000

2) Forliquidretainingstructure :AsperIS3370:2009(Part-2)

(Forthicknessmorethanorequalto 150mm,reinforcementshallbe provided on both faces)

11.0 MINIMUMTHICKNESSOFSTRUCTURALMEMBERS

Thefollowingmin.thicknessshallbeusedfordifferentreinforcedconcretemembers Irrespective of design thickness.

CIVILMEMBER	WIDTH(mm)
Wallsforliquidretainingstructures	225
Roofslabsforliquidretainingstructures	125
Bottomslabsforliquidretainingstructures	225
Floorslabsincludingroofslabs,walkwayscanopyslabs	100
Wallsofcables/pipetrenches,undergroundpitsetc	125
Columnfootings	300
Parapets,chajja	100
Precasttrenchcover	75
Beam	230(width)
	300(depth)

12.0 SPACINGOFREINFORCEMENT

Minimumdistancebetweentwoparallelmainreinforcementbarsshallplacedasper Relevant Indian Standards (Latest Revision).

Inlocations where reinforcementis congested, groupingofbarsbytouching oneanother maybepermittedprovidedtherequirementsofminimumhorizontaldistanceasspecified

above are complied with and provided further that development length is adequately increased.

13.0 RCC/PCCSPECIFICATIONS

Footings - M25(Fck-25N/mm^2)-forbuildings

Super structure – M25 (Fck – 25 N/mm^2)

Raft foundation – M-25forwaterretainingstructure

Water retaining structure – M 25 (Fck – 25 N/mm^2)

Slabs – M-25 (Fck – 25 N/mm^2)]

PCC for column footings – Aspertenderspecification

PCC for wall footings and plinth beams – As per tender specification

Reinforcedsteelhighyieldstrengthdeformed(HYSDbars/TMTBars)

14.0 JOINTS

Movement joints such as expansion joints, complete contraction joints, partial contraction jointsandslidingjointsshallbeprovidedanddesignedto suitthestructureasperrelevantIS specification. However,contractionjoints shallbe providedat specified locations spaced not more than 7.5 m in both right angle directions for all walls and rafts. Expansion joints of suitablegapatsuitableintervalsnotmorethan30 mshallbeprovidedinallwalls,floorsand roof slabs of water retaining structures. Construction joints shall be provided at right angles to the general direction ofthe member. The locations of construction joints shall be decided on convenience of construction. To avoid segregation of concrete in walls, horizontal construction joints are normally to be provided at every 2-m height. PVC water stops of 150 mm width shall be used for walls and 230 mm width for base slabs. Alternatively contractor can use G.I. Sheets of 18 gauge and 200 mm wide. Expansion joints for non-liquid retaining structures shall be provided as per IS 3414. Expansion joint if required shall be furnished in detail drawings.

15.0 NOMINALSTRIPINGTIME(BasedonIS 456)

Incasewhenthecubestrengthatsevendaysarefoundto beloworinthecaseswhenother cements are used, stripping time and removal of props may have to be extended. In normal circumstances, (generally where temperatures are above 20° C) and where ordinaryPortland cement is used, forms may generally be removed after expiry of following periods:

Type of Formwork	**Minimumperiodbefore striking formwork**

a) Verticalformworktocolumns,walls,beams, 3days

b) Soffitformworktoslabs(Propstobere-fixed immediately after removal of formwork) 18-24 days

c) Soffitformworktobeams(Propstobere-fixed immediately after removal of formwork) 7days

d) Propsto slabs:

I. Spanningupto4.5mt. 7days

II. Spanningover4.5mt. 14days

e) Propstobeamsandarches:

I. Spanningupto6mt. 14days

II. Spanningover6mt. 21days

16.0 CURINGOFDIFFERENTITEMS

During construction, curing shall be carried out especially from 7.00 AM to &. 7.0 P.M even on holidays with proper manpower, necessary pumps and pipe lines, connections etc.

Exposed surfaces of concrete shall be kept continuously in a damp or wet condition by poundings or by covering with a layer of sacking, canvas, Hessians or similar material and kept constantly wet for at least 14days from the date of placing concrete in case of OPC and at least 10 days where mineral admixtures or blended cements are used. The period of curing shall not be less than 21 days forconcreteexposed to dryand hotweather conditions and where mineral admixtures or blended cements are used. For the concrete containing PPC or Portland slag cement, period of curing may be increased. For, other items the curing shall be done as follows or as directed by the engineer-in-charge.

a) Brickwork-atleastfor - 10days

b) Plasterwork – atleastfor7days

c) Sandfaced plaster – atleastfor15days

d) Tilesorstoneflooringand dado - atleastfor10days.

17.0 SpecialConsiderationforSteelStructures

a. SteelStairs

All steel staircase shall normally clear width (back to back of stringer) of 1000 mm and maximuminclinationwithhorizontalof35°75'.However,incaseofspacerestriction,

minimum clear width up to 750 mm and slope up to 45° may be provided with prior approval.

The vertical height between successive landings shall not be exceed 2.75m. Channels (min. MC150) shall be provided as stair stringers. Treads shall be minimum 250 mm wide made of chequered plate / grating, with suitable nosing, and spaced equally so as to restrict the rise to maximum 180 mm.

b. SteelLadders

Ladders shall be provided to platforms, walkways, instruments and equipments that do not require frequent access. Ladders shall preferably be vertical and its angle with vertical shall not exceed 5°. Ladders shall be minimum 450 mm clear width with 20 mm dia. MS rungs spaced at 300 mm (maximum)

Ladders of more than 4.5 m height shall be provided with safety cage. However safety cages to start at 2.5 m above the lower landing level.

c. PlatformsandWalkways

All steel platforms above grade shall be constructed with kick plates at edge of platform to preventtoolsormaterialsfromfallingoff. Itshallconsistof8mm thick steelplate projecting 100 mm above the platform surface. Kick plate shall be painted with the same type of coating as the material to which it is attached.

d. SpecialConsiderationforBrick/StoneMasonry

All Masonry works shall be designed in accordance with IS: 1597, IS: 1905, IS: 2212, IS: 4326 and other relevant IS codes as applicable. Structural design of Brick / Block Masonry shall be in accordance with criteria specified by section 4 of National Building Code of India Part IV.

AllMasonrywallsforbuildingsshallberaisedonplinthbeams.

Bricks shall be of minimum compressive strength of 50 kg/sq.cm conforming to IS: 1077. Brick masonry shall generally be in cement mortar 1:6 (1 cement : 6 sand). However, 115mm thick masonry shall be constructed in cement mortar 1:4 with 2 nos. of 6 mm dia. Reinforcement provided after every fourth layer.

e. Grouting

Non-shrink flowable grout shall be used for under pinning work below base plate ofcolumns.

Non-shrinkcumplasticizeradmixtureshallbeaddedinthegrout.Forgroutingofbaseof machine foundation high strength ready mixed non-shrink flowable grout shall be used.

CrushingstrengthofthegroutshallgenerallybeonegradehigherthanthebaseConcrete.

Minimum grade of grout shall be M 25.

Nominal thickness of grouting shall be at least 50mm for columns and pedestals of major equipment. For secondary posts, stair and ladder base, etc. grouting shall not be less than 25mm thick.

18.0 SoilBearingCapacity

Thecontractorhastoassesssoilbearingcapacityforallworksathisowncostanddesignthe structures on the basis of data received after investigation. The soil investigation report has to be submitted to Department.

19.0 FiltrationSystem

The contractor has to assess the size of the particle in the raw water and size of themaximum particle allow for Micro Irrigation System to be adopted at later stage. The design standard of the Primary as well as Secondary filtration system should be as per IS or general practice.

SECTION–II

SURVEY,INVESTIGATION,PLANNING,DESIGN AND DRAWING

SECTION–II

SURVEY,INVESTIGATION,PLANNING,DESIGNANDDRAWING

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CONTRACTOR SUPERINTENDING ENGINEER

SECTION–II

A.SURVEY,INVESTIGATION,PLANNING,DESIGNANDDRAWING

1.0 DEFINITIONS:

DefinitionsofmostofthetermsusedintheContractdocumentareas follows:-

A. RISING MAIN: Main pipe line taking off from the Pump house for carrying water to the delivery chamber(optional). If delivery chamber is not provided, then the Rising Main should be considered upto the last off taking of Minor.

B. PRESSURE MAIN: Equivalent to Rising main taking off from the pump house for carrying water till the last offtaking of Minor.

C. GRAVITYMAIN:Mainpipelineorpipelinestakeofffromintakeor Deliverychamber(optional)or Ridge of Rising main/Pressure main which follows positive gradient and carries gravity flow for distribution of water. The gravity Main should end at the last offtaking of Minor.

D. CONVEYANCESYSTEM:

   a. Distributaries:All pipelines taking off from Rising main/Pressure mains or delivery chamber(optional) for conveying water to Minor.

   b. Minors and sub-minors: Consisting of minors serving an area of about 200 to 500 Ha off taking from Rising main/Pressure main/distributaries and sub minors off taking from Distriburaries/minors.

   c. Field pipeline: Water distribution system beyond minor and sub minor Outlet uptoend use i.e.Sub Chak(1 Ha)

E. CulturableCommandArea(CCA)

   For Design purpose:

   The Culturable Command area for design purpose will be the area of the village/villages that can be irrigated, worked out from Revenue Record after deducting (i) Un-commandblehigher lands, (ii) Pastures, (iii) fallow land iv) Gochar, v) cremation ground vi) roads, vii) devasthanam and (vi) abadi area.

   Chak:

   It is a sub division of C.C.A. typically about 20 Ha in size. The area can be vary upto 20% as per Chak boundary condition. The outlet point is preferably expectedto be on middle area withina chak. Sub Chak is the sub division of the Chak about 1 ha in size. The last outlet point should be such that two sub Chak can be served at one location. The size of the Branch Field pipe and distribution pipealong with field pipeupto 1Hashould besufficient to convey the minimum

discharge of 0.813 lps.The Velocity should be within the permissible limit as per guideline and IS as applicable.

1.1 Theabovedefinitionsareonlyforguidelinesandthe Contractorisatlibertytouseand incorporate latest technology for regulating piped flow for irrigation.

2.0 SCOPEOFWORK:

ThescopeofworktobecarriedoutforPressurizedUGPLIrrigationSystemshallbeasunder :-

2.1.1 Construction of Permanent Bench Marks.

2.1.2 Conduct hydrology study (Yield&flood) at the intake location for estimating water availability for kharif crop, scour depth computation, HFL and normal flood levels.

2.1.3 Survey work for block contouring at 50 cm intervals on the revenue village maps, planning, design and estimate of the project having components of Intake Works, Pump House, Rising main/Pressure main, Delivery chamber(optional) associated appurtenant including its distribution network down to 1 Ha chak. Survey work will be used for preparation of land acquisition cases, Water User's Association formation proposal, operation and maintenance manual.

2.1.4 PreparingaGeneralArrangementPlanforeachschemewithPlanningof Rising main/Pressure main and furnishing most economical and feasible diameter &alignments proposal with alternative survey wherever necessary should be conducted. After getting approval of the alignment from the competent project authorities contractor has to take up survey & investigation of distributaries, minors & sub-minors etc. up to outlet point, preparing & obtaining approval for the most economical and feasible alignment from the competent project authority and furnish the following details :

A. Kilometer wise L-section and design statements of Rising main/Pressure mains with apex details, location of CD works, detailed designs of curves, part village map showing the alignment of that KM, cross sections at 150 M. interval on alignment for complete Rising main/Pressure mains on village maps. Distributary /Sub Distributary/Minor alignment map with apex details, kilometer wise L-section, location ofcontrol works, detailed designs of curves, cross sections at 90 M. interval on alignment. Complete distributary, minors and sub-minors network on revenue village maps indicating bearing of the centre line of pipe line with reference to boundary stones of survey numbers.

Detailed topographical survey including contour mapping of the command area on revenue village maps with contour at 50 cm interval including details of chak wise and distributary/minor wise irrigable area and planning of complete distribution system withoutlet details.

Final location survey including marking of pipe line alignment on revenue village maps with contours at 50 cm intervals, showing of B.Metc.

Preparationoflandacquisitioncases in requiredproformaand sketchonrevenue village maps as per Odisha Land Acquisition Act.

B. Detailstobesurveyed

The objective of the survey is to provide sufficient detail to enable the design of the whole Project including the irrigation distribution networks. The survey shall include, but not be limited to the following:

I. Establishment of a network of triangulated control points incorporating benchmarks or with a separate system of benchmarks. Existing monuments should be usedwherever possible and their accuracyconfirmed. In addition,where control pointorbenchmarks are not available, new points are to be established at the head of each Distributary, Minor and Sub-minor.Where the distancebetween thesepointsexceeds2.0Km,intermediatepointaretobe established.

II. Pucca, kacha and all other motorable roads and accesses including bridges and railways.

III. Principalfootpathsandfootbridges.

IV. Location, invert level and principal dimensions of all irrigation off-takes, crossdrainage structures, regulators etc. whether temporary or permanent for existing irrigation work within the command area.

V. Locationandtypeofalltubewellsandopenwells,villagehandpumpsetc.

VI. Villageboundaries(tri-junctionmarkerpillars)wherethesearelocatedonthe ground. Due note of the village name within each boundary shall also be made.

VII. Servicesandutilitiesincludingelectricity,watersupply,sewerage,cableetc.and their supporting high tension poles or posts:

VIII. Drainage courses including nallas, ditches,check dams or anyotherstructureson drainage courses etc;

IX. Raised field boundaries or any other such points that cannot be used in the Digital Terrain Model for contour generation unless they are at a level that represents the prevailing groundsurface.

X. Water bodies including rivers, lakes, tanks and ponds, rock outcrops borrow pits and quarries forestry (protected, reserved, preserved, private or otherwise) other significant ground cover where cultivation cannot take place.

C. After getting approval to the alignment from the project authorities, the contractor hastofixthechainagestoneat150mintervalalongalignmentoncentrallineandapex stonesateverydeviationofalignmentdulyindicatingapexNo.andchainage.The chainage stones and apex stones shall be of size 20x20x75 cms. Projection of the stone above ground level will be 25cms.

D. Permanent Bench marks with values should be furnished on site. The permanent bench mark (PBM) shall have to be established by the contractor atthe Pump House along the Rising main/Pressure main, delivery chamber(optional)s, along distributaries & minors in command area in the cluster by double leveling and cross checking. Their location shall however be decided in consultation with the project authorities.

ForPowerSystemConnectivity

E. For Planning & development of suitable system connectivityfrom the Local Grid ,the contractor shall conduct Preliminary route survey, finalization of route alignment, detailed survey,structure(tower/pole)spotting,geo-technicalinvestigation, optimization of structure location and check survey in respect of overhead lines. On approval of the route alignment, Design, selection and installation of foundation for structures, poles for single/double circuit over head lines. The design, testing, supply and erection methodology of 33kV, HT (6.6 KV) & LT single/double circuit support structures (low based towerstructure/M.S rail pole/RS Joist/ H poles/PSC poles), associated cross arms,nuts,bolts& washers,D-shackles,supportstaysandaccessorieslikedanger plates, anti-climbingdevices, structure identification plate and earthing devices.

F. Planning& Design of conductors, insulators, insulator hardware, earth wire, joints, clamps for conductors, earth wire clamps and accessories including stringing;

G. Design of special structures/towers including design and construction of foundations for crossings like Railways, Rivers, power lines etc; the slack span connections of conductors from terminalstructurestothesub-stationgantrystructureatTransmissionand/or Distribution licensees interface (i.e. point of supply).

H. Planning,designofMSDSS(33/6.6kV),Distributionsub-station(6.6/0.415kVor 33/0.415kV)forpowerrequirementandallrelated"ConsumerInstallation"including EMS withappropriateinstrumentationandoperation&maintenanceoftheinstallationfora specified period as detailed in the bid document.

2.1.5 **Furnishing alignment proposal:** DISNET planning should be designed such that energy consumptionisminimised.ApartfromkilometerwiseL-sectionofRisingmain/Pressure main, distributary, minors and sub-minors, contractor has to furnish the detailed network of the distribution system on revenue village maps with contours of 0.50 m. intervals, showing distributaries/ Minors/Lateral outlets and sub blocks with ROR details. A Command Area Information Data Base showing the village map Number with irrigable area, names of beneficiaries etc in each Chak should be furnished.

2.1.6 **Design and drawing of Rising main/Pressure main** (If delivery chamber is not provided, then the Rising Main should be consider upto the last off taking of Minor.) **and related works:** Design of Rising main/Pressure mains, economical diameter and allcomponents should be as per IS, CPHEEO, MORTH/ Departmental and other prevalent norms. Contractor has to prepare and get approved Longitudinal Sections, Design Statement of Rising main/Pressure mains and main distributary and minors of entire package length of each schemewhichshouldbefurnisheddulyconsideringlossesincludingheadlosses.Cutoff

statementshouldbereach-wiseandshouldindicategrosscommandareaandirrigablecommand of the blocks

coming under the reach, designed discharge, discharge required, roughness coefficientswith respect to type of pipe selected. Distribution network should be designed for the reaches shown in the cut off statement and got approved from the competent authority.For design of head work, detailed hydraulic calculations, water thrust etc., should be analysed, suitable water hammer reducingmajors anddevicestobedesignedand transitioncurvesand smooth joints should be designed and got approved.

2.1.7 **PreparationofScheduleofquantities:EstimateandSched**ule of quantities shouldbefurnishedseparatelyforentireproject.Itemofworkshouldbein accordancewiththe **specification and r**ates mentioned in the current "Schedule of rates" of the state of Odisha and prevailing market rates for non-scheduled items supported by rate analysis and quotations from manufactures of selected material. The detailedestimates in triplicates sets and also in soft copy which shall include detailed report, estimates and detail surveysheets. ThesameshallbeapprovedbytheChiefEngineer& Basin Manager, RBVN Basin, Brahmapur.

3.0 CONSTRUCTIONOFBENCHMARKSTRUCTURESASPERSPECIFICATION:

3.1 The contractorwill collect the detailsof Surveyof India bench marks in the area.With this as a datum additional net-work of Temporary Bench Marks (TBMs) shall have to be established by the Contractor on an average notmore than 1 No/100 ha of C.C.A. by doubleleveling and cross checking. Their locations shall however be decided in consultation with department. Contractor shall fix temporary bench mark preferably on permanent structures in the command area. Values of such bench marks shall be fixed with reference to the Permanent Bench Mark established by SOI as indicated by the Engineer-in-Charge. The representatives of the Engineer-in-Charge not below the rank of Assistant Engineer shall remain present and check the survey while establishing the temporary bench marks and permanent benchmarks.

ApropersystemshallbeevolvedfornumberingtheTBMsasdirectedbyEngineer-in-Charge. A plan to a scale of 1:15000 indicating location and levels of all PBMs established in the command area shall be prepared and submitted to the Department.

3.2 **ConstructionofPermanentBenchMarks(PBMs):**

ThePBMsshallbeconstructedatlocationasmaybedirectedbyEngineer-in-Charge. This should be located preferably at one corner of the field or field boundary, Govt./noman's land which will not hamper the agricultural operations or as instructed by the Engineer-in-Charge.A10mm diaanchorabout300 mm inlengthwithsteelplate120 x120 x 6 mm. Shall be embedded in the concrete, and the top of the steel plate shall be 100 mm belowthetop levelof concreteand truly horizontal.The levelofPBMshall beestablishedon topofsteelplate.AdequatecareshallbetakenbytheContractorforcuringtheconcretelaid for thePBMs. The PBMsshall be numbered in oil paint for identification. Whereblack cotton soil is met with the foundation will have to be taken to extra depth and filled with M-10 c.c. & standard size bench marks shall be constructed over this.

4.0 FIELDTOFIELDSURVEYFORBLOCKCONTOURINGWITHCONTOURSat50cmINTERVAL AND PREPARATION OF VILLAGE MAPS SHOWING CONTOURS AND FIELD DETAILS :

For plotting contours at 50cm intervals, ground levelsmust betaken foreach surveynumber covering all corners and the centre of the fields with spot levels at every 50 m intervals and reading shall be taken up to 5mm accuracy. Additional spot levels shall be taken on roads, nalla, drain, railway etc. The leveling staff should be placed in the field and not on the field bunds as to represent the local topography. The levels must be taken at point in the field shall also be marked on the village sheet. Additional spot levels must be taken at points that appear abnormally higher or lower than the general elevations of the plot so that the ridge and valley lines can be marked and ascertained. For drawing valley lines, the levels of the bottom of the nalla must be taken. All Kachha and Pucca roads, ditches, well, house, railway lines, high tension lines, electric poles, telephone poles, nalla, irrigation pipe lines, and all other prominent features etc. shall be shown on the map. The reduced levels shall bemarked on village map at the corners of each field and additional spots as taken. Thereafter contours shall be marked in broken lines and full meter contours shall be marked with continuous full line. Concurrent checking of survey, investigation etc, shall be done by the departmental officer posted at work site. At least ten percent field levels shall be gotchecked by the Engineer-in-Charge.

The leveling work should commence from the permanent Bench Marks, whose value is known. The BMs shall be constructed as per standard specifications. All the BMs shall be connected by double leveling accurately. Every day's work shall be closed on any one of the bench mark mentioned above and the accuracy of the day's work checked by Engineer's representative present throughout the activity. The contour map is to be prepared in the same scale of village maps and plotted on them.

4.1 Contouring

All relevant topographical survey data shall be incorporated in the Digital Terrain Model (DTM) using GIS applications. The contractor shall take sufficient spot heights to ensure adequate generation ofcontours at 0.50m interval and as done as per guidelinesprovided in SOI publication"MAP EDUCATION" 1993 forgenerationoffinal productor usingappropriate acceptable computer software. Complete mosaic of the whole command area shall also be prepared and supplied in appropriate contour interval.

4.2 SurveyAccuracies

a) General

The Contractor will be required to ensure the various minimum levels of accuracy outlined below until such time as he can demonstrate supplemented with codal provisions or invogue with examples to the satisfaction of Engineer-in-charge in the best interest of thework and these variation of accuracies should be at no additional cost to the Employer.

b) ControlPoints

In the case of triangulated control points and traverse work, maximum closure accuraciesare to be better than 1:25,000 in plan of the distance traversed and 15 mm per kilometervertically. All angles are to be measured to the nearest 1 second and all distances are to be measured to the nearest millimeter, Co-ordinate pairs for control points are to be reported to the nearest millimeter.

4.3 **Co-ordinateSystem**

A local grid system, based on the SOI projection, shall be established for each distribution network such that all co-ordinates within the scheme are positive. This shall be agreed with the Contractor at the start of the Contract and linked to the Survey of India (SOI) grid where suitable coordinated control points are identified and the Contractor advised of the corresponding offsets. Where applicable, suitable azimuth control will be applied and the methodology adopted outlined in the report. The geographic information or geographical information system (GIS) software should be used for preparation all maps, plans and depiction of topography. Modern GIS technologies rely on digital information, for which there are a number of collection methods. The most common method of data creation is digitalization, where a hardcopy map or survey plan is transferred into a digital medium through the use of a CAD program, and geo referencing capabilities.

4.4 **SatelliteImagery**

Satellite imagery of 0.8 m or higher resolution from NRSA, Hyderabad, covering thecomplete project area is to be procured as part of the Contract. The imagery shall be cloud free and of the Rabi/Kharif 2010-11 period such that field boundaries are clearly distinguishable. The imagery is to provide a crosscheck of the location of existing major infrastructure and where relevant, field boundaries. The imagery is to be procured in hard copy and in digital format as well. This imagery will become the property of the Employer at the completion of the Works.

4.5 **Collection,StorageandProcessingofFieldData**

All field measurements together with their relevant field codes are to be automaticallystored in electronic data-loggers either within the field instrument or attached to field instruments and downloaded from storage remotely or directly to computer for processing. Recording by hand and transcription of field data is not considered appropriate for this project given the time frame available and will not be permitted. GIS application should be used.

5.0 Surveying, Planning, Designing and estimation including preparing land plans and schedules for landacquisitionandalso collectingdataof roads andcart tracks inthe commandarea for

5.1 **Distributionnetwork**

i) MarkingalignmentonSOIMaps:

F. Besides marking the Intake works, pump house of each scheme, the alignment of Rising main/Pressure main, (If delivery chamber is not provided, then the Rising Main should be consider upto the last off taking of Minor.)distributaries are to be marked and boundary of

block for which the contractor is required to plan, design and estimate distribution network shall be indicated on The Survey of India Maps to a scale of 1:50000/1:10000 with contours

a) Risingmain/Pressuremain,Deliverychamber(optional)&distributaries

Followingbroadprinciplesshallbefollowedwhilefixingtheinitialalignment

i. Onthecontourmapvalleylinesandridgelinesshouldbemarked.

ii. The alignment of the Rising main/Pressure main & distributary should be marked so as to command maximum possible area.

iii. The alignment shall be straight as far as feasible. Smooth curves shall be providedwhere necessary to minimize head loss.

iv. Alignmentshouldbeawayfromvillagesitebyabout50m.

v. Majorcrossingofrailways,roadsanddrainsshouldpreferablybeatrightangles;

vi. Haveminimumnumberofroadorcrossdrainageworks.

vii. Permanent structures such as wells/tube wells, house etc. should as far as feasible be kept away from alignment.

viii. TheDeliverychamber(optional)shallbeasfaraspossibleinwasteland/Govt.lands.

ix. Delivery chamber (DC) shall be provided on the basis of topography and design philosophy. However DC is not mandatory.

Automated Primary Filtration System at Pumping Station (multi at other location if necessary) shall be provided. Necessary provisional arrangements shall be made in Distribution network at 20 Ha. Chak towards installation of Secondary filtration unitfor future requirement.

b) CulturableCommandAreaPlanning:

After marking the alignment of the Rising main/Pressure main (If delivery chamber is not provided, then the Rising Main should be consider upto the last off taking of Minor.) and distributary As it is a pipe line system CCA will be on both sides of it. Spread of a CCA will be between the pipe line and the drainage line and should, as far as possible, be limited to revenue boundary of a village. In cases where a village is divided by the distributary and ifthe sub divided areas of village are large enough there will be two CCA and if the areas are small they should be clubbed with adjoining CCA. The byelaws governing the formation of Water Use Association (WUA) shall be kept in mind while delineating CCA.

c) MinorsandSub-Minors:

A minor is a pipeline off-taking from the distributary or Rising main/Pressure main. It serves generally command area of typically about 200-500 ha. In a few cases where distance between Rising main/Pressure main and the command boundary is less, a minor can serve more than one village with the upper limit of command area raised to about 1000 ha. A minor shall off-take from the Rising main/Pressure main or distributary at the highest levelin the CCA. All the principles listed for fixing alignment of a distributary shall be followed. If

the command area of a village as intercepted by a drain or a railway line or a major road, it may be necessary to take out a sub minor to serve the command on the other side

Alltheexercisesmentionedat(a)(b)&(c)aboveshallbecarriedoutjointlybytheDepartment officers or their authorized PM consultants and the contractor.

ii) Reconnaissancesurvey:

After fixing the alignment of Rising main/Pressure main, distributaries and minors on SOI Sheet the contractor shall carry out reconnaissance survey in field to verify that the ground features as shown on plan tally with actual as existing on site. Any variation as a result of subsequent eventssuch asdevelopmentof brick kilns,new artificial drains, roads, pipe lines, transmission lines, railway lines, wells, buildings or farm houses etc shall be noted and alternation in the alignment fixed earlier may be done after Engineer-in-charge visiting the site. On the basisof the levels available either fromSOI sheetorat cornersoffields, if taken, a line diagram shall be prepared to determine exit water head required at chak head, CCA head and the distributary head. During reconnaissance survey special attention shall begiven to ascertain that the drainage lines marked on map on the basis of contours doactually exist on site. This can be done by local inquiry and site observations. If any variation is noticed the chak boundaries should be refixed.

5.2 **Minor/Sub-Minorpipelines:**

A-chakplanning:

These shall be generally aligned along field boundaries. After fixing the alignment of sub minor with considerationof formationof WUA, the contractor shall carryout reconnaissance survey in field to verify if the features on the plan tally with actual ground conditions and structures such as tube wells, houses, gharbadi plots etc. are not located along thealignment fixed. The location of the outlet,command areahaving each point for every field shall also be verified on the field to confirm that the 20 Ha chak outlet with little variation about10% shallbeproposedpreferably atthemiddlepointintheChak.Inthesamewaythe last outletting point (at two ha level) should be as far as possible in the middle reach of the common boundary between two sub Chak so that the friction losses in MIS shall be minimum. The Engineer-in-charge shall examine the layout, have discussion with the contractors and if necessary, visit the site jointly and suggest alternatives regarding adjustment of sub-chaks, drainage layout etc.

Chak outlets shall be provided inside the designated CCA. The outlet management system (OMS) including SCADA Central control unit has to be provided in PLC room of pump house.

5.3 After observing these formalities layout may be considered as approved by the department and the contractor shall proceed with detailed survey according to the specifications.

5.4 **Finallayout:**

5.4.1 **After approv**al of the preliminary layout as provided under 5.3 above, the contractor shall proceed with the work of field to field surveys for taking longitudinal sections of the alignments, collecting the field data for the approved pattern.

5.4.2 The survey work should commence from an established TBM and end on established TBM only at the end of the day's work. The closing error should not exceed the permissible limit.

5.4.3 Levels shall be taken at 30 m interval for all L-Section covering apexes, lowest point of depressions, highest point of ridges and turnout. However, Contractors are responsible to locate all turnouts/outlets at the highest possible locations to serve the maximum possible command. Apex locations shall be fixed by giving location sketches with reference to the survey Nos/Block No. boundaries of fields. Contractor shall demarcate the apexes, tangent pointsandturnoutpointlocationsofthedistributaries,minors&subminors,anddemarcate the apices on sub minors and branch sub minors by excavating a pit of size 60 cm x 60 cm x 60 cm which shall be shown to the Department authority at the time of inspection. On approval by department the Contractor shall arrange to construct the reference Pillars ofsize 15cm x 15cm x 75cm.

The contractor shall submit final layout prepared as stated above to the Engineer-in- Charge for approval. The Engineer-in-charge shall scrutinize the proposal and convey his observations to the contractor within fifteen days. The contractor shall promptly complywiththeremarksand/orifnecessarydiscussthepproposalmadebyhimwiththeEngineer-in-charge and sort out differences. The Engineer-in-charge shall convey the final approvalwithin one month.

5.4.4 Checkingofworksdonebycontractor:

The department officer posted at works site shall concurrently check the work of transfer of PBM and TBM surveying &leveling by arithmetical checking plotting of survey work onvillage map checking of contours, pipe line alignment marked on village maps & verifying same actually at site also.

6.0 DESIGNSANDPREPARATIONOFPLANS&ESTIMATES:

After receiving approval to the final layout, the contractor shall proceed with the task of preparing final designs of Intake Works, Pump House and appurtenances, Rising main/Pressure mains, delivery chamber(optional)s and distribution system, its detailed designs, fixing permanent bench marks along the alignment of intake works, pumping station, Rising main/Pressure main, delivery chamber(optional)(optional), distributaries and minors and preparation of plans and estimation of the complete system.

All system shall be designed using relevant IS codes and prevalent practices. Contractor shall also furnish details of land to be used for Rising main/Pressure main distributaries, minors, sub minors, and drainage lines in prescribed format after marking land width and curves on village plans. Contractor shall construct and establish permanent bench marks at the rate of no less than one nos. per five KM grid and temporary bench marks on average not morethan one no per 100 Ha of CCA along the approved alignment of Rising main/Pressure main,

distributaries and minors. EPC contractor shall furnish Bill of Quantities within 30 days of approval of detail drawing and design.

7.0 DETAILEDDESIGNOFTHESYSTEM

BASIC DELIVERY CAPACITIES:

The designed duty shall be 0.55 lps/Ha(including conveyance losses of 5% within the pipe network+Over Design Factor of 5%) for the design hydraulics up to 1.0 Ha Sub Chak levelwith minimum residual Head of 15 Mt. The rotational Irrigation is allowed only within the 20 Ha. Chak for1 Ha. Sub Chak . The Head losses in the primary automated filtration as well as secondary manual filtration system should be taken in to consideration while finalisation of pipe network as well as Pumping and Motor finalisation for system. However, total system shall be compatible with Micro irrigation.

CONVEYANCELOSSES :

The conveyance losses for underground pipeline system shall be taken as per Indian standards/any approved guidelines. Additional flow requirement for compensation of conveyance water losses of 5 % with pipe network.

Designed Exit gradient & Velocity:-

The complete irrigation system consists of underground pipeline system and the undulatingtopography&soiltypeshouldbeconsideredformicroirrigation.The velocityinpipelinesandexitgradientatoutletsare tobekept asper thefollowingcriteria.

- -Minimum residual headof 15.0 mat the end of field pipe i.e. network upto 1 Ha Sub Chak.

Velocityformaximumabout1.8m/secandminimum0.6m/secinhydraulic calculation for M.S/D.I/HDPE pipes as per Standard practice.

SERVICEAREA:

ThesizeofSubChakshallgenerallybeabout1Ha.Theentirecommandoftheproject will be subdivided into service area of about 200 to 500 ha which will be the basic unit for allocation of water to the WUAs. The service area would be combined to limits of a single village. The contractor is required to study Pani Panchayat Act of Odishaand study the local habits and suggest model operational plan to be implemented or to be enforced for safety of project and smooth functioning of the system. Each chak should be controlled by outlets as per the operational plan.

8.0 SURVEYING, COLLECTING,PLOTTING, PREPARING DESIGNSDRAWINGS ANDESTIMATES OF STRUCTURES FORIF ANY AS PER APPROVED PLANNING AND DESIGN

a. IntakeWorks

b. PumphouseDesignofpumpsandelectricalaccessories,AutomatedFiltration System.

c. Risingmain/Pressuremains

d. Deliverychamber(optional)

e. Distributaries

f. Minorsandsub-minors

g. Allrelatedcomponentsdetailedunderthepowersystemconnectivity

8.1 The contractor is expected to take at least 1 trial pit of 1.5 m x 1.5 m x 2 m deep below pipe lying level or GL whichever is lower or up to hard rock level only at each of the structure on distributaries & minors. The Engineer-in-charge shall check and certify the classification of the type of strata of trial pits before acceptance of final report submitted by the contractor.

8.2 For the structureson Rising main/Pressure main anddistributaries, thecontractor shall carry out the survey over sufficient area by taking levels at 3x3 m interval in either direction. The contractor shall also plot L-Sec along the centre line for a length of 200 m & plot cross sections at the centre and at the end points of the L-Sec. In case of structures on minors similar grid shall be prepared over sufficient area by taking levels at 3x3 m interval in either direction. L-Section shall be plotted along the centre line and cross sections shall be plotted at the centre and either end of the L-.Section.

(a) The necessity, location and type of structures shall be governed by site condition and head loss etc.

(b) In caseofconstructionofsub-minorsthecontractorisnotrequiredtosubmit individual design & drawing of each structures. However typical design and drawing shall be furnished for each structure with a statement showing location and relevant levels and dimensions ofthe structures separatelyforeachscheme.However,thecontractorshall have to give separate estimate for each individual structure.

8.3 The hydraulic and structural design for all of the structures shall be done as per latest guidelines provided in 'Manual on Water Supply and Treatment" published by Central Public Health and Environmental Engineering Organisation (CPHEEO),Ministry of Urban Development, New Delhiand relevant latestI.S./International/MOST code and practices in vogue for such type of irrigation works.

Alldeliverychamber(optional)s/ structuresshallbedeemedto bewaterretainingstructures so far as application of IS-7784-Part-I 1975, IS-7784-Part-II-Section-I, 1983 and IS-456-2000 and IS- 3370-1967. However the latest version of the codes shall prevail for the detailed planning, design and execution. Unless otherwise specified, the design will be carried out by working stress method.

9.0 ADDITIONALPOINTS:

I. As far as possible Intake works, pump house, delivery chamber(Optional) should be situated in government land.

II. Each water delivery pipeline must end in a tail escape in natural drain. Pressure release device should be provided at inlet to control flow of water and regulate it to exact requirement particular minor/sub-minor.

III. StandardizednotationwillbesuppliedbytheDepartmentalongwiththeformatfor drawings (dimensions, lettering, name plate etc.)

IV. Thoughdesigndetailshavebeensuppliedorreferredto,theContractorwillbe responsible of design of a workable and economical system.

V. Proposedirrigation patternand typeofirrigation forthe areaon the basisoftopography and soil characteristic of the area.

VI. It is envisaged to fill the village ponds and suggest suitable common point of raw water discharge to meet the water need of the village and delivery shall be designed to cater for such needs. The cost of water supply shall also be incorporated in estimates.

The contractor if asked will have to justify both technically and economically any of the design and layout details suggested by him and if he is not able to do so, shall have to accept changes as suggested.

10.0 ADDITION/MODIFICATIONS:

Should circumstances arise which call for addition/modifications in the design criteria, the department shall intimate the additions/modifications to the contractor. These additions/modificationswillhavetobetakenintoaccount.Onapprovaloftheproposal,

contractorshallsubmitfinalpresentation.Alldrawingsshallbepreparedincomputer. Separate layers should be used to depict different details in Auto CAD drawings.

I. Index map to the scale of 1:15000 showing alignment of Rising main/Pressure main, distributaries, CCA boundaries, important roads, railways, major drains and village boundaries etc.

II. A combined contour map to a scale of 1:15000 shall be prepared showing alignments of distributaries, minors, type and location of structures, chak, link/ main drains, roads and cart tracks, S.O.I. bench marks and permanent bench marks constructed in one mosaic.

III. Contour maps of CCA in villages to a scale of 1:4000 (village map) showing there on alignments of minors and sub minors, type and location of structures, head at off-take and structure location, chak and sub-chak layout alignment of drainage network anytype and details of structures provided thereon, location of permanent bench marks, kachha and pucca roads, ditches, wells, houses, railway lines, high tension line, electric poles,telephonepoles,irrigationpipelines,WaterSupplypipelines,ONGC/IOCpipeline and all other important prominent features.

IV. Contour map of CCA to a scale of 1:4000 showing contours plotted at 50 cm intervalwith all field details.

V. PlanandsectionsofDeliverychamber(optional)sshowinghydraulicdetails,locationand type of structures etc. trial pit details etc.

VI. CrosssectionoflayingdetailsofRisingmain/Pressuremainsanddistributionnetwork.

VII. Detailed drawings of structures to a scale of 1:50. In case of layout etc. the scale can be 1:100 and in case of details of components the scale can be 1:25.

VIII. LinediagramofpipelinesanddistributionnetworkCCAwise.

IX. Pipelinewiselandplanschedule.

X. Alignment strip plans and land width of pipe line networks on village map to a scale of 1:4000 m showing apexes, tangent lengths, curve lengths, land width required to be acquired etc.

XI. Northlinesforplansshallbeinsame direction.

Note:

1. In case where all the details cannot be accommodated in one volume there can be two or more sections but in such case care should be taken that complete details of an itemis covered in one section.
2. Where map can not be accommodated in one drawing, the overlap of 5 cm on all sides shall be provided.
3. Auniformblockshallbeprovidedontherightsidebottomcornerasperthedetails given by the Engineer-in-charge.

4. Drawings: All drawings, map plans should be computer printed on transparent sheet by plotter. A proper numbering system should be used. Each such tracing should be accompanied by 5 legible ammonia print on superfine paper / photo copy taken outfrom it.

5. EstimateandStatements:3legiblecopiesofestimates/statements/designnotes/reports etc. typed on computer and its print out in laser jet printer.

6. Land acquisition proposals in the formats as per requirement of revenue department in six legible copies typed on computer and its laser print out.

7. The Contractor shall submit original tracing and field books. The contractor shall also return the documents furnished by the Department.

8. All above record in CD and one hard disc with operating software. Submission of completeanimatedproposalinMediaPlayerorinFlashshowingallcomponentsofwork and working animated model so as to give terrain depiction, showing villages, towns, boundaries, river, intake works, pumping station, water conductor systems virtual working model.

9. Operationandmaintenancemanualdraftoftheprojectwithmastercontrol.

11.0 Specifics

I. Survey work will be handed over to the Departments in Auto C**A**D 2007 format drawings, separate layers will be used for each attribute and standardized blocks will be used to portray repeated features such as telegraph poles. A list of such layers andcorresponding line-types and blocks as the Contractor proposes shall be agreed prior to the commencement of drawing production.

II. Drawing shall be prepared at a scale of village map and shall include a map location legend and scale bar no each sheet.

III. Drawing shall be on standard A 1 sheets. All drawing shall have a 20 mm border on all sides. The title block shall be in the bottom right hand corner of the page and the title block area above it shall be 100 mm wide. No part of the model space drawing shall extend into the title block margin above it all notes, scale bars and legends shall be located in the margin above the title block.

IV. All survey data shall be presented in model space (with Auto CAD) and all other non spatial data and constructions (title block, legend, frame etc) shall be located in paper space.

V. Each drawing shall include a 100 m x 100 m grid with clearly referenced co-ordinates using GIS along the drawing border.

VI. Where these occur within limits of drawings, the drawings shall show the location of benchmarks and control points used during the survey. Each shall be fully referencedand its details included in the report.

VII. Each drawing shall show the details agreed with the Departments, the remaining layers though present in the drawing file, shall remain hidden.

12.0 Survey&InvestigationforSystemconnectivity

12.1 SURVEYANDMARKING:

12.1.1 The preliminary Survey: - Walk over survey, theodolite survey, and profile survey (if required) shall have to be carried out to establish the Route alignment by the Contractor for new lines. Survey shall cover all crossings like railways, roads including NH, power lines, telecommunication lines (under P&T Deptt), rivers, forest area, proximity to buildings etcand should be clearly indicated in the route map. Rly crossing shall be indicated clearly by color code or by bold letter. **Route alignment shall be plotted on Survey of India topographical maps [size (1:25,000) or (1:50,000) where ever available].**

12.1.2 Preliminary Survey Reports: Three copies of the alignment reports along with other information, if any, shall be submitted in report form, to Superintending Engineer in charge oftheDivisionwithcopymarkedtotheCE&BM, RBVN Basin, Brahmapur for approval.Thedetailedsurvey:-It shouldbetakenuponlyaftertheroutemapisapproved.

Preliminary route alignment in respect of the proposed line may undergo changes due to alteration of place and other unavoidable constraints. Detailed survey shall be covered by the following general guide lines:

- Routeoftheelectriclineshallbeasshortas possible.
- The line is as near as possible to the available roads in the area. Difficult and unsafe approaches are avoided
- Good farming areas, religious places, forest, civil and defence installations, aerodromes, public and private premises, ponds, tanks, lakes, gardens, and plantations are avoided as far as practicable.
- InvolvementofForestlandshouldbeleast&restrictedasfaraspossible.
- The line should be far away from telecommunication lines as reasonably possible.Parallelism with these lines shall be avoided as far as practicable.
- Angle pointsin theroute shall beminimized.Railwayand road crossingshall beminimumon the line route and in case it is not possible to avoid the same the crossings at right angles shall be preferred but the crossings shall not be less than 60^0 in any case.
- Thesurveyshallbeconductedalongtheapprovedalignmentonly.
- Relevantdrawings & data shall be furnished to the appropriate authorities and obtain statutory clearances for Railway crossings, Highway/Roads, Telephone/ Power line crossings etc. All such clearances are the responsibility of the contractor.
- Owner shall arrange all required consent/approvals including civil aviation, road, river, railway, canal, power line crossings and environmental and forest clearance etc. from the concerned authorities.
- Owner in accordance with the requirement of construction shall arrange right of way and wayleaveclearances.Compensationforrightofwayandwayleavesshallbegivenasper

applicablelaws,rules,regulations,guidelines/directivesoflocaladministration/revenue authorities.

- For river crossing/ Crossing of nallas : Taking levels at 25 meter interval on bank of river and at 50 meter interval at bed of river so far as to show the true profile of the ground and river bed. In case of railway/ Road Bridge, road, the levels shall be taken at least 100 m. on either side of the crossing alignment. Both longitudinal and cross sectional shall be drawn preferably to a scale of 1:2000 at horizontal and 1:200 vertical.

- To facilitate checking of the alignment, suitable reference marks shall be provided. For this purpose, concrete pillars of suitable sizes shall be planted at all angle locations and forothers with suitable wooden/iron pegs.

12.2.2 Detailed Survey Reports: After completing the detailed survey, the contractor shall submit the followings along with compliance reports, if any, to Superintending Engineer inchargeoftheDivisionwithcopymarkedtotheCE&BM,RBVN Basin, Brahmapur for approval.**finalprofileand towerschedule/poleschedule**

- **billofquantity (BoQ)**

After approval, the contractor shall submit **six** more sets of the approved documents along witha **soft copy** for record purpose and submission to concerned Distribution Licensees (WESCO/SOUTHCO).

12.3 Way-LeaveandTreecutting:-

12.3.1 Way-leave permission which may be required by the contractor shall be arranged at his cost. While submitting final-survey report for approval, proposals for way-leave right of way shall be submitted by the contractor. DoWRmay extend help/ facilitateto get the permission within a reasonable time for which due notice shall be given by the contractor in such a way so that obtaining permission from appropriate authority do not hinder the continued and smooth progress of the work.

12.3.2 The employer shall not be held responsible for any claim on account of damage done by the contractor or his personnel to trees, crops and other properties.

12.3.3 The contractor shall take necessary precautionto avoid damage to any ripe and partially grown crops and in the case of unavoidable damage, the employer shall be informed and necessary compensation shall be paid by the contractor.

12.3.4 All the documents required for application to the statutory authorities must be prepared by the contractor & submitted to the employer for submission of the application towards approval of Railway Crossing etc. However, the responsibilities lie with the contractor to get the clearance.

12.3.5 Trimming of tree branches or cutting of a few trees en-route during survey is within the scope of survey to be done by the contractor. Contractor shall arrange for necessary way-leave and compensation in this regard. During erection of the line, compensation for tree cutting, damage caused to crops, actual cutting and falling of the trees including way-leave permissionforsuchrouteclearanceshallbearrangedbythecontractorathiscost.The

contractor will identify the number of trees and detail of obstructions to be removed for erection of the line and intimate the employer well in advance in case of any help. Other related works like construction of temporary approach roads, etc. as required, shall be done by the contractor and the same will lie within the scope of contractor's work and such cost shall be considered to be included in the rates quoted by him.

12.4 Check survey:-

The contractor shall undertake the check survey during execution on the basis of the alignment profile drawing and pole/ structure schedule approved by DoWR. If during check survey, necessity arises for minor change in route to eliminate way leave or other unavoidable constraints, the contractor may change the said alignment after obtaining prior approval from the authorized Engineer, DoWR.

13.0 WorkOwnership

Following completion of the survey work and final payment of all dues the survey work including all data and computations satellite imagery and drawings shall become the property of the Employer. The Contractor shall not distribute copies of the Work to third parties except the Departments, without the prior written consents of the Employer.

14.0 Back-upCopies

The Contractor shall submit all records with licensed software in Compact Discs (DVD) in 5 copies with proper referencing and interlinking of data with references so as to access data as web page. The data shall also be supplied in an appropriate capacity hard disc with all operating software used. The data shall also be available with contractor till the expiry of defect liability period and if required by department the same shall be supplied in softcopies.

B. LAND ACQUISITION

THELANDACQUISITIONCASESARETOBEPREPAREDANDSUBMITTEDIN THEFORMATSPRESCRIBEDBYTHEREVENUEAUTHORITYCOMPETENTTO PASS THE AWARDS. ODISHA LAND ACQUISITION ACTS, RULES AND REGULATIONSINRESPECTOFLANDACQUISITIONASENFORCEDFROMTIMETO TIMEARETOBESTRICTLYFOLLOWED

SECTION-III

TECHNICALSPECIFICATIONFORCIVILWORKS

ccdfdsfdsfsd
CONTRACTOR

SUPERINTENDING ENGINEER

TECHNICALSPECIFICATIONFORCIVILWORKS

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EXCAVATION

1.1 SCOPEOFWORK:

Theitemshallincludeclearingsite,excavationforPumphouse&similarother.

All the excavation and removal of excavated material and its disposal in a manner hereinafter specified, the rate for the item ofexcavation shall also include.

i) Clearingofsite.

ii) Settingcut works, profiles etc.accordingto sanctioned plan, oras directedby Engineer-in-charge and setting up benchmarks and other reference marks.
iii) Providingandsubsequentlyremovingshoringandstruttingifandwhennecessary.
iv) Necessaryprotectionincludinglabour,materialsandequipmentstoensuresafetyandprotection against risk or accident.
v) Supplyoffacilitiesforinspectionandmeasurementsatanytimetotheconcernedgovt.officials.
vi) Compensationforinjurytolifeanddamagetopropertyifanycausedbycontractor'soperations connected with this item

1.2 CLEARINGTHESITE:

ThesiteofexcavationshallbeclearedofallgrassvegetationfencingbushesandtreesasdirectedbytheEngineer-in-charge.Thematerials,obtainedfromsuchclearanceshallbethepropertyofthe Govt. and shall be stacked as directed by the Engineer-in-charge so as not to cause obstruction to the work.

1.3 LAYOUT:

All materials such as pegs, bamboos and strings and templates for marking out slopes, and tools required for line out shall be provided by the Contractor at his own cost. The centre line of excavation shall be clearly marked by pegs or by stones at each chain or change of direction or at shorterintervalsoncurves,inthebeginning.Thefinallineoutwillbedonebyfixingreferencestone at suitable distances on either side *of* the centre line, so that they are not disturbed during the constructionperiod.Thepositionof thesestoneswillbemarkedonthecrosssection.

No change in the sanctioned plans and designs is permissible without the written permission of Engineer-in-charge.

Before starting the work, the Contractor shall have to sign the field books and plans showing the working longitudinal sections and cross sections of the portions of the alignment, that he has to tackle.IftheContractorfailstosignthemwithinthreedaysofbeingcalledupontodoso,thelevels and sections as recorded by Engineer-in-charge or his Assistant will be final & binding on the Contractor.

Contractorshallprovideandmaintainthequarryroadsandtemporaryroadsrequiredforconveying and transport of materials at his cost.

Forthepoints, whicharenotcoveredbythesespecifications,theinstructions givenbythe Engineer-in-charge shall be final and binding on the Contractor.

The material available from all excavation and remaining surplus after use on the work from adjacent work etc. can be used by the Contractor free of cost provided these materials are used solelyforthespecificcontractorworkandpriorapprovaloftheEngineer-in-chargeistaken.

1.4 EXCAVATION

Sectionshallbeexcavatedasshownonthedrawingsorasdirectedbytheengineer-in-charge.
Suitablearrangementsfordrainageshallbeprovidedtotakesurfacewaterclearofexcavation during the progress of work.
Excavationmaybecarriedoutbymanuallabourorbyexcavatingmachine

1.5 EXCAVATIONINROCK:

Excavationinrockshallbemostlycontrolledblastingsoasnottoendangersurroundingstructures. All sharp points of rock are chipped off. Blasting in a manner, which is likely to produce over breakage, which in the opinion of Engineer-in-charge is excessive, shall not be permitted. Special care shall be taken to prevent over-breakage or loosening of materials on bottom and side slopes. Excavationinexcessoftheprescribedsectionshallnetbepermittedandnopaymentwillbemade for such excess excavation.
Thematerialexcavatedshallbestackedoneithersideasspecifiedonthedrawingorasdirectedby the Engineer - in - charge.

TheExcavationshallbecarriedoutaccordingto thedesignwithsideproperly sloppedasshownin the drawings and as directed by the Engineer - in - charge. The cress section adopted in cutting is likely to change in side slopes according to the depth of different strata during actual excavation. TheContractorthereforeshallgetclearinstructionsfromEngineer-in-charge,beforecommencing any cutting work.

No claims for any variations in quantity of excavation resulting from the deviation from the instructionsoftheEngineer-in-chargeshallbeaccepted.Inportionswheredeepcuttingofmore than 6 m. is to be done, the mode of excavation to be followed must be got approved from the Engineer - in - charge, before starting the work.

Theexcavationshallactuallybecarriedoutinsteps.Thestepsshallhavesuchwidthanddepththat after they are cut, the required final side slopes is attained. Cutting of steps shall be done when altered level is reached and after one monsoon.

1.6 REMOVALOFLOOSEROCKETC:

Beforeanyworkofexcavationistakenupallloosero ck,semi-detachedrockin/orclosetotheareas tobeexcavated,thatisliabletofallorotherwiseendangertheworkmenontheprojectshallbe

stopped.Themethodsemployedshallbesuchaswillnotshatterorrenderunstableandtherefore unsafe any rock that was originally sound or safe. Any material not requiring removal as contemplated herein, but which may later become loosened or unstable shall be promptly and satisfactorilyremoved.Thecostofsuchclearingshallbedeemedtohavebeenincludedintheunit rates accepted under the different items under excavation.

1.7 CLASSIFICATIONS**:**

TheClassificationofstratashallbeasunder.

i) **SOFTSTRATA:**

Thisshallincludeallkindsofweatheredrockshale,clay,soil,siltsandandgravel,softaverageand hardmurumandanyothermaterials,whichcanbestberemovedwithashovelafterlooseningwith apickandorbar.Itshallalsoincludeisolatedbouldersupto0.1cubicmeterseach.Whichdoesnot need blasting and could be removed with a pick / bar and shovel.

ii) HARDSTRATA:

Thisshallincludeallrockoccurringinmassesinalltypesofgeologicalformationsthatcouldbestbe removedbyblasting,wheresuchblastingispermissible.Itshallalsoincluderockwhichowingtothe proximityofbuildings,structures,electriclines&publicroadsorforanyotherreasonshastobecut bymeansofchiselsorwedges.Itshallalsoincludebouldersinmassandisolatedbouldersover0.1 cubic meter each that required blasting or wedging and breaking for easy removal. Merely use of explosives in excavation shall not be considered a reason for classification in hard strata unless regular blasting is clearly necessary in the opinion of the Engineer - in - charge. The hardness of strata or material to be excavated presence of different type of geological constituents requiring; increased drilling efforts, consumption of explosives, labour and use of machinery shall not be considered as reason for claim / increase in contract rates.

Incaseofthedisputesovertheclassificationofstratametwithduringexecution,thedecisionofthe Engineer - in - charge will be final

1.8 MAINTENANCEOFSLOPESINEXCAVATION:

Anyshoringandstruttingrequiredduringexcavationandafterwardsshallbedeemedtobecovered by the rates quoted for the items.

1.9 SLIPS:

Slips shall be avoided, but if any slips occur on account of any reason, the excavation shall be promptlyrestoredtostability.Noextraclaimsshallbeentertainedforsuchslips.

TheContractorshallhavetomakegoodtheworkathiscost.

1.10 USEOFEXCAVATEDSTUFF:

Excavationshallbedonesystematically.Onlythoseexcavatedstuff,whichwillbepermittedforuse, shall be used.

1.11 DEPOSITIONOFEXCAVATEDSTUFFCLEAROFFTRAFFICLINESETC.

Disposal of all material from excavation shall be as per approved disposal plan of instructions of Engineer - in - charge, regarding the location and deposition of the stock piles, spoil banks of embankment.Beforeanyexcavationisstartedthedepositionofspoilshallbecarefullyplannedso asnottoobstructnormaltrafficandtrafficlinesrequiredfortheconstructionmaterials,andshallbe dumped sufficiently clear off the edges of the excavation so as not to endanger stability of the slopes of the excavation and also to permit ample space for lorry paths, installation and lifting of dumping devices, stacking construction materials etc.

1.12 SORTINGANDSTACKINGOFMATERIALS:

Excavatedmaterialsshallbesortedoutandstackedasunder.

a) All the excavated materials from the soft strata shall be sorted on. The material not useful shall be deposited as directed by the Engineer - in – charge. Materials useful shall be, sorted out and neatly stacked. Every stockpile of the material shall be of regular size and not less than 5 m. in height.

b) **HARDSTRATA:**

Rubble and boulders from hard strata shall be stacked in separate area as directed by the Engineer - in - charge. Stockpiles shall be of regular shapes, allowing for easy measurementNo stockpiles shall measure more than 200 Sq.m. In plan and more than 1.5 m. in height, unless specifically permitted by the Engineer - in - charge in writing.

1.13 SURPLUSMATERIALS:

The excavated materials, if not required shall be stacked in spoil banks with neatly made stable slopes at top and a suitable berm being left between the toe of bank, and edge of excavation, as directed.

1.14 STACKINGINSTOCKANDWASTE PILES:

After sorting is done, useful materials of various types shall be stacked in stockpiles and rest may be disposed off as directed by the Engineer - in - charge.

Useful material shall be stacked in separate area as directed with reference to the nature of the material. Stockpiles shall be of regular shapes allowing for easy measurement No stockpile shall measure less than 60 m. length and 5 m. height unless specially permitted by the Engineer - in - charge

The excavated material shall be stacked within the area approved by the Engineer - in - charge. If the excavated material is deposited in unauthorized land, such work will not be measured for payment unless suitable action as may be directed by the Engineer - in - charge is taken by the contractor. In additional to non - payment of such work suitable amounts as directed by the Engineer - in - charge will be recovered from the Contractor as directed towards any extra cost whichmay have to bear on account of the Contractors un-authorized action.

1.15 USEOFEXCAVATEDMATERIALS

All the materials available from excavation will be the property of Govt. and shall be deposited as directed by the Engineer - in - charge. The Material of approved quality may be used by the Contractor in the item of work included in Schedule of requirement of the tender or on ancillary for preparatory work free of charge. Prior approvalof the Engineer - in - charge for such free use shall however be taken.

1.16 SILTINGOFEXCAVATION:

1.17 SILTINGDUETOFLOODS,EMPLOYERNOTRESPONSIBLE:

Ifexcavatedpitsgetsiltedduetointerveningfloods,slipsoranyothercause,tillcompletionofthe work, the Contractor shall excavate and restore the pits and section to the required shape and dimensions without any extra cost.

1.18 BOXEXCAVATION:

Initiallyboxexcavationshallbecarriedoutuptotopofhardstrata.Thereafterstableslopesmaybe cut in soft strata as stated hereafter

On sinking hard rock in foundation trench the surface of this rock shall exposed on all area ofthe trenchanditshallbebroughttothenoticeofEngineer-in-chargebythecontractor.TheEngineer- In - charge or his authorized representative shall take levels of the top of hard stratum along predeterminedsectioninthepresenceofContractororcontinueduptofoundationleveltobefixed by the Engineer - in - charge.

1.19 EXCAVATIONINWETCONDITIONANDDEWATERING:

Unlessotherwisespecifiednodistinctionwillbemadeastowhetherthematerialbeingexcavatedis dry, moist or in wet condition.

1.20 CONTRACTORTODEWATERWHENEVERREQUIRED:

The area under all the works pertaining to this tender and adjoining area as necessary shall be maintained free of water.

The area shall also be maintained free of water after any part of the work is completed for inspection,safetyandinstallationforanyotherreasonsdeterminedasnecessarybytheEngineer- in - charge. The sumps shall be well lighted and shall be readily accessible for inspection. The Contractor shall pump out all water from the site and appurtenance works and shall keep the foundation free of water, while excavating, concreting and placing masonry and continue to keep theworksfreeofwaterforaperiodasmayrequiredfromproper-settingofmortarorconcreteor otherwise required for the completion of work.

TheContractorshallhavetoconstructandmaintainduringconstructionofstructures,cofferdams, diversion channels and other diversions or protective works as necessary after approval from Engineer-in-charge.TheContractorshallnotbeentitledtopayclaimsordamagesonaccountofor by reason of any amount of leaking through under or around cofferdams, diversion channels and either diversion or protective worksof overtopping of diversion works.

1.21 PREPARINGANDTESTINGOFFOUNDATION:

1.22 SCALINGANDTRIMMINGOFFOUNDATION:

After excavation to the required depth is completed scaling and trimming operations for the removalofallpiecesloosenedduringexcavationorpartlyseparatedfrommainrockmassbyseams orcracksshallbecarriedouttothesatisfactionoftheEngineer-in-charge.

1.23 TREATEMENTOFWEAKLOCALSPOTS:

All weathered or partly decomposed pieces of rock shall be removed so as not to leave on the foundation any rock other than that which is an integral part of rock mass. Areas of low bearing capacity, steep inclined seams, faults, and Crushed zone in an otherwise good foundation, if permitted to be kept shall be cleared out to a sufficient depth and refilled and plugged with masonry or concrete as directed by the Engineer-in-charge.

1.24 FINALFINISHEDSURFACEOFFOUNDATION:

The finally prepared foundation shall present a rough surface in cross section to give added resistance to sliding. All smooth surfaces shall be roughened artificially to give a good bond. The surfaceshallbefreefromsteepanglesandtheedgesofbenchesshallbechamferedapproximately to45°.Pinnaclesofsharpprojectionshallbeknockedoffandprominentknobsflattened.

1.25 TESTINGFORSOUNDNESS:

The finally finished foundation rock shall be tested by striking with a heavy hammer and if loosed portion of foundation rock is revealed by a hollow sound, it shall be excavated further (without blasting) till a clear ringing sound is obtained.

1.26 EXCAVATIONOUTLINES:

Allexcavationshallbeperformedinaccordancewiththelines,grades,levelsanddimensionsshown inthedrawingorestablishedbytheEngineer-in-charge.Thedimensionsshowninthedrawingare tentative. During the progress of work it may be necessary or desirable to vary the slopes or the dimensions of excavation from those specified in the drawing. The side slopes of the excavations shall be as steep as would stand with safety as decided by the Engineer-in-charge. If the slopes established are found to be steeper and likely to slip, they shall be made flatter by removing the additionalmaterialandintroducingsuitablebermsifpossibleandstablefacesestablished.

1.27 BLASTING:

1.28 OBSERVINGRULESREGARDINGBLASTING:

Inconductingblastingoperationsproperprecautionsshallbetakenfortheprotectionofperson,the workandproperty.AllGovernmentlawsrelatingtothedesignandlocationofmagazine,transport and handling of explosives and other measures for the prevention of accident shall be strictly observedWarningsignsshallbe prominently displayedonthe magazines,andwarningsignsgiven for each blast. Specifications for blasting given under the separate section shall be carefully and rigidly observed.

1.29 STORINGOFEXPLOSIVES:

Explosivesshallbestoredinasafeplaceatsufficientdistancesfromtheworkandunderthespecial care of watchman so that in case of accidents no damage occurs to the other part of work. Explosives, detonators and fuses shall be each separately stored. No Objection Certificate from DistrictMagistrateorinspectorofExplosivesshallbeobtainedasrequiredbytheContractor.

1.30 RESTRICTIONSONBLASTING:

a) Blasting which may disturb or endanger the stability safety or the quality of the foundation will not be permitted.

b) Blasting within 30 meter ofmasonry work in progress of a permanent structure shall not be permitted.

c) Blasting operation shall be monitored so as not have peak practical velocity near important structures to exceed 10 ppv.

d) Progressiveblastingshallbe limitedtotwothirdofthetotalremainingdepthofexcavation.

d) Nolargescaleblastingoperationshallberestoredtowhenthefoundationexcavationreaches thelasthalfmeter.Onlysmallchargespreferablyblackpowdermaybeallowedso asnotto shatter the foundation

e) Rulesofblastingareasappended.

1.31 EXCAVATIONINHARDSTRATAWITHCHISELLINGAND/ORCONTROLLEDBLASTING:

1.32 EXCAVATIONINHARDSTRATA:

Wheretheexcavationinhardstrataisinvolved,sinceusualblastingoperationsarelikelytodamage theadjoininghouses,transmissionlinesorhinderthetrafficonimportantroads.Theexcavationfor a good length is required to be done under controlled blasting conditions and / or chiseling. The item will include excavation in hard strata to correct sections as shown in the drawings with chiselingand/orcontrolledblastinganddepositingtheexcavatedstuffasandwheredirected

TheContractorshallobtainwrittenpermissionoftheEngineer-in-chargebeforeundertakingthe work under this item for specific reaches.

Theholesforblastingshallbedrilledforadepthofonly40cmthusincreasingthenumberofholes and correspondingly decreasing the charge required for each holes.

Theholesasfaraspossibleshallbeslant.Alltheholesafterchargingwillbecoveredbygrillofsteel rodswhichshallbesuitablyloadedbygunnybagsfilledwithsandorMurom.Thesteelgrillshallbe soloweredovertheholesthatitdoesnottocauseanydamagetothe(usewireorchargesandcare shall be taken to seethat the fuse wires remain free.The loading shall be sufficient to prevent the overthrow of rock after blasting In addition to the above loading; the steel grill shall be securely anchored to the adjoining rock by chains. The steel grill shall extend at least 3 meters beyond the area to be blasted.

Chiseling manually or excavation by pneumatic rock breakers shall be restored to as directed by Engineer --in - charge where blasting cannot be permitted.

Any alternate technique approved by the Engineer- in - charge may be used, but approval to execute the work by the above mentioned method or alternate technique would not relieve the Contractor of the responsibility of damageto the power line and properties.

B. DRILLINGANDBLASTING

2.1 General
2.2 Materials
2.3 Personnel
2.4 Storageforexplosives
2.5 Useofexplosives
2.6 DisposalofDeterioratedExplosives
2.7 PreparationofPrimers
2.8 Chargingofhole
2.9 Blasting.
2.10 Electricalfiring
2.11 Precautionsafterblastingandmisfire

DRILLINGANDBLASTING

2.1 GENERAL

Blasting where required will be permitted only when proper precautions have been taken for the protectionofpersonsandpropertyinaccordancewithIS4081-1986(Indianstandardspecification forsafetycodeforblastingandrelateddrillingoperations).Whilecarryingoutexcavation,adequate precautions in accordance with IS 3764-1992 (Indian standard specifications for safety code for excavation work) shall be taken.

Explosives such as gelatine, prilled ammonia nitrate detonators and fuse coils etc required for the rock blasting are to be procured by the contractor at his cost. The contractor has to purchase the blasting materials on the name of work and on the name of contractor. The materials without mentioning the above two names on the bill will not be accepted. It shall be the responsibility of the contractor to store the explosives purchased by him in accordance with the rules of the explosives act and other rules framed by Government of India. He should possess/acquire proper license for transport of explosives, portable magazines for possession and use of explosives and shot fires as per revised act 1983.

Heshallalsofurnishthefollowingdetailsofportablemagazines&transportvehicles:

Capacity	LicenseNo.anddate	Validityperiod

The contractor shall acquaint himself with all the applicable laws and regulations concerning storing, handling and use of explosives. All such laws, regulations and rules, as prevalent fromtime to time shall be binding upon the contractor.

The Provisions detailed in the specification are supplementary to the above laws, rules and regulations, are also applicable. Further, the engineer may issue modifications, alterations and new instructions from time to time. The contractor shall comply with the same without these being made a cause for any claims.

AlistofI.Scodeapplicableisfurnishedbelow:

IS4081-1986:SafetycodeofblastingandrelateddrillingoperationsIS

3764-1966: Safety code for excavation work.

In addition to the above I.S. codes, the specification of O.S.S and manual for quality control andinspection shall also be complied with.

2.2 MATERIALS:

All the materials such as explosives, detonators, fuse coils, tamping materials etc. that are proposedtobeusedintheblastingoperationsshallhavethepriorapprovaloftheEmployer.Only explosives of required make and strength are to be used.

Black powder and safe explosive shall be used wherever possible. Explosives with nitroglycerine shall be used where the above explosives are not effective.

The use of fuse with only one protective coat is prohibited. The fuse shall be sufficiently water resistant as to be unaffected when immersed in water for thirty minutes. Rate of burning of the fuse shall be uniform and not less than 4 (four) seconds per 26 millimeters of length with 10%(ten percent) tolerance on either side. The fuse known as instantaneous fuse shall not be used. The fuse shall be inspected before use and the moist, damaged or broken ones discarded. The rate of burning of all new types of fuses shall be examined. When they have been in stock for a long time they shall be treated before use. The detonators used shall be capable of producingeffective blasting of the explosives.

2.3 PERSONNEL:

Excavation by blasting will be permitted only under the personal supervision of competent and licensed persons and trained workmen employed by the contractor at his cost. All supervisors and workmen in-charge of makeup, handling, storage and blasting work shall be adequately insured by the contractor.

The person in charge of the explosive magazine shall be very reliable and his deployment shallbe approved by the Employer.

The contractor shall make sure that his supervisor workmen are fully conversant with all the rules to be observed in storing, handing and use of the explosives. It shall be assured that the supervisor in charge is thoroughly acquainted with all the details of handing and blasting operations.

2.4 STORAGEOFEXPLOSIVES:

The contractor shall build a magazine or make suitable permanent arrangements at his cost for safe storage of the explosives. Contractor shall provide portable magazine for carrying the explosives to work-spot from the magazine at his cost.The site of the magazine, its capacity and design shall be subject to approval by the Inspector of Explosives before the construction is taken up. As a rule, the explosives should be stored in a clean, dry, well ventilated, bullet proof and fire proof building on an isolated site.

The contractorshallprovide armedguardsecurityofrequirednumberforexplosivemagazineor while transporting to work site as per rules in force at his cost.

Theexplosivesdetonatorsandfusecoilsshalleachbeseparatelystored.

A careful and day to day account of explosives shall be kept by the contractor in a register in manner prescribed by the employer. The employer may also pay surprise visits to the storage magazine. In case of any unaccounted storage pay surprise visits to the storage magazine. Incase of any unaccounted storage of the explosives or if the account is not found to have been maintained in a manner prescribed by the engineer, the contractor shall be liable to bepenalized in which case he shall not be entitled to any compensation for the losses etc. The action taken under this clause shall be in addition to that which might be taken by the competent civil authorities in the court of law.

Themagazineshallatalltimesbekeptscrupulouslyclean.

No unauthorized person should at any time be admitted inside the magazine. A notice shall be hung near the storage prohibiting entrance of unauthorized persons.

The magazine on no account be opened during or on the approach of the thunder storm and no person shall remain in the vicinity of the magazine during such periods.

Magazine shoes without nails shall at all times be kept in the magazine and a wooden tub or cement through about 300 millimeters high and 460 millimeters in diameter filled with water shall be fixed near the door of the magazine.

Persons entering the magazine must put on the magazine shoes which shall be provided by the contractor for the purpose and be careful.

i) Nottoputtheirfeetontheclearfloorunlesstheyhavethemagazineshoeson
ii) Nottoallowthemagazineshoestotouchgroundoutsidethecleanfloor.
iii) Nottoallowany dirtorgrittofallontheclean floor.

Person with bare foot shall, before entering the magazine, dip their feet in water and then step direct from tub over the barrier (if there be one) on the clean floor.

A brush or broom shall be kept in the lobby of the magazine, for cleaning the magazine on each occasion it is opened for the receipt, delivery or inspection of explosives. No matches or inflammable material shall be allowed in the magazine. Light shall be obtained from the electric storage battery lantern.

Nopersonhavingarticlesofsteelorirononhimshallbeallowedtoenterthemagazine.

Oily cotton, rags, waste and articles liable to spontaneous ignition shall not be allowed insidethe magazine.

Workmen shall be examined before they enter the magazine to see that they have none of the prohibited articles on them.

No tools or implements other than those made of copper, brass, gun metal or wood shall be allowed inside the magazine. All tools shall be used with extreme genteelness and care.

Boxes of explosives shall not be thrown down or damaged along the floor and shall be stacked on wooden trestles.

Where there are white ants, the legs of trestles should rest in shallow copper, lead or brass bowlscontainingwater.Openboxesofdynamiteshallneverbeexposedtothedirectraysofthe sun. Empty boxes or loose packing materials shall not be kept inside the magazine. Magazines shall be inspected at least twice a year by any officer representing the engineer.

He shall see that all the rules are strictly compiled with. The magazine shall have a lightening conductor whichshould be got tested at least once a year. The contractor shall comply with all the recommendations made by the officer testing the lighting conductor and also rectify the defectsnotifiedto himwithin16 daysfailingwhichthe engineershallbeentitledtocomply with the same at the contractor's expense which shall not be open to question. The engineer may take any action that he may consider fit at the cost of the contractor.

Thefollowingshallbehunginthelobbyofthemagazine.

a. AcopyofrulesbothinEnglishandinthelanguageswhichtheworkerconcernedare familiar with.
b. Astatementshowingthestockinthemagazineonthatday.
c. Acertificateshowingthelastdateoftestingofthelightingconductor.
d. Anoticethat"smokingisstrictlyprohibited".

2.5 USEOFEXPLOSIVES:

For the transport of the explosives and detonators between the store and the site, closed and strong containers made of soft materials such as timber, zinc, copper, leather shall be used.

Explosives and detonators shall be carried in separate boxes. For the conveyance of primer, special container shall be used.

The boxes and containers used shall be kept closed. Explosive shall be stored and used chronologically earlier received shall be used first. A make up house and used chronologically earlier received shall be used first. A make up house shall be provided at each working place in which cartridges will be making up by competent and licensed men as required for the work.The makeup house shall be separated from other buildings. Only electric storage battery lamps shall be used in this house.

Nosmokingshallbeallowedinthemakeuphouseorgenerallywhiledealingwithexplosives.

2.6 DISPOSALOFDETERIORATEDEXPLOSIVES:

All deteriorated explosive shall be disposed off in an approved manner; the quantity of the deteriorated explosives to be disposed off shall be intimated to the engineer prior to itsdisposal.

2.7 PREPARATIONOFPRIMERS

The primers shall not be prepared near open flames of fire. The work of preparation of primers shall always be entrusted to the same personnel. Primers shall be used as early as possible after they are ready.

2.8 CHARGINGOFHOLES:

The work of charging of holes shall not commence before all the drilling work at the site is completed and the contractor's supervisor shall satisfy himself to that effect by actual inspection. While charging, open lamps shall be kept away. For charging with powered explosives, a naked flame shall not be allowed.Only wooden tamping rods, without any kind of metal on the rod shall be allowed to be used. The tamping rods shall have cylindrical ends. Bore hole must be of suchsize that the cartridge can easily pass down them, they shall not however be too big.

Only one cartridge shall be inserted at a time and gently pressed into the hole with the tamping rods, the sand, clay or other tamping materials used filling the holes completely shall not be tamped too hard.

2.9 BLASTING

Blasting shall be carried during the fixed hours of the day which shall have the approval of the engineer.Thehoursoncefixedshallnotbealteredwithoutpriorwrittenapprovaloftheengineer. The site of blasting operation shall be prominently demarcated by red danger flags. The order to fire shall be given only by the contractor's supervisor in charge of the work and this order shall be given only after giving the warning signal three times, so as to enable all the labour, watchmen etc., to reach safe shelters.

A whistle / bugle with distinctive note shall be used to give the warning signals. The whistle/bugle shall not be used for any other purpose. All the labour shall be made acquainted with the soundof the whistle/ bugle and shall be strictly warned to leave their work immediately at the first warning signal and to move for safe shelters. They are not to leave the shelters until all clear signals have been given.

Alltheroadsandfootpathsleadingtotheblastingareashallbewatched.

In special cases, suitable extra precautions shall be taken. The Engineer may however permit blastingforundergroundexcavation,withoutrestrictionoffixedtime,providedthatheissatisfied

that proper precautions are taken to give sufficient warning to all concerned and that the work of other agencies on the site is not hampered. For lighting the fuse, a lamp with a strong flame such as a carbide lamp shall be used.

The contractor's supervisor shall watch the required time for firing of the fuses and shall see that all the workmen are under safe shelters in good time.

2.10 ELECTRICALFIRING

Only the contractor's supervisor in charge shall possess key of the exploder and short firing accessoriesandheshallkeepit alwayswithhimself.Specialapparatusshallbeusedasasourceof current for the blasting operations power lines shall not be tapped for the purpose.

The detonators shall be checked before use. For blast in series, only detonators of the same manufacture and of the same group of electrical resistance shall be used. Such of the electrical lines as could constitute danger for work of charging shall be removed from the site. The firing cables shall have a proper insulating cover so as to avoid short circuiting due to contact withwater metallic parts or rock.

The firing cables shall be connected to source of current only when nobody is in the area of blasting. Before firing the circuit shall be checked by a suitable apparatus. After firing with or without an actual blast the contact between the firing cable and the source of current shall be cut offbefore anyone isallowedto leave the shelters.Duringstorm/rain,the blastingoperationsshall be suspended.

2.11 PRECAUTIONSAFTERBLASTING

Aftertheblast,thecontractor'ssupervisormustcarefullyinspecttheworkandsatisfyhimselfthat all the charges have exploded. After the blast has taken place in the under-ground works, workmen shall not be allowed to go to the place till all the toxic gases are evacuated from theface.

MISFIRES:

If it is suspected that part of the blast has failed to fire or is delayed, sufficient time shall be allowed to elapse before entering the danger zone. When fuse and blasting caps are used a safe time should be allowed and then the contractor's supervisor alone shall leave the shelter to see the misfire. None of the drillers are to work near this hole until one of the two following operations has been carried out by supervisor.

Either i) the supervisor should very carefully (when the tamping is of damp clay) extract the tamping with a wooden scraper or jet of water or compressed air (using pipe or soft materials)and withdraw the fuse with the primer and detonator attached after which a fresh primer and detonator with fuse should be placed in this hole and fired out

or (ii) the hole may be cleared of 300mm, of capping and the direction then be ascertained by placing a stick in the hole. Another hole may be drilled at least 226mm away and parallel to it. Then balance of the cartridge and detonators found in the muck shall be removed.

Before leaving his work, the contractor's supervisor should inform the supervisor of the relieving shift of any case of misfires and should point out the position with red cross denoting the same, also stating what action if any, he has taken in the matter. A register of misfires and their location and how they are dealt with shall be maintained by the contractor.

The contractor's supervisor should also at once report at the contractor's office all cases of misfires, the cause of the same and what steps were taken in connection there with.

The names of the day and night shift supervisors of the contractor must be noted daily in the contractor's office. If misfire has been found to be due to a defective detonator or dynamite the whole quantity of box from which the defective article was taken must be returned to the contractor's office for inspection and shall be disposed off.

Drillingholesnotcompletedexplodedbyblastingshallnotbe permitted.

The contractor should produce his firer's/Blaster's license and furnish the particulars in the following statement.

Sl.No.	Name	No. offirer's/ Blaster'slicense&date	Validityperiod

Blasting operation, when considered necessary shall be resorted to only with the written permission of the Engineer. Prior inspection shall be carried out for the safety of the public and property. Blasting operations in the proximity of over-head power lines, communication lines, utility lines or other structures shall not be carried out until the operator or the owner or both of such tines have been notified and precautionary measures deemed necessary have been taken.

C. DEWATERING

3.1 Scopeofwork.
3.2 General.
3.3 Contractorresponsiblefordiversionetc.
3.4 De-silting.
3.5 Repairs&removalofdiversionchannelsbunds,etc.
3.6 Disposalofwater. .
3.7 Itemtoinclude.

DEWATERING

3.1 SCOPE:

The item shall include all dewatering during construction work of intake structures, Pump House & pipelineetc.anddiversionworkrequiredinamannerhereinafterspecified.

3.2 GENERAL:

Thearea of work shall be kept dry by resorting to pumping or in combination with manual labourfor bailingcutwaterwithbuckets,etc.,oranyothersatisfactorymethodtobeadoptedshallbeentirelyleftto the choice of the contractor provided dewatering iscarried out satisfactorily and the scheduled programme is adhered to. The contractor shall plan, construct and maintain satisfactorily, safe and full proofarrangementfordewateringto ensuresafeconditionexcavationandlayingconcreteandmasonry in thedrycondition.Thecontractorshallsupplydetailsof hisproposalsforapprovaloftheEngineer,butsuch an approval will in no way release the contractor from his responsibility for the adequacy of dewatering arrangement and for the quality and safety of the work, for all of which the contractor shall be solely responsible.

Other approved methods may be used by the Contractor at his discretion and cost to prevent or reduce seepage andto protect thearea to be excavatedifthe soil is porous.

PUMPING:

Adequate pumping arrangement shall be made for dewatering and keeping the same dry while laying pipes or concreting is in progress. Pumps of required capacity and required number and stage shall be providedtoensuretheabove.Pumpingshall bedone fromasumpinsidetheexcavationasnecessary,in suchamannerastoprecludethepossibilityofmovementofwaterthroughanyfreshconcreteormasonry and washing away parts of concrete or masonry pumping shall be allowed during laying of concrete or masonryandforaperiodofatleast24hoursthereafterunlessitisdonesuitablesumpshallbeseparated from concrete or masonry by effective means. Pumping shall be done in such a way as not to cause damage to the work or property blow subsidence etc.

The contractor shall make his own arrangement for necessary labour, materials pumps, engines, well pointsandothersuitablemachineryanddevicesrequiredforsuccessfulexecutionofitemofdewatering.

3.3 CONTRACTORRESPONSIBLEFORDIVERSIONETC:

The Contractor shall plan, construct and maintain satisfactorily necessary diversion channels and other temporary diversionandprotective works andfurnish, install, maintainandoperate allnecessary pumping and for dewatering the various parts of the works and maintaining the work site as free from water as required for approved construction operations.

ADEQUACYOFDIVERSION:

Allbundsdiversionofflowandotherarrangementsproposedtobemadeshallbebypriordiscussionand approvalbytheEngineer.Onapproval,theyshallbeconstructedandmaintainedattheContractorscost. Approval of the plans for the diversion works will not relieve the Contractor of the responsibility for the adequacy of diversion and dewatering arrangements.

CONTRACTORTODEWATERWHENEVERREQUIRED:

The area under all works as necessary shall be maintained free from water. The areas shall also be maintainedfreeofwaterafteranypartoftheworkiscompleteforinspection,safelyandorforanyother reasonsdeterminedasnecessary.TheContractorshallpumpallwaterfromthesiteoftheworksandshall keep the work area free of water while excavating, concreting and continue to keep the works free of water for periods as may be required forproper setting of concrete or otherwise required for the completion of works.

The Contractor shall not be entitled to any claim or damages an account of or by reason of any amount of water leaking through under or around the bunds, diversion channels and other diversion or protective works or overtopping.

3.4 DESILTING:

It channel excavation is filled due to accumulation of surface flow during the progress of the work or during rainy season or due to any other cause, all pumping required for dewatering the pits and removing silt shall be done without extra cost.

3.5 REPAIRSANDREMOVALOFDIVERSIONCHANNEL,BUNDSETC.:

After having served their purpose the temporary bunds shall be removed to the extent directed by the Engineer from time to time.

The diversion channel, bunds etc. are likely to be damaged due to floods or due to any other reason. If they are so damaged, they shall be redone as directed without extra cost to the Department.

Such removal or repair work shall be done in such a manner as not to damage any permanent works. This shall be done at Contractor's cost.

3.6 DISPOSALOFWATER:

The water from the excavated area shall be disposed off in the manner detailed below or in any other manner in conformity with the rules in force and approved by the Engineer.
In undeveloped areas such as countryside where sewerage system has not been introduced the water may be led to the nearest natural drain or pond through properly laid and dug channels or throughpipes.

Disposal of water shall in no case cause inconvenience or nuisance to the in habitants of the area or cause damage to property and structure nearby.

Government regulations shall be complied with the rights or private land owners shall be respected regarding disposal of water.

Contractor shall be responsible for all the incidental like obtaining permission of local bodies andpersons concerned to lead the water to the open channels, making use of lands and properties ownedby private persons or public bodies etc. and for the damage caused in theoperation of this item.

3.7 ITEMTOINCLUDE:

1. All Labor materials, pumps, plants, equipments, staging, shoring, strutting, sumps and other arrangements necessary for dewatering during excavation and construction of other item requiringdewatering.

2. Dewatering construction area and keeping the same dry while excavation, masonry and concrete work is in progress and till the work comes above the water level and till the Engineer consider that the mortar or concrete has sufficiently set.

3. Dewatering till all the items requiring dewatering are fully complete. This shall also include time required for final section of structure and taking measurements of all the items requiring dewatering.

4. Removing stuff of any sort which might find access into the trenches by blowing, slip or due to any other cause whatsoever from the sides of bottom ,of the excavation or from elsewhere during or after or due to dewatering,

5. Leading water to the nearest natural or artificial drains, with all incidental requirements concerned any compensations etc.

6. Compensation for the injury to the workmen and the public or damage to the nearby properties during and on account of dewatering and disposal of water.

D. DRILLINGANDGROUTING

4.1 General
4.2 DrillingGroutholes
4.3 Testingandpreparationofholes
4.4 Clearingholes
4.5 Pressuregrouting
4.6 Groutingequipment
4.7 Methodofapplyinggrout
4.8 Testforgroutingwork
4.9 KeepingRecordsofdrillingandgroutingoperations
4.5 Grouting
4.6 Finishing
4.7 Calibrationofpressuregaugesandwater meters etc.

DRILLINGANDGROUTING

4.1 GENERAL:

This includes drilling and exploration of holes, installation of grout pipes and fitting, pressure grouting and sealing of foundation etc during construction work.

4.2 DRILLINGGROUTHOLES:

In such areas, asmay bedesignated holes shall be drilled toaminimum sizeof38min in diameter and to maximum depth of 15 meter. Drilling pattern shall be generally indicated on drawings. However, the drilling pattern may be varied according to the situation and shall be taken as directed by the Engineer - in - charge.

Holes for consolidation grouting of foundation rock shall be drilled by jackhammers, wagon drills etc. i.e. by the percussion method. Each hole shall have uniform diameter throughout its length.

Miscellaneousdrillinginconcreteormasonryorrockorcombinationoftheseforlocaldrainageor shallow grouting shall also be done by percussion type drilling method.

Groutholesforconsolidationofthefoundationwillbeofvaryingdepthsintorockasdirected.The consolidationgroutingmaybeproposedtobedoneaftertheconstructionofmasonryorconcrete of required height for having adequate load on foundation rock.

All holes shall be drilled with equipment of the type specified most suitable for the particular job as approved by the Engineer-in-charge,

The depth and the requirements of the drill holes indicated are approximate and may be altered as per actual needs at the time of foundation excavation and the actual experience of washingand grouting of holes.

The grout holes shall be drilled normal to the surface of rock, or if so directed to any inclination, the directed as may be indicated without any extra cost.

Asthe constructionwork progresses thedevelopmentofleakagesorthe unusually poorcondition of surrounding foundation might require additional drilling and grouting of area which may have earlier been drilled, grouted and even covered by concrete masonry.

Re-drillingrequired,ifany,incaseofincompleteholesbecauseofthecontractorsfailuretoclearthe holes before the grout has set or for -any other reason shall W performed at the contractors expense.

Afterthedrillingofgroutholeshasbeencompleteditshallbetemporarilycappedorpluggeduntilit isgrouted.Anyholethatgetscheckedbeforeitisgroutedshallbeopenedtothesatisfactionofthe Engineer-in-charge and at the expense of the contractor,

4.3 TESTINGANDPREPARATIONOFHOLES:

Thecontractorshallfurnishnecessaryequipmentandshallmakeotherpressuretestsasdirectedby the Engineer-in-charge.The equipmentshallhave sufficientcapacity to testgroutholesandinthe specified manner as directed. A suitable pressure gauge and water meter shall be installed to indicate pressure and water leakage from hole.

ThecontractorshallmaintainaproperdataasapprovedbytheEngineer-inchargeforalltestingof drilledholes.

4.4 CLEARINGHOLES:

Before grouting and when a suitable small grout of holes has been drilled, all but three holes (consecutive or as otherwise considered suitable for the purpose of clearing) shall be pumped under pressure as determined by the Engineer-in-charge, into two holes and allowed to escape from third until all possible loose material and mud etc. has been washed out of communicating seams or other passage ways, if any. Combination of these holes at the time shall thus be clean before applying any grout into the holes. Suitable valves shall be used to permit alternate or continuous Injections of air and water and for quickly switching of the flow from one hole to the other so as to produce turbulent action necessary to dislodge the softer materials. The water and air connections shall be interchanged at frequent intervals to cause water flow in every possible direction.Theoperationshouldbecontinuedtillreasonablycleanwateremergesoutoftheholes. In general the pressure of water and of air shall be such as to maintain the minimum possible velocity but sufficiently low to prevent heaving and movement of rock. The normal pressure should be about 2.75 kg/cm^2. High pressure shall be used where so directed by the Engineer-in-charge. The connected holes shall be blown clear of any detritus that might have settled in the seams therein, washing; shall be so timed as to immediately precede the grouting. Before the grouting of a hole is taken up, the adjoining holes shall be kept clear so that they are ready for grouting in case they are found connected to the hole under grouting.

4.5 PRESSUREGROUTING:

The proportion of cement and water will be as determined by the Engineer-in- charge. Cement and water shall be of the same quality as specified masonry and concrete in the dam.

The grout shall be applied as a low pressure (as may be specified by the Engineer-in-charge) initially and gradually butwithin the time as specified by the Engineer-in-charged, increased up to the maximum pressure specified at which it shall be maintained for maximum period of about 10 minutes Thereafter, care shall however, to be taken to release the pressure immediately should there be signs of any movements of any part of heaving rock, which might amongst other observations, be indicated of sudden and erratic fall in pressure- If grout appears at the surface, the cracks should be filled by lead wool, calking the same tightly in the cracks.

At the time when grouting has just been commenced in any hole, it is found that the grout has been freely flowing too far or fast from the hole at low pressure, grout shall be immediately thickened in order to block the leakages in sufficient distance from the hole and thus localize the area to be grouted for any particular hole or series of holes. As a hole approaches refusal thegrout shall progressively be thinned and grouting operation continued to refusal at the specified maximumpressuremaintainedforaperiodofminimum10minutes,Theconsolidationgroutingof the foundations shall be done at pressure up to 3 to 4 kg/cm^2 or by the engineer-in-charge.

Utmost care and precautions shall be taken to ensure that the masonry or concrete is not damaged during the grouting- Any damage caused to the concrete or masonry or any other element, material or structure in the present work or adjacent to it, shall be made good by the contractor at his own expenses and to the satisfaction of the Engineer -in-charge.

4.6 GROUTINGEQUIPMENT:

The equipment for mixing and grouting shall be capable of effectively mixing in correctedspecified proportions, agitating the grout and pumping it into the holes in an uninterrupted flowat the designated pressure up to a maximum of 15 kg/cm2 There should be satisfactory arrangements for accurately measuring the quantity of water, cement and other ingredient Agitation shall have paddle of suitable design and shape to keep the mix in proper consistency till it is pumped into the hole - Standard equipment of approved quality shall be used.

The mixing and conveying system shall be laid out to provide sufficient capacity for a heavy flowof grout. The mixer shall be in two compartments or parts so that grout could be mixed in one when that from the other is being pumped. The components or parts shall be independently connected to pump. In general an uninterrupted flow of grout shall be maintained and the grout conveyed from thepumpto the hole through a pipe.

The mixer shall be placed as near the hole aspossible and long Pipe lines avoided. The flow of grout into the holes shall be controlled by a pressure relief valve bypassing and returning to mixer, all grout not accepted by the hole at the desired pressure.

Proper pressure gauges shall be provided to measure the pressure of the grout pumped into the hole. They shall provide with diaphragm to prevent grout mixgetting into the gauges & clogging them. The circulating System shall be so provided that the grout shall be kept circulating continuously at sufficient velocity to prevent settlement of cement or clogging of pipeline and fixings. The pumps and the pipelines shall be flushed with clear water at frequent intervals, to keep them clear. Deposit of grout in the pump, mixer, etc. not removed by flushing shall be removed by scrapping, chipping etc. A fine screen capable to being readily removed, cleaned and replaced would be desirable between the mixer and the pump. Proper arrangements shall also be provided with equipment to stock adequate quantity of cement etc. likely to be required for the grouting.

After the grouting operations are completed for the shift on the day the remaining unused grout mix shall be thrown away. Also a mix not used up completely within one hour after mixing of that which in the opinion of the Engineer-in-charge has set or clogged shall be thrown away.

4.7 METHODOFAPPLYINGGROUT:

The grouting ofholeshall be continued until the holeor acontinuationof holestakes groutmixat a rate less than.

Rateof grout	TimeinMinutes	Pressure
0.03Cum	20	AsdecidedbytheEngineer-in-charge anddependinguponthelocation

The grouting shall however, be stopped when the pressure gauge registered sudden rise or when other indications are seen on extension or upheaval of rock, under the pressure being applied

After the hole has been grouted it should be closed by means of a valve to maintain the grout under pressure in the seams or crevices into which it has been forced

After any hole is grouted, it should be examined of cement just settled unduly with water coming up, the amount of settlement depending on the proportion of mix used. Holes where such settlement has taken place are to be cleaned of all soft sediment and grouted again under pressure.

Grouting operations shall always be started in the side of pattern towards which the scams dip so that the trapped air may be more easily forced out.

Grouting shall be continued until at specified pressure the hole refuses to take grout more than specified above. If for any reason grouting operations must be stopped before a hole has been grouted to refusal, clear water shall be kept running into the hole until grouting is resumed. Where grouting of foundation is to be done after concrete or masonry has been placed, no holeor connection shall be grouted until all concrete or masonry within a radius of 15 m. and to a thickness of not less than 3 m. has attained sufficient strength. For grouting these areas after concrete or masonry is placed and has set, pipe nipples shall 0e installed where foreseen and necessary connection made for later grouting.

4.8 TESTFORGROUTING WORK:

To test the efficiency and penetration of grouting fresh holes shall be drilled as directed by the Engineer-in-charge after the grouting operations are completed. These holes shall be tested by waterunderpressure equalto themaximumgroutpressure adoptedatthe particularlocationand the amount andthe rate ofleakage ifany measuredineachsuchhole.Ifthe Engineer -in-charge sodirectssuchholesshallbegroutedatpressurespecified bytheEngineer-in-charge.Ifnotthese

holesshallbeleftopen.Noextrapaymentwillbemadefortestingtheholesbywater.Ifsuchholes are grouted under directions of the Engineer-in-charge such grouting will be paid for as ordinary groutingonthebasisofquantityofcementactuallyforcedin.Costofdrillingofsuchholesshallbe paid under the appropriate item of drilling.

4.9 KEEPINGRECORDSOFDRILLINGANDGROUTINGOPERATIONS:

Records shall be maintained by the contractor of drilling grouting and testing etc. neatly and systematicallyinthemannerapprovedbytheEngineer-in-chargetheexactlocationsofallholesin relationstoproperreferencelinesandaccuratelogsofalloperationsshallbedetailedintherecord maps and section shall be complied showing all conditions of holes grouted. All information regardingthegroutingoperationsamountofgrouttakeneffectsobservedinthesurroundingholes androcketc.shallbenotedforeachhole.Observationaboutbehaviorofholesunderairandwater pressure, appearance of wash water, quantity and proportion of grout used, time and pressure of grouting applications etc. shall be noted for each hole.

A copy of such records shall be submitted to the Engineer-in-charge daily during drilling and groutingoperations.

4.10 GROUTINGMUSTBEDONEINTHEPRESENCEOFTHEENGINEER-IN-CHARGE:

Whenever pressure grouting is to be done, the contractor will give due notice thereof to the Engineer-in-charge,toenablehimorhisauthorizedrepresentativetobepresentduringthegrouting operations, which will always be done in his presence.

4.11 FINISHING:

The grout mix, that might flow out or otherwise or split on the foundation rock or concrete or masonryorothersurfaceshallberemovedexpeditiouslywithoutallowinganytimeforthegroutto set on any of the aforesaid surfaces After the grout has set, the grout holes shall be plugged with cementmortarintheproportionofonetotwobyvolumeandthesurfacesfinishedsmoothmline with the floor at that location.

4.12 CALIBRATIONOFPRESSUREGAUGESANDWATERMETERSETC:

The contractor should calibrate the pressure gauges and water meters from time To time at his cost as directed by the Engineer-in-charge. The contractor shall produce necessary test certificate for such calibration. The pressure gauges and water meters, which have been duly tested and calibrated, shall only be used for grouting and testing holes.

E. BUILDINGWORKS

1.0 BrickMasonry
2.0 Plastering
3.0 Pointing
4.0 Steel/Aluminumdoors&windows
5.0 RollingShutter
6.0 Flooring
7.0 Damp proofing
8.0 Fencing
9.0 ChequeredPlate
10.0 Oilbound Distemper
11.0 WaterProofing
12.0 Watersupply&Sanitaryfitting(General)
13.0 LightingConductor

13.0 BRICKMASONRY

13.1 Scope
13.2 Bricks
13.3 Mortar
13.4 Preparationoffoundationbed
13.5 Laying
13.6 Itemto include

BRICKMASONRY

Providing first class kiln burnt brick /Fly Ash masonry with conventional/I.S. type bricks cement mortar 1:6 in superstructure including pointing with cement mortar 1:3 on outside exposed faces and racking out joints where plastering is to be done, watering and scaffolding complete.

1.1 SCOPE

The item refers to First class Kiln Burnt Brick/Fly ash masonry in superstructure of buildings required for construction of Control Room and Pump House Complex and other places wherever required.

1.2 BRICKS

Bricksshallbeoffirstclassofthetypementionedintheitem.

1.3 MORTAR

Cement mortaror limemortar as mentioned in the item shall complywith specifications and shall be of proportion as mentioned in the wording of the item.

1.4 PREPARATIONOFFOUNDATIONBED

If the foundationis tobe laid directlyontheexcavated bed, thebed shallbe leveled, clearedofall loose materials, cleaned and wetted before starting brick masonry. If the masonry is to be laid on concrete footing, the top of the concrete shall be cleaned and moistened. The contractor shall obtain the Engineer's approval for the foundation bed, before foundation brick masonry isstarted.

1.5 LAYING

Brick work shall be laid in English bond unless specified otherwise. Bricks in each course shallbreak joint with those in the course below and above. Brick work shall be constructed for the number of floors as specified or, the drawings. The fixtures, plug, frames of doors windows, cupboards etc. shall be housed in to the brickwork as the correct location and levels while laying brick work only.The iron and steelfixturesin brick masonry shall be laid in 1:3mixcementmortar to prevent corrosion. The ends of steel beam resting on masonry shall be built round with space for repainting where necessary. If required to beembedded, they shall be protected with red lead primer coat and a thick coat of hot coal tar or embedded in 1:2:4 cement concrete, Portions of timber scantlings in contact shall be painted with 2 coats of hot boiling coal tar before fixing in masonry.

The beams shall be supported on templates of dressed stone or plain reinforced concrete fixed in the wall. The templates will not be paid for separately. Where the R. C. C. slabs bear on the walls, the top of the.wall shall be leveled and finished smooth with 12 mm thick 1:4 cement mortar and cured. The plaster may be white washed or covered with paper to minimize friction when movementofslabisexpected.Whererequired,rebatesshallbecutintothebrickworktoholdthe

frames of doors, windows, etc. Holdfasts shall be built into the brickwork. Holes, sleeves,openings etc., of the required size and shape shall be left in the brick work during laying only for fixing pipes, service line, passage of water, etc. The dimensions of openings shall be as far as possible conform to the whole multiples of brick dimensions to minimize cutting of bricks. After the service lines, pipes etc. are fixed the extra hollow left in the hole shall be filled with 1:3cement mortar or 1:3:6 cement concrete and shall be finished neatly with facing bricks. The frames of wooden doors and windows and heavy steel door and window frames shall be built inas the brick work is being constructed. But for ordinary steel doors and windows, required openings for frames, holdfasts, etc., shall be left in the wall and frames embedded later to avoid damage to the frames. Well seasoned tapered wooden plugs of the size shown in the drawings or directed by the Engineer shall be embedded in the brick work during laying only. The joints with frames etc shall be neatly finished while pointing or plastering.

The top of brick work for receiving slopping roofs, gables, etc. shall be finished to the required slope and the required height. No hollow space shall be left between the roof and the top of the wall. Anchors of roof trusses etc. shall be embedded in the masonry as it proceeds.

Fixtures (except wooden plugs) frame, anchors, templates etc. shall however, be paid for under separate items.

For the face of brickwork where plastering is to be done, joints shall be racked out to a depth not less than the thickness of joints. The face of brickwork shall be cleaned and mortar droppings removed the very day that brickwork is laid. Scaffolding shall be double.

TechnicalSpecificationforFlyAshBricksshallbeasperIS:3812(PART-I)-2003&IS:12894-2002

2.0 PLASTERING

2.1 Scope
2.2 Scaffolding.
2.3 Preparatorywork.
2.4 Gauge.
2.5 Plastering
2.6 Finishing.
2.7 Molding.
2.8 Wateringandcuring
2.9 Badwork.
2.10 Cementplasterintwo coats.
2.11 Toolsand accessories
2.12 Programmeofworkinrelationwithplastering,
2.13 Generalprecautioninplastering.
2.14 Finishing.
2.15 Itemto include.

PLASTERING

Providingcementplaster 20mm(about3/4")thickIntwocoatsincementmortar1:3toconcreteor brick surfaces, in all positions including scaffolding and curing complete.

2.1 SCOPE:-

ItemreferstoPlasteringtotheBrickmasonryrequiredforConstruction.

Cement mortar shall have the proportion of cement to sand as mentioned in the wording of the item or in the special provisions and shall comply with specifications of cement Mortar.

2.2 SCAFFOLDING:

Scaffoldingrequiredforfacilityofconstructionshallbeprovidedbythecontractorathis expense.

Scaffolding shall be double or single as is warranted for the particular class of masonry. But the endofpoles shallnotbe placedin theposition of headerstones.Scaffolding shallbe erected with steel sections or pipes, bullies or bamboos of adequate strength so as to be safe for all construction operations. The contractor shall take all measures to ensure the safety of the work and working people. Any instructions of the Engineer in this respect shall also be complied with. The contractor shall be entirely responsible for any damage to property or injury to persons resultingfromerectedscaffolding,defectiveladdersandmaterialsorotherwisearisingoutof his default in this respect. Proper scaffolding shall be provided to allow easy approach to every part of the work. Overhead work shall not be covered.

Pot log holes shall be made good by bricks to match the face work when scaffolding isremoved after ensuring that all holes behind are solidly filled with M15 cement concrete.

2.3 PREPARATORYWORK:

All joints in the face work that is to be plastered shall be raked out to a depth equal to not **less,** than the width of the Joints or as directed by the Engineer. The raking shall be done taking care not to allow any chipping of brick masonry. In new work the raking out shall be done when the mortar in the joints is still green, Smooth surfaces of concrete, old plaster etc. must be suitably roughened to providenecessary bond forthe plaster.All dirt, soot,oil,paintor any othermaterial that might interfere with satisfactory bond shall be removed. The surface to be plastered shall be cleaned and scrubbed with fresh water and kept wet for 6 hours prior to plastering. It shall bekept damp during the progress of the work. The plastering shall not be commenced unless the Engineer-in-charge passes the preparatory work in writing.

2.4 GAUGE:

Patches of Plaster 15 cm x 15 cm. (about 6" x 6") shall be put on about 3 m (about 10') apart as gauges to ensure even plastering in one plane.

2.5 PLASTERING:

In all plaster work the mortar shall be firmly applied with somewhat more than the required thickness and well pressed into the joints and on the surface and rubbed and leveled with a flat wooden rule to give required thickness. Long straight edges shall be freely used to ensure a perfectly plane and even surface. All corners must be finished to their true angles or rounded as directed by the Engineer, The surface shall be finished to plane or curved surfaces as shown onthe plan or directed by the Engineer and shall present a neat appearance.

The mortar shall adhere to the masonry surface intimately when set and there should be no hollow sound when struck. Cement plastering shall be done in squares or strips as directed. Plastering shall be done from top downward.

2.6 FINISHING:

In any continuous face of a wall, finishing treatment of any type shall be carried out continuously and day to day breaks made to coincide with architectural breaks in order to avoid unsightly junctions.

2.7 MOULDING:

All mouldings shall be worked true to template and drawn neat, clean and level. All exposed angles and junctions with doorframes etc. shall be carefully finished, arises shall be beaded if ordered.

2.8 WATERINGANDCURING:

All plasterwork shall be kept damp continuously for a period of 14 days, to prevent excessive evaporation onthe sunnyor windward sideof thebuildings in hot, dryweather.Mattingor gunny bags may be hung over on the outside of the plaster in the beginning and kept moist.

Should the contractor fail to water the work to the satisfaction of the Engineer, the Engineer may engage requisite labour, materials or equipment to water the work properly at the cost of the contractor.

2.9 BADWORK:

Should the mortarof the plaster perish through neglect ofwateringor for any other default and if the work is not done as specified above, the plaster shall be removed and redone at the contractor's expense.

2.10 CEMENTPLASTERINTWOCOATS:

Whenplasteristo be laidintwo coats,the average thicknessoffirstcoatofplasterisgenerally 10 mm (about 3/8") on Brickwork. The first coat is applied as per specifications given so far but the surface is not floated or polished but roughened to give a key to the second coat of plaster.Before the first coat hardens, it shall be combed in way lines about 10 cm apart and 3 mm (about 1/8 ") deep. The first coat shall be kept damp for at least 2 days immediately following its application. It shall then be allowed to become thoroughly dry. Before starting to apply thesecond coat the surface of the first coat shall be damped evenly. The finishing coat shall be ofsuch thickness as to make the total average finished thickness equal to the required plaster thickness as per item. The finished surface shall be true and even, and present a uniform texture throughout and all joining marks shall be eliminated.

2.11 TOOLSANDACCESSORIES:

Tools and accessories used in plasterwork may advantageously conform to I.S. 1630 -1960. All tools shall be cleaned by scraping and washing at the end of each day's work or after use. Metal tools shall be cleaned after each operation all tools shall be examined to see that they are thoroughly cleaned before plastering is begun.

2.12 PROGRAMMEOFWORKINRELATIONTO PLASTERING

The programming of other building operations before, during and after plastering shall be according to the instructions contained in clause 4 of I. S. 1661-1960.

2.13 GENERALPRECAUTIONSINPLASTERING:

All general precautions as specified in IS. 1661 - 1960 clause 9, shall be taken and preparation of the background shall be done as laid down in I.S. 1661-1960 clause 13. Care shall be taken to see that other parts of the work or adjacent works are not damaged while plastering.

2.14 FINISHING:

When no finish is specified the plastered surface shall be rubbed well to an even place with a wooden float for external surface and finished smooth with a steel trowel for internal surfaces.

When cement finish is specified, a coat of pure Portland cement slurry 1.5 mm thick shall be applied to the plastered surface while the second coat is still fresh

Thethicknessofthecementplastershallbe20mm(about2/3")excludingcementfinish.

3.0 POINTING

3.1 Scope
3.2 Rakingof joints
3.3 Colour
3.4 Itemto include

POINTING

Providingpointingwithcementmortar1:4forbrickworkincludingscaffoldingandcuringcomplete.

3.1 SCOPE:-

ItemreferstopointingtotheMasonryWorksrequiredforConstructionWork.

1. MATERIALS–CEMENTMORTAR:

Cement mortar for pointing shall be of the specified proportion and be as per specifications given in specifications for mortars. Normally the mortar mix shall be cement one part to sand 4 parts (1:4).

2. SCAFFOLDING:

Scaffoldingtobeasperspecificationforconcrete/Brickwork/ plastering.

3. CONSTRUCTIONDETAILS:

Unless other type of pointing is specified in the item or the special provisions pointing shall be of the groovedtype. The joints inthe masonry shall be rakedout to a depthnot less thanthe widthof the joint or asdirected inthe special Provisionsorby the Engineer,whenthe mortaris green. The joints are to be brushed clean ofdust and loose particleswith a stiff brush. The areashall then be washed and the joints thoroughly wetted before pointing is commenced.

3.1The raked out joints shall be filled with mortar of the specified mix and required consistency and well pressed and rubbed smooth.

3.2As semicircular depression 3 mm. (about 1/8") diameter shall be made in the joint by pressing a clean string with trowel keeping the sting exactly horizontal and on the centre line of the joint.The vertical joints shall be similarly marked. These depressed lines will then be immediately rubbed with a nayla till they become uniformly 6 mm (about 1/4") deep and 6 mm (about 1/4") wide. Intersection of the horizontal andvertical jointsshall be finished neatlywith the vertical line just touching the horizontal line but not crossing it. The pointing mortar shall not spread over the adjoining bricks, Mortar pointing shall be restricted to the width of the joints all superfluous mortar shall be removed with trowel.

3.3 RAKINGOFJOINTS:

Where the joints have not been raked out when the mortar is green the joints shall be chipped to the required depth, (without damaging the brick work) thoroughly cleaned of all loose particles andwashedbeforepointingisdone.Theraked,joints shallbedampwhencementmortarisbeing applied to them.

3.4 COLOUR:

If colour is ordered by the Engineer to be added to the mortar to match the colour of stones, approved pigment of the required colour shall be added to the cement in the mortar.

4. WATERING

Thepointedfaceshallbekeptcontinuouslywetfor14daysafterinitialset.

Should the contractor fail to water the work as specified, the Engineer may if required in theinterestof workandtokeepthescheduled prograrmme,supply labour;materialsand equipment to water the work and charge the cost to the contractor.

5. BADWORK**:**

Should the mortar perish or deteriorate through neglect of watering or any other default and if the work is not done neatly and as specified above, the pointing shall be removed and redone at the expense of the contractor.

4.0 STEEL/ALUMINIUMDOORS&WINDOWS

4.1 Scope
4.2 TeakWoodboxingandarchitraves
4.3 Finishing
4.4 Itemtoinclude

STEEL/ALUMINIUMDOORS&WINDOWS

Providingandfixingsteeldoorsofvarioussizesasperdetaileddrawingswithout/withhotdipzinc coating without/ with ventilators including fabrication, glazing with hot acetinic/ plain/ obscured glasspanesofapprovedtypeandquality,kickplatesallfixturesandfastenings,without/withteakwood boxing and architraves and finishing with oil painting complete.

4.1 SCOPE:

The item refers to providing and fixing of steel door in a building for Control Room & Pump House.Thesteeldoorsshallconformtol.S.1038-1968andfixingandglazingthedoorshall be done as per I.S. 1081-1960.
Alternative type of door & window i.e. with Aluminium frame & is chosen. The same shall be got approved by Engineer-in-Charge.

4.2 TEAKWOODBOXINGANDARCHITRAVES:

When included in the item teak wood boxing and architrave of 6 cm x 2 cm or other sizes showninthedrawingsshallbeprovidedallroundthedoorfrominsideandtheedgesshall befinishedwithplasterordadoworkasthecasemaybetoobtainafinishedjob.Thejoints of the window frame with masonry shall be finished neatly with cement mortar.

4.3 FINISHING

The steel doors which are not hot dip zinc coated shall be finished with 2 coats of oil paint of approved colour and shade on a primer coat of red lead. The doors boxing and architravesshall be finished with 2 coats of oil paint approved color and shade on a primer coat of redlead.Thewoodenboxingandarchitravesshallbefinishedwith2coatsofoilpaintof approved shade.

5.0ROLLINGSHUTTER

5.1 Scope
5.2 Finishing
5.3 Paintingironandsteelwork
5.4 Itemto include

ROLLINGSHUTTER

Providing ·and fixing rolling steel shutters fabricated from 18/20 gauge steel laths with side guides, bottom rail, brackets, door suspension shaft, rolling springs, locking arrangements and housing box at the top including painting complete.

5.1 SCOPE:

The rolling steel shutters required for Pump House Complex shall be of approved make and design & shall be suitable for fixing in the position ordered, i.e. outside, inside, on or below linte1 or between jambs.The shuttersshallbe ofmanually operatedpullorpushup type upto 10 Sqm areas.Ifareaofthe shutters is between 10 Sqm three ball bearings shall be provided for easy operation. The particulars of the shutters shall generally be as under unless anyother suitable changes are proposed by the approved manufacture and accepted by the Engineer

a) The shutter shall be constructed with curved slats or laths from mild steel sheets of the specified gauge. The laths shall be machine moulded and straightened withan effective bridge depth of 16 mm (about 5/8").These slats shall slide into one anotherformingacontinuous hingethroughouttheir lengthandshall be fittedwithalternatingendlock.

b) Side guide and bottom rail shall be built up from mild steel rolled sections but in the case of small shutter they may be of pressed steel. The sizes of these members shall be as shown on drawings or as approved by the Engineer. The guides shall be generally 6 cm.(about 2 1/2")

c) Rolling springs shall be manufactured from tested unbreakable high tensile tempered spring steel wire or strip of adequate strength to balance the shutter in all positions.

d) Thespringsassemblyshallbesupportedonstrongmildsteelorbrackets shaped to fit the lintel. The shutter when coiled up shall be housed in a box of 18 gauge steel metal.

e) Locking arrangement shall be provided al the bottom of the shutter at both ends. The shutter shall be opened from outside.

f) The shutter shall be complete with door suspension shafts, locking arrangements, pulling hooks, handles and other accessories.

g) Firing shall be done in a workman like manner so that the operation of the shutter is easy and smooth. All work disturbed orcut away shall be made good to match the existing.

5.2 FINISHING:

The wholework shall be painted with1 coat of red lead and 2 coatsofaluminumorother paintof approved shade.

5.3 PAINTINGIRONANDSTEELWORK:

In addition to specifications for oil painting “General " the following shall also apply for painting Iron and Steel Work -

Operation and workmanship for painting iron and steel work shall be as per I.S 1477 (Part I) 1959, code of practice for finishing of Iron and Steel in Buildings, painting and allied finishes. Subject to the following -

i. The method of preparation of the surface for painting shall be as specified by Engineer in charge- Where Iron and steel works need repainting(maintenance), instructions detailed In clause n of I. S. 1477 (Part - I) 1971 shall befollowed.

ii. Red lead paint shall be used for primer coat unless other paints are specified. The number of primer coats shall be given in detailed specifications for each item where not given it shall be one coat.

iii. Intermediate protective treatments (pre-treatments) shall be omitted unless specified in the special provisions.

iv. The finishing coat shall be of the paint as specified for each item by the Engineer. The number of finishing coats of the required shade of colour shall also be specified for each item separately. They shall be two when the number is not specified.

v. Actual date of painting girders, steel tanks and other steel structures shall be neatly marked by the contractor on the structure according to the instructions of the Engineer-in Charge.

6.0 FLOORING

6.1 General
6.2 Material
6.3 ConstructionDetails.

FLOORING

Providing 50 mm thick Heavy Duty CC flooring with non metallic hardener in the sevice area.In other places, Providing and laying polished shahabad/Tandurkotah stone flooring 25 mm to 30 mm thick on top of slab on a bed of 1:4 cement mortar (20 mmthick) including cement float for mortar bedding cement pointing in c.m. 1:3 curing, cleaning etc. complete with all leads and lifts.

6.1 GENERAL

i. Allthestoneslabsshallbesquareinshape.Thedimensionsofpolishedstoneofappropriatesize & patternplaindiamondasspecifieddirectedby theEngineer-in-charge.Tolerancesinthickness shall be +/-3 mm.

ii. The exposed surface of the specified stone flags shall be machine polished to a smooth, evenand true plane and the edge machine cut square and to the required shape when necessary. Samples shall got to be approved by the Engineer-in-charge who will keep them in his office for reference.

iii. Thethicknessofjointsshallnotexceed1.5mm.

iv. Jointsshallbegroutedwithneatcementslurry.

v. When the bedding and joints of the flooring have completely set, the surface shall be machine polished to give a smooth, even and true plan to the floor and thoroughly cleaned.

6.2 MATERIALS

Polishingstonepavingslabs.

The flag stones specified in the item shall be got approved by the Engineer-in-charge. At it's thinnest part, no stone shall be thinner than 25 mm. polished stones shall be hard. Sound, durable resistant to wear. rectangular in shape or square if directed by the Engineer-in-charge and of the specified width. They shall have plain surface. Uniformity of size shall generally be maintained in any one room. The stone polished shall be without any soft veins, cracks or flows and shall have a uniform colour. They shall have even natural surfaces free from broken flakes on top and shall be chiseled on edges to half its depth. true and square to ensure uniform width of joint. The evenness of the surface and edges of the slab shall be allowed for the slabs. The edges shall be quite straight. The under face may be left as quarried. Samples of stone slabs to be used and their dressing shall be got approved by the Engineer-in-charge and the slabs to be used shaft conform to the approved sample.

BEDDING

Cement mortar for the bedding and cement mortar pointing shall be of the proportion as specified on the item, cement mortar shall comply with para 7.9 used for bedding.

6.3 CONSTRUCTIONDETAILS

BEDDING

Base of cement concrete shall belaid and compacted to a reasonably true plain surface and to the required slopes and below the level of the finished floor to the extend of the thickness ofthe slab and mortar bedding. Cement mortar for bedding be mixed by a mechanical mixer, Amount of water added shall be the minimum necessary to give just sufficient plasticity for laying and satisfactory bedding. Care shall be taken in preparing the mortar to ensure that there are no hard lumps that would interfere with the even bedding of the stones. Before spreading the mortar, the sub-floor or base shall be cleaned of all dirt, scum or laitance and of loose materialandthenwellwettedwithoutforminganypoolsofwateronthesurface.Incaseof R.C.C. floors, the top, shallbe left a little rough. All points of level for the finishedpaving surface shall be marked out. The mortar shall then be evenly and smoothly spread over the base by the use of screed battons only over so much area as will be covered with slabs within half an hour. The thickness of the mortar bedding shall not be less than 1 mm not more than 25 mm. The required slope shall be given to the bed.

FIXINGSTONESLAB:

Before laying the stone polished shall be thoroughly wetted with clean water. Neat cementgrout of honey like consistency shall be spread an the mortar bed over as much areas as couldbe covered with the slab within half an hour. The specified type of stone polished shall laid on the here cement float and shall be evenly and firmly bedded to the required level and slope in the mortar bed. Each stone polished shallbe gently tapped with a wooden mallet till ft is firmly andproperty bedded.There shallbe no hollowsleft.Ifthere isahollowsoundongentle tapping ofthe slabs,suchslabsshallbe removedandresetproperly.The massonshallmake the jointsof uniform thickness and in straight lines. The joint thickness shall not exceed 1.5 mm and filled solidly with mortar for their full depth. The joints shall be struck smooth but there shall be no smearing on mortar over the slabs. When pointing to be done, the joints shall be marked W for not less than the width of the joints when the mortar is green. The stone polished shall be laidso as to give continuous parallel long joints with cross joints at night angles to them. The edges of the adjoining slabs shall be in one plane. Where the slabs cover open edges of floor or windowsills the edges neatly rounded off. This shall be included in the rate.

When diamond pattern paving is provided in the item, the slabs shall be square and laid to the diamond pattern with triangular shaped slabs to make up the edges. In plain pattern stones on each course shall break joint those in the next.

POINTING:

When pointing is to be done, the joints shall be pointed with cement mortar of the proportion mentioned in the wording of the item para 7.13. If the slabs are smeared with mortar they shall be cleaned immediately after pointing. When pointing is not specified joints shall be struck.

CURING**:**

Theflooringshallbekeptwell-wettedwithdampsandorwaterforfourteendays.Itshallbe kept undisturbed for at least seven days.

CLEANING:

Allflooringshallbethoroughlycleanedandhandedcleanfreefromanymortarstainsetc.

7.0 DAMPPROOFING.

7.1 Scope
7.2 Materials
7.3 Laying
7.4 Itemtoinclude

DAMPPROOFING

Layingdamp-proofcourseforthebasementwithlatesttechnologyshallbeadopted.

7.1 SCOPE:

Theitempertainstotheprovisionandlayingofdamp-proofcoursebasementincludingthe primer, bitumen binder and bitumen felts required for slabs of Pump house & other buildings.

7.2 MATERIALS:

Thefollowingmaterialsshallbeusedfordampproofing.

1. FlexiblematerialslikeButylrubber,hotbitumen,continuousplasticsheets under floors, bituminous felts, sheets of lead, copper etc.
2. Semirigidmateriallikemasticasphalt.
3. Rigidmaterialslikeimperviousbricks,stones,slates,cementmortarwithwater proofing compound or cement concrete painted with bitumen etc.
4. Coarsesandlayerunderfloors.

Specificationofabovematerialsshallbetakenfromtherelevant ISCodes.

8.0 FENCING

8.1 SCOPE.

8.2 MATERIALS.

8.3 ITEMTO INCLUDE.

FENCING

Providing& erectionof2.4 m highchainlinkfencing50 x50 mm x10 gauge fixedwithhorizontal30 x30 x 3 mm M.S. angles and 20 x 3.15 mm M.S. Strips with nuts & bolts & welding including inclined barbed wire fencing 8 rows @ top supported on M.S. angles 65 x 65 x 6 mm including fixing angles in C.C. 1:3:6 blocks of size 0.50 x 0.50 x 1.00 @ 2 m c/c fastening the chain link and barbed wire painting the M.S. angles & strips with one coat of lead zinc primer & two coats of oil paint with all leads & lifts etc. complete.

8.1 SCOPE:

Theworkscoversprovidingchainlinkfencingaroundtheworkarea.

The item pertainsto the provision&erectionofchainlinkfencing2.4m highof50 x50 x10 gauge (3.25 mm dia.) supportedon vertical M.S. angles 65 x 65 x 6 mm. Fixed with horizontal 30 x 30 x 3 mm M.S. angle & 20.3.15 mm M.S. strips with nuts & bolts & welding as mentioned in the item & drawings including providing & laying C.C. 1:3:6 for foundation blocks, fastening. The chain link and barbed wire and painting M.S. angles & M.S. strips with one coat of primer and two coats of oil paint.

8.2 MATERIALS:

Chainlinkfencing50x50x10gauge(3.25mmdia.)shallbeused&itshallbeoftheusual commercial type, Barbed wire shall confirm to IS 278-1969.

Structuralsteeli.e.M.S.angles,M.S.stripsetc.shallbeasperStd.Specificationforstructural steel work.

C.C.1:3:6forfoundationblocksshallbeasperstandardspecificationforcementconcrete.

9.0 CHEQUEREDPLATE

9.1 Scope

9.2 Material

9.3 Erection

9.4 Itemtoinclude

CHEQUEREDPLATE

Providingandfixinginposition8mm.thickchequeredplatewithweldingjointing,overlappingas perdrawingincludingnecessaryfixturesandfasteningwithallleadsandliftsetc.complete.

9.1 SCOPE

Theworkcoversprovidinglaying of chequeredpaltesinthe Pumphouse andother work complex. Theitemprovidesfor8mm,thickchequeredplateflooringwithM.S.Angle50*50*6mm forsupportoftheflooringatlandinglevelandopeningnearpumps.

9.2 MATERIALS

TheM.S.chequeredplate &M.S.Angleshallconfirmtol.S. 225–1969&IS 800-2007&shall beofrequiredsize&shape.ThelengthofM.S.angleshallbe2.97m.

9.3 ERECTION

TheM.S.anglefirstlyfixedinwall/oroverblockoutonarrangementforsupportto chequeredplateasdirectedbyEngineer–in–chargeorasperdetaileddrawing.Afterfixing theangleinconcretechequeredplateofrequiredsizeshallbecutandweldedtoM.S.Angle.

10.0 PAINTINGOFBULDINGS&OTHERCIVIL WORKS

10.1 Scope
10.2 Primingcoat
10.3 Applicationof distemper
10.4 Itemtoinclude

PAINTINGOFBULDINGS&OTHERCIVILWORKS

10.1 SCOPE

All External surfaces of the building shall be of weather coat type as per Paints manufacturers specs.

Providing and applying washable oil bound distemper of approved colour and shade to internal surfaces, in 1/2/3 coats, including scaffolding, preparing the surface to receive the priming and finishing coats complete.

PAINT

Washable oil bound distemper of approved make,colour and shade shall be used. It shall conform to I.S. 6278:1971, SP 1650:1973. Approved quality distemper like Shalimar, Berger, Asian paints, Nerolac etc. or of equivalent type shall be used.

SCAFFOLDING

This may be provided as per requirement to serve the purpose of a safe working area for painters.

PREPARINGTHESURFACE

Thesurfacetobedistemperedshallbecleanedandallcracks,holesandsurfacedefectsshallbe repaired with gypsum and allowed to set hard. All irregularities shall be sand-papered smooth and wiped clean. The surface so prepared must be completely dry and free from dust before distempering is commenced. In the case of walls newly plastered, special care shall be taken to see that it is completely dry before any treatment is attempted.

For the old surface which had earlier been distempered, the surface shall be cleaned of grease, dust etc. The flakings of previous coatings if any, shall be taken off. All cracks, holes and surface defects shall be repaired with gypsum and allowed to set hard and then sand papered smooth and wiped clean. But in case the surfaces are coloured or white washed, the wash must be removed thoroughly first.

10.2 PRIMINGCOAT

The priming coat shall be applied over the completely dry surface in the manner recommended by the makers in the case of patent distempers. When no priming coat is specified by the manufacturer a finely powdered chalk mixed with a thin solution of glue shall be applied to prepare a good, hard background, the coating when dry being rubbed as clean and smooth as possible.

10.3 APPLICATIONOF PAINT

The instructions of the makers shall be followed regarding preparation of the surface and application of priming and finishing coats. Paint shall not be mixed in a larger quantity than is actually required for a day's work. Hot water should be used to prepared the mixture. Distempers shall be applied in dry weather with a broad stiff brush in long paralled strokes. The treatedsurfaceshallbeallowedtodryandharden.Thenextcoatofdistempershallbelaidonin exactly the same manner as the first one but only after the earlier coat laid has thoroughlydried.Thenumberofcoatsofdistempertobeappliedshallbeasmentionedintheitem.The

brushes used should never be allowed to rest on the bristles and after the use they should becarefully and thoroughly cleaned.

WATERPROOFING

11.1 General
11.2 Materials
11.3 Laying
11.4 Itemtoinclude

WATERPROOFING

Water Proofing on roofs and wall water retaining structures shall be done as per the IS Specification using water proofing compounds of reputed manufacturers approved by the owner.

12.0 WATERSUPPLY&SANITARYFITTINGS

12.1 GENERAL

All the items under this group shall conform to the specifications given for each of the items, in addition to the bye-laws of the local bodies within whose jurisdiction the items are executed.

Where the bye-laws of the bodies differ from the detailed specifications for an item, the bye-laws shall override these specifications.

All damage done to floors, walls, etc., during the process of fixing water supply draining and sanitary installations shall be restored to their original condition.

All the pipes, fittings and appliances shall be free from cracks and other flaws before fixing and shall be undamaged in all respects during and after fixing. Any damage shall have to be rectified satisfactorily.

Allthepipes,fittingsandappliancesshallbethoroughlycleanedbeforefixingandparticularcare shall be taken to see that no extraneous material gets into them during fixing.

All items required for ensuring leak proof and efficient functioning of the pipes and appliance shall be carried out without extra claims.

Allcuttingandwasteofpipesinvolvedinfittingthemshallbeincludedintherate. All diameters of pipes shall be the diameters of the inside bore.

Allthepipes, appliances, fixturesand allother materialstobeusedshallbenewand ofgood quality.

Allthewatersupplyandsanitaryitemsshallbecarriedoutbyexperiencedand/orlicensed plumbers to the entire satisfaction of the municipal bye-laws and the Engineer.

13.0 LIGHTNINGCONDUCTOR

13.1 General
13.2 Materials
13.3 Fixing
13.4 Testing
13.5 Itemtoinclude

CONTRACTOR

SUPERINTENDING ENGINEER

LIGHTNINGCONDUCTOR

Providing and fixing copper lighting conductor including copper rod, upper terminal, tape conductor, earth plate excavating, laying the conductor and refilling complete.

13.1 GENERAL

The item pertains to the provisions and fixing of lightning conductor including the upper terminal, conductor and the earth plate.

13.2 MATERIALS

(a) Coppertapeconductor,25mmx3mm(1"x 1/8").
(b) Solidcopperroduppterminal19mm(3/4") diameter1.5m longwitha knobat the end with a conical spike on top.
(c) Suitableclampstofixtheconductortothewall.
(d) Copperearthplate1.5mmthickandonesquaremeterinarea.
(e) Charcoalandsandforfilling.
(f) Castironpipeof60mmdiameterincludingfittingsshallconformtoI.S.1230-1968.

13.3 FIXING

The upper terminal shall be fixed vertically at the highest point on the building and shall be at least 1.5m long. The terminating cone on the knob shall have a height equal to the radius of its base.

The conductor tape shall be attached to the upper terminal at the lower end by double riveting and soldering and shall be fixed alongthe building face fromoutside, most exposed to rain, with suitable hold-fasts at every 1.3m or less. The conductor shall preferably be in one piece and shall be straight as far as possible. If required to be bent, the straight length between the ends of bend shall not be less than half the curve length. For a height of 3 meters from the ground the conductor shall be enclosed in a 60mm diameter cast iron pipe secured to wall for protection from injury or theft. All metal surfaces, ridges, roofs, gutters, etc., shall be connected to the conductor with metal connections.

All joins in copper rod and tapes besides being well cleaned, sand papered, screwed, scrapped or riveted, shall e soldered in addition.

The lower extremity of the conductor shall be carried to 1 meter under the ground.

Necessarytrenchandpitshallbeexcavatedforlayingoftheconductorandthe copper plate. Thetrenchshall be 10 to 13meters long and onemeter deep andshall lead to a spot 5 to 6 meters from the building.

A copper tape of 25mm x 3mm shall then be riveted and soldered to the lower endof the conductor and carried along the trench up to the spot where the copperplate shall be buried. The other end of the tape shall be connected to the copper plate by riveting and soldering.

All the joints from the upper end of the top terminal to the earth plate shall be mechanically and electrically perfect.

The copper plate shall as far as possible be buried 60cm to one meter below the subsoil water level in the driest season of the year. Where the permanent waterlevel is deep, it is necessary to provide shallow earthsin trenches laid away fromthe building, the depths varying from 3cm in clay soils to 60cm in sand or shinglethrough which the rain percolates more freely. The length of these trenches shall be from 10m to 30m in dry soil.

Alternatively the conductor tape may be attached to a copper plug suitably riveted andsoldered.Thisplugshallthenbeinsertedinto awatersupply pipeby couplingor T joint.

The earth plate shall be surrounded with charcoal. The copper conductor shall belaid in charcoal and the trench filled with sand.

The surface drainage shall, as far as possible be directed towards the trench.

Generallycoppertape androd should not be painted.If so directed by theEngineers forarchitecturalpurposestheupperterminalandtheconductorshallbepainted with a red oxide base and two coats of paint to match the adjacent wall.

13.4 TESTING

The lightning conductor shall be rested for the resistance by a suitable apparatus. The overall resistance of the complete conductor system from the top finial to the earth in wet weather should be about 1 to 2 ohms. It should never exceed 10 ohms. If the results are beyond the above limits, the defects shall be rectified so as to get satisfactory results.

F. TRASHRACKSANDGATES

GENERAL:-

1.1 SCOPEOFWORK

The Scope ofthework covers the following itemsofworkas per relevant IS Codes of Gates, Trash Racks & Hoists.

(a) Manufacturing and supplying including painting (field and workshop both), transport, erection, testing and commissioning of vertical gates with suitablehoisting arrangements.

(b) The scope of work also covers manufacture, transport, supply and erection of all the anchorages including first stage and second stage embedded parts required tobe embedded in the first stage / second stage concrete for above gates. The scopeof work also includes providing 2nd stage cement concrete of approved grade inblock outs as per approved manufacturing drawings.

1.2 The scope of work also covers proper storing of all components, sub-assemblies, electromechanical parts etc. of the items to be furnished under this tender and keeping them in safe custody till they are taken over by the owner in the final installed form.

1.3 The Contractor shall furnish at his own expense all the materials, consumables,tools, plants, equipments, machinery etc. and labour and supervision required for carrying out manufacture / fabrication , transportation, supply installation, painting (both field and shop), testing and commissioning of the above mentioned components and equipments of the gates and hoists as per the conditions and specifications, in these tender documents and as per drawings as may be approved by the Engineer-in-ChargeThe Contractor shall also carry out at his own expense all the preliminary and enabling works and all other incidental works such as establishing a field workshop and stores, furnishing and installing erection aids, cranes if necessary, scaffoldings, ladders, temporary bracings and supports etc. complete as required to facilitate execution of work and shall also carry out at his own expense all other operation covered under the meaning and intent ofconditions and specifications in the tender documents. The cost tendered by the Contractor for the above items shall be deemed to be inclusive of all expenses required to be incurred by him for executing the work.

1.4 APPLICABLEB.I.S.CODES:

All materials & methods and procedures for the work of design, manufacture, transport, supply and installation shall conform to latest edition Indian Standard Specification and other publication listed below unless otherwise specified.

IS:800 CodeofPracticeforGeneralConstructioninSteel.
IS:808(Part–1)DimensionsforHotRolledSteelBeamsM.B.Series. IS :
808(Part – II) Dimensions for Hot Rolled Steel Column Series.
IS : 814 All parts Specification for covered Electrodes for Metal Arc Welding ofstructural steel, Welding Sheets.
IS : 815 ClassificationandcodingofcoveredElectrodesforMetalArc Welding of Structural steel.

IS : 816	CodeofPracticeforUseofMetalArcWeldingforGeneral Constructionin Mild Steel.
IS : 961	HighTensileStructuralSteel
IS : 1028	IS : 1458 Bronze Bushing
IS : 7205	Safety code for erection of structural steel.
IS : 7215	Tolerancesforfabricationofsteelstructure.
IS:8500	Weldablestructuralsteel(Medium&Highstrengthqualities)
IS : 9595	RecommendationsofmetalArcweldingofcarbonandcarbonmanganese steels.
IS:9917	Specificationforcalciumbaseheatstablegrease.
IS : 9954	Pictorialsurfacepreparationstandardforpaintingofsealsurface. IS :
11228	Recommendations for design of screw hoists for Hydraulic gates.
IS : 11855	General Requirements for Rubber seals for Hydraulic gates.

The above list is only indicative & in no way complete or exhaustive. Any other materials necessary as per approved drawings have to be procured and used by the Contractor within quoted rates.

1.5 TECHNICALPROVISIONFORGATES

The materials shall conform to the specifications as mentioned in the approved drawings and as per direction of the Engineer-in-charge. The Contractor shall go through the approved drawings thoroughly and bring to notice of the Engineer-in-charge immediately of any discrepancy or deficiency before taking up fabrication. The Engineer-in-charge shall not be responsible if any problem arises due to discrepancy in the drawings noticed during or after fabrication. The Contractor shall be fully responsible for smooth operating of the gates under all conditions. Thegates shall be capable of being operative at any opening under all conditions of unbalanced operations and shall be free from vibrations at all conditions of gate operation. The leakage through the gates shall not exceed the permissible limits.

1.6 METALWORK,FABRICATIONANDMACHINEWORK:

1.6.1 Generalworkmanship.

All fabrication work under the contract shall be done in accordance with the specifications and works shall be performed and completed in a through workman like manner as per the practice in manufacture and fabrication of materials of the type covered by the specification. The work, shall in all cases, be of the highest quality and carefully performed to the specification of the Engineer-in-Charge. All materials and workmanship furnished by the Contractor be free from injurious defect. He shall replace free of cost to the Engineer-in- Charge , any defect in material or workmanship noticed during erection and shall bear all cost of the modification in the field of any defect for which he is responsible. Workmanshipshall conform to the latest standards, laid down in Indian Standard specification.

All members shall be free of twists, bends or other deformations and all surfacesthat will be in contact shall be thoroughly cleaned before assembling. Parts shall be adjustedtolineandfitandshallbefirmlyboltedorotherwiseheldsecurelytogether so that surfaces are in close contact before drilling, reaming or welding is commenced.

If weight limitations and transport clearances do not permit anchorages and miscellaneous embedded parts, they shall be fabricated into sub-assemblies. The Contractor shall submit a drawing showing the sub-assemblies into which he proposes to fabricate the gates, anchorages, miscellaneous assemblies and embedded parts and hoists for transporting them to site.

Plates with laminations discovered during cutting, welding or at any other time shall berejected.Minorsurfaceimperfectionscanberepairedwhereverpossiblewiththe prior approval of the Engineer-in-Charge. Materials not supplied or workmanshipnot performed in accordance with the approved drawings and / or with the specifications shall be rejected and replaced.

All parts of the gates, hoists shall be fabricated in accordance with the specifications and approved drawing. The Contractor shall take special care in fabrication of the partsaffectingstrength,rigidityandwatertightnessofthegates.Thesealbasesshall be finished after the plates have been welded to the skin plate and the finished surfaces of the seal bases shall be in the same plane within the tolerances as specified elsewhere.

1.6.2 FITSANDTOLERANCE

Fits used for difference components shall be according to the best modern shop practice. Due consideration shall be given to the special nature of function of the parts and to the corresponding accuracy required to secure proper operation. The fits shall be in accordance with the Indian Standard “Guide for the Selection of the Fits (First Revision) IS: 2709.

1.6.3 SCREWTHREADS

The threads for bolts and nuts shall have metric threads of International Standards Organisation and conforming to Indian Standards “ISO Metric Screw Threads Diameter Pitch Combination IS: 4218 Part.II.

1.6.4 MACHINEFINISH

The type of finish, unless otherwise specified shall be that most suitable for the part to which it applies and shall be smooth, average or rough as defined under Indian Standard“AssessmentofSurfaceRoughness(WithAmendmentNo.1to3)IS:3073.A smooth finish (Three Delta, that is 0.20 to 0.8 micrometers) will be required for all surfaces in sliding / rolling contact, an average or commercial finish (Two Delta, that is1.6 to6.3micrometers)forsurfacesincontactwhereatightjointisrequiredanda rough finish (Single Delta, that is 12.5 to 25 micrometers) for all other machined surfaces which are not in contact, but which require finished for dimensional accuracy.

1.6.5 FABRICATIONOFSTRUCTURALSTEEL:

1.6.5.1 The structural steel work for the equipments covered by the specifications shall confirm to the requirements of "Reamed work and shall conform to the following requirements unless otherwise called for in these specifications.

1.6.5.2 STRAIGHTENING

Before being laid off or worked in any manner, structural materials shall be straight without twist, bends or kinks and if straightening is necessary, it shall be done by methods that will not injure or mark the materials. Heating or hammering shall not be permitted. All steel surfaces to be welded shall be cleared of dirt, rust and mill scale prior to fabrication.

1.6.5.3 SHEARING,CHIPPINGANDGASCUTTING:

Shearing, chipping and gas cutting shall be done carefully by torch or by arc and all portions of the work which shall be exposed to view shall present a neatappearance. Gas cutting shall be mechanically controlled. Re-entrant cuts and copes in beams and channels shall be filled before cutting.

1.6.5.4 PLANNINGORFINISHINGEDGES:

Planning or finishing of the sheared or cut edges of plates or rolled shapes shall not be required except otherwise specified for welded edges or as shown on the Contractor 's drawings, approved by the Engineer-in-Charge

1.6.5.5 WELDEDEDGES:

The edges of plates or shapes to be joined by welding shall be properly formed to suit the selected type of welding. Sheared edges of plates and shapes to be jointed by welding shall machined or chipped to sound metal before welding.

1.6.5.6 BENTPLATESANDSHAPES

Where bending of plates or forming shapes is required, these shall be bent to the proper curvature by cold forming. Heating and hammering to correct curvature shall not be permitted.

1.6.5.7 DRILLINGANDREAMING:

Holes shall be accurately located drilled and reamed perpendicular to the faceofthe member and if necessary a template shall be used. Holes in material 20mm, or lessin thickness shall be sub-punched or sub-drilled before assembly and reamed to full size during assembly. Holes in materials more than 20mm in thickness shall be sub-drilled 3mm. smaller than the normal diameter of the rivet of bolt before assembly and reamed to full size during assembly.

Counter boring shall be done carefully to meet the requirements for clearance and fill the weld studs. Anchor bolt holes shall be punched or drilled out to full size. All holes shall be made by the following methods.

1) **Punching.**

Punching of holes to full size shall not be permitted. For sub-punching, the diameter of the punch shall be4.5mm smaller than the nominal diameter of the bolt usedand the diameter of the punch shall not be more than 2.50mm larger than the diameter of punch. All holes shall be clean cut without any burn or ragged edges or burrs.

2) **Drillingandreaming**

For sub-drilling, the diameter of the drill shall be 3mm. smaller than the nominal diameter of bolt used except where tapping is required for tight fit bolts. Ribbed bolts or dowel are to be used full size drilled or reamed holes shall not be less than 1.5mm nor more than 2.5mm larger than nominal diameter of the bolt used. Holes for ribbed bolts shall be drilled or reamed to 1.5mm. less than the diameter of the ribbedshunkoftheboltstoensureatightfit.Reamingofsub-punchedorsub-drilled holesshall bedonewithmachines after assembly.The templatesshall beusedwhen assembled reaming is impracticable. Tapped holes shall be drilled to the proper diameter for the tap used and shall be tapped carefully so that the threads will be continuous, smoothly cut and free from imperfections.

1.6.5.8 ACCURACYOFPUNCHING,DRILLINGANDREAMING:

1) Beforeassembly :-

The accuracy of all holes shall be such that during assembly, a cylindrical pin 3mm. less in diameter than the normal size of the holes shall be entered perpendicular to the face of the member.

2) Duringassembly:-

The accuracy of reaming and drilling during assemblyshall be such that not lessthan 85 percent of any group of continuous holes in the same plane shall show no offset greater than 0.5mm between adjacent thickness of materials, unless a greater degreeofaccuracyiscalledforonthedrawingsapprovedbytheEngineer-in-Charge- in these specifications.

1.6.5.9 WELDEDSTUDS:

Welded studs wherever used shall be welded in place with automatic end-welding guns. Templates of sufficient thickness to afford good alignment shall be used to accurately locate the studs during the welding cycle and to locate matching holes in other materials. Bushing shall be used for template holes, if necessary to ensure angular alignment of the studs and location, accuracy required for proper fit of parts to be assembled.

1.6.6 PATTERNS:

The price bid shall include the cost of all necessary patterns. Patterns shall remain the property of the Contractor. While making patterns, care shall be taken to avoid sharp corners or abrupt changes in cross section and ample fillets shall be used. The Contractor shall provide pattern thickness as will conform to his standard foundry practice and as may be necessary to ensure that all metal thickness of the finished castings shall be in accordance with the dimensions shown on the Contractor's drawings approved by the Engineer-in-Charge

1.6.7 WELDINGS:

1.6.7.1 PREPARATIONFORWELDING:

Members to be joined by welding shall be cut accurate to size, and where required shall be rolled orpressed to thepropercurvature in accordance withthe dimensions shownontheEngineer-in-Charge's drawings.Theedgesof thememberto bejoined by welding shall be sheared, flame cut or machined to suit the required type of weldingandto allowthroughpenetration.Thecut surface shallexposesoundmetal, free from laminations, surface defects caused by shearing or flame cutting operations and other injurious defect. The surfaces of plates to be welded shall be freefrom rust,greaseandotherforeignmatterforadistanceofatleast50mm,back from the edge of the weld. In assembling and during welding the components parts of built upmembers shallbe held in placewith sufficient and proper clampsorother adequate means to keep all parts in proper position.

1.6.7.2 WELDINGTECHNIQUE:

All welding shall be performed by electric arc process using coated electrodes or othermeanswhereby theatmosphereisexcludedfrom themoltenmetalandwhere applicable, automatic machines with correct precision control shall be used. After being deposited, the weld shall be cleaned of slag or flux and shall show uniform section, smoothness of weld metal, feature edges without overlap and free from porosity and clinkers. Visual inspection at the edges and ends of welding shall indicate good fusion with the base metal. When weld metal is deposited in successive layers, each layer except the last shall be peened moderately with a tool before the next layer is applied. Particular care shall be taken in aligning and separating the edges of members to be joined by butt welding, so that complete penetration and fusion at the bottom of the joint shall be ensured. All pin holes, cracks and other defects shall be repaired by chipping or grading the defects to sound metal and re-welding. Where fillet welds are used, the member shall fitclosely and shall be held together during welding. The welding rods used for manual welding shall be of heavily coated type and shall be suitable for all position welding whererequired.Whileweldingprecautionshallbetakento minimizestressesdueto expansion and contraction and distortion due to heat by using the proper sequence in welding i.e., by peening the welds while hot or by other satisfactory methods.

Rectification of distortions by blows after welding shall not be permitted. Weldsshall not be primer coated until they have been inspected and approved by the Engineer-in-ChargeThe welding shall conform to Indian Standard "Code of practice for use of Metal Arc welding for general construction in mild steel IS: 816. All skin plate welds shall becontinuous and water tightand shall develop thefull strength of plate. The electrodes shall conform to the "Indian Standard Specifications for covered Electrodes for Metal Arc welding of structural steel for welding products other than sheets and for welding sheets (Part-I and II) IS: 814.

The Contractor shall prepare shop and field welding procedure including stress relieving and preheat requirements and shall submit this procedure to the Engineer-in-Charge for approval. The procedure shall be in accordance with the best modern welding practice and shall be such as to minimize residual stresses and distortion of the finished members of the structure. Approval of any procedure, however, shall not relieve the Contractor of the sole responsibility for producing a finished product meeting all requirements of these specifications. Welds in contact with rubber seal shall be ground flush, all corners and corner welds in contact with rubber seal shall be rounded.

1.6.7.3 APPROVALTESTOFWELDINGPROCESS:

Specification of the welding procedure that are proposed to be used shall be established andrecorded and a copy of such procedure, specifications togetherwith certified copies of reports of results of tests made in accordance with the procedure specifications shall be furnished by the Contractor . The procedure specifications shall confirm to the Indian Standard "Approval Tests for welding procedure Part-I Fusion Welding of Steel IS: 7307 (Part-II).

1.6.7.4 QUALIFICATIONOFWELDERS:

Allweldersassignedto theworkshallhavepassedqualificationtestforwelders.Ifat any time, work of the welder appears to be questionable, such welder shall be requiredto passadditionalqualificationtest conformingto IndianStandard"Code of Practice for Training and Testing of metal Arc welders " IS:817 and Indian Standard "Approval test for welding procedure part-I Fusion welding of steel IS: 7307 (Part-I).

1.6.8 CASTINGS:DELETED

1.6.9 FORGINGS:DELETED

1.6.10 ERECTIONOFBOLTS,NUTS,WASHERSANDOTHERFASTENERS:

Erectionofbolts,washersandotherfastenersshallbefurnishedintheamountof15 percent the bolts, nuts, washers and other fasteners whichever is greater, in excess of the nominal nature of each size and length required for complete installation of equipment.

Bolts in tension shall have net section at root of thread 15 percent in excess of the net section required in tension.

1.6.11 WASTAGEOFSTEEL

There shall be some wastage of steel section and plates during fabrication & cutting losses. It is the responsibility of the Contractor for minimizing such losses & the cost of such lost steel shall be deemed to have been included in the Bid price. Contractor salsoshallnotbecompensatedforthewastageofsteelunderpricevariation clause.

1.7 CLEANING,SURFACEPREPARATIONANDPAINTING:

1.7.1 GENERAL

The Contractor shall furnish, prepare and supply all materials for cleaning surface preparation and painting of metal work as hereinafter specified. The cost of furnishing, preparing and supplying all materials which are required for cleaning, surface preparation, painting and coating operations including supply of all labour, tools and equipments shall be included in the rate quoted.

1.7.2 CLEANINGANDSURFACEPREPARATION:

1.7.2.1 Cleaningofdifferentcomponents

(i) GateLeaves/HoistandHoistbridges:

All the surface (except non ferrous surface and machined mating ferrous surface) of the gate leaves for the gates , hoist & hoist bridges etc. shall be cleaned and preparedforpaintinginaccordancewiththe"METHOD–Aspecifiedvidesection 1.7.2.2.1below.

(ii) Embeddedparts:

Thesurface(exceptnon-ferroussurfaceandmachinedmattingferroussurface)ofall the embedded parts for all the gates shall be cleaned and prepared for painting as under.

Alltheexteriorferroussurfacesoftheembeddedpartswhichareto comeincontact with concrete shall be cleaned by the "METHOD-B" specified vide section 1.7.2.2.2 below.

The ferrous unfinished surfaces of the embedded parts which will be exposed to water or atmosphere shall be cleaned and prepared for painting in accordance with the "METHOD –A" specified vide section 1.7.2.2.1 below.

(iii) All the exterior surfaces of the hoist and heads including non-matting finished surfaces and unfinished surfaces of hoist stems, coupling and stem retaining device shall be cleaned and prepared by the "METHOD-A" specified vide section 1.7.2.2.1 below.

(iv) The ferrous surfaces of the pipes and other fittings for the surfaces of hoist support frames and girders, ladders , hand railings, grating etc. shall be cleaned and prepared by the "METHOD – B" specified vide section 1.7.2.2.2 below.

(v) The exposed external surfaces of the bought out components like gear boxes, worm reducers etc. which are shop coated by their respective manufacturers shallbe cleaned by suitable means in a manner which will avoid any damage to the components. The damaged portion (if any) of the shop coat on such items shall be repaired.

(vi) Any other metal work not specifically mentioned in the foregoing paras (i) to (v) above but which requires painting shall be cleaned and prepared for painting as directed by the Engineer-in-Charge.

1.7.2.2 METHOD-AANDMETHOD-B

1.7.2.2.1 TheMETHOD-Ashallbeasunder:-

The weld surfaces shall be de-slagged and weld splatters, burrs and other objectionable surface irregularities shall removed carefully. All rust, mill scale and other foreign substances shall be removed from the surfaces by scrapping, chipping, vigorous wire brushing, blasting or other effective means. Care shall be taken to avoid excessive brushings of steel. All oil, grease, dirt and all other contaminantsshall then be removed by the use of cleanmineral spirits, xylol orwhite gasolineand clean wiping materials.

1.7.2.2.2 METHOD-B:

In case rust forms of the surfaces become otherwise contaminated in the interval between cleaning and painting, re-cleaning shall be carried out by the same method as herein above specified for the respective items. Surfaces of stainless steel, Nickel, Bronzeandmachinedsurfacesadjacenttometalworkbeingcleanedorpaintedshall be protected by masking tape or by other suitable means during the cleaning and painting operation.

1.7.3 PAINTMATERIALSANDPAINTING:

1.7.3.1 GATELEAF:

All the surfaces (except non-ferrous surfaces and machined mating ferrous surface) of the gate leaves for all the gates shall be after cleaning as per section 1.7.2.2.1 above, applied with 1(one) coat of Epoxy Base Primer followed by 2(two) coats of COAL TAR EPOXY. The Epoxy Base Primer and coal tar epoxy paint shall generally conform to the particular given in the relevant IS Codes or as directed by the Engineer-in-Charge. The first coat of the Epoxy Base Primer shall be applied within 4 hours of cleaning. The dry filling thickness (DFT) of each coat of zinc rich primer shall be at least 50 microns. The dry filling thickness (DFT) of each coat of coal tar epoxy paint shall be at least 100 microns.

1.7.3.2 EMBEDDEDPARTS:

The surfaces (except non-ferrous surface and machined mating ferrous surfaces) of all the embedded parts for all the gates after cleaning as per the relevant foregoing para shall be coated as under:

i) All the exterior ferrous surfaces of the embedded parts which are to come in contact with concrete shall be given 2(Two) coats of cement wash mixed with5% potassium dichromat. The first coat shall be applied immediately after cleaning and second immediately before pouring concrete.

ii) The ferrous, unfinished surfaces of the embedded parts (except stainless steel) which will be exposed to water or atmosphere shall be painted with the same paint materials (viz. Epoxy Base Primer and Coal tar epoxy paint) and coated in same manner as specified for the gate leaves vide foregoing section 1.7.3.1.

1.7.3.3 HOISTSANDOTHERPARTS

i) All the exterior surfaces of the hoist stem (screw hoist) machined matingfinished surfaces shall be given one coatof Epoxy BasePrimer at a coveragerate ofapproximately6squaremetersperliter.Thisshallbefollowedbytwocoatsof alluminiumpaintofsuitablegradeatacoverageratеat5squaremetersperliter per coat, without thinning. The hoist stems, couplings and stem retaining device shall be given four or more coats of red lead priming paint to achieve a total dry film thickness of 0.15 mm.

ii) Miscellaneous items such as hoist support frames and girders, control cabinets, ladders hand railings, and gratings etc. shall be given 2 coats of Alkyd priming paint or machinery grade paint or Aluminum paint as directed by the Engineer-in-ChargeThe exterior surfaces of the bought out items like electric motors,gear boxes etc. which are shop coated by the manufacturer shall be given one additional coat of the same paint as original shop coat or one coat of Alkyd primingpaintormachinerypaintor AluminumpaintasdirectedbytheEngineer-in-charge.

1.7.3.4 APPLICATIONPROCEDURE:

a) Painting shall not be done when the ambient temperature is less than 10 degrees C and when relative humidity is more than 80%.
b) Primer coats shall be applied without any time lag after the cleaning and surface preparation as per clause 9.7 above and care shall be taken to ensure that paint is not applied to damp surface.
c) Painting shall be discontinued during rain and dust storm and shall not commence until the surfaces are perfectly dry and clean.
d) Welds and adjacent parent metal shall not be painted or touched up prior to de-slagging inspection and approval.
e) All materials shall be in a thoroughly mixed conditions at time of application andshall not be thinned unless otherwise specified. When paint is applied by spraying, suitable means should be provided to prevent segregation during the painting operation.
f) Any warming of the paint materials shall be performed by means of hot water bath and except as specifically provided. Paints shall not be heated to a temperature higher than 38^0C.
g) Each coat of paint shall completely and uniformly cover the surface and shall be free from runs and sags. Each coat shall be allowed to dry or harden sufficiently as per manufacturers recommendations before the next coat is applied.
h) The detail application procedure indicating method of preparing and applying etc. shall be evolved in consultation with the paintmanufacturer which shall be followed by the Contractor.
i) Surface to be painted that will be inaccessible after installation shall be completely painted as per schedule prior to installation.

1.7.4 REPAIRANDPROTECTIONOFCOATINGS:

Metal work that has been shop painted or field painted should be handled with care so as to preserve the coatings in best practicable condition. Before proceedings with afreshcoattheContractorshallcleanandrepairallareasofthepreviouscoatwhich are defective or damaged. Previous coat on the areas where the coating is loose, weakly bonded blistered, abounded or otherwise defective shall be removed toclean metal by scrapping, chipping, power wire brushing or other effective means. Areas thus prepared shall be cleaned of all dust, dirt and other contaminationsusing clean rags and clean solvent. These surfaces shall then be repainted in accordance withthepaintingschedule.Hairlinecracksorareaswherethethicknessofcoatingis less than specified but which are otherwise damaged shall be cleaned of all dust and other contaminations if any, and shall be recoated with additional paint to build the coatingtospecifiedDFT.Allrepairedareasofpaintwillberequiredtopass

acceptance tests performed by the Engineer. The cost of cleaning and painting of damaged and defective areas shall be borne by the Contractor.

1.7.5 INSPECTIONOFPAINTMATERIALSANDACCEPTANCETESTFORPAINTCOATINGS:

The Contractor shall use the paint materials made by reputed manufacturerswhose paint have been successfully used on the underwater high head gates ofother comparable hydro project in India. The particulars of the paint product intended to be used and name of the manufacturers shall be furnished to the Engineer-in-Chargeforapprovalpriortomakinganyuseofanypaintmaterialsinthe works.

All paint and coating materials shall be made available for sampling at least 30 days prior to use and no paint or coating materials shall be used until they have been tested and/or approved by the Engineer-in-Charge

1.8 SHOPTESTSANDINSPECTIONS:

1.8.1 **GENERAL**

All materials and components of the equipments offered under the specifications shall be tested by the Contractor prior to fabrication. After fabrication theequipment shall be assembled in the shop and shop tests shall be performed by the Contractor to ensure accuracy in fabrication and workmanship. The Contractor shall carry out such tests as may be required by the Engineer-in-Charge in order to determine that the gates, hoist will fulfill the functions for which they have been designed. The Contractor shall be responsible for all modifications and adjustments required for the work as a result of such tests. The test shall be repeated, if necessary, until they are successfully carried out to the satisfaction of the Engineer-in-Charge

1.8.2 **TESTSOFMATERIALS:**

All materials, supplied parts and assemblies thereof being used in the work to be done under these specifications shall be of tested quality and all works performed shall be subjected to rigid inspection and no article or material or supply shall be dispatched until all tests analysis and sub-inspection have been completed and certified copies of reports of results and analysis have been accepted by the Engineer-in-charge.

1.8.3 **SHOPASSEMBLYANDTESTS**

1.8.3.1 GENERAL:

The gates hoists along with hoist bridge shall be completely assembled in the shop for inspection and to ensure that all parts to be connected are fitted properly and that all the dimensions, clearances and tolerances called for in these specifications and / or shown in the drawings of Engineer-in-Charge are obtained. Any template or layout plates required to ensure correct matching of holes in connecting parts for erection shall be furnished by the Contractor to the Engineer-in-Charge.The gates and the hoists shall be assembled in a vertical / inclined position to ensure proper alignment and holes for field connections shall be carefully drilled or reamed while the gates are being shop assembled. The gates shall be shop assembled as considered necessary to check fabrication and all parts shall be carefully match marked to facilitate erection at site.

1.8.4 INTERCHANGEABILITY

Where possible all similar items and removable parts of similar equipments of gates,hoists and their embedded parts shall be interchangeable with each other.

1.9 TRANSPORTATIONANDSTORAGE

1.9.1 **GENERAL**

All the components to be furnished against items of BOQ and all the spare parts as may be ordered by the Engineer-in-Charge shall be transported by the Contractor as per the requirements stated below. The Contractor shall be also responsible for proper storage of the above mentioned components (till the acceptance of the final installed forms) at his field store or field workshop near project site. The land for establishing the field store / workshop is the responsibility of the Contractor for which no extra cost will be paid.

1.9.2 TRANSPORT

i) All the components shall be transported (including loading and unloading) by the Contractor from his workshop or any other place of their manufacturer as the case may be to the said field store / workshop near project site. The transport of the fabricated components from workshop to the said field shall be done after all shop tests are completed and after obtaining clearance from the Engineer-in-Charge.SuchclearancegivenbytheEngineer-in-Chargeshallnotbeconstruedasacceptance of any components and the same shall in no way absolve the Contractor of his responsibility for satisfactory performance of the equipments or any office obligations under this contract. It shall be ensured that respective components are transported and brought to project site sufficiently inadvance of the programme for their erection.

ii) The Contractor shall be responsible for any damage or loss in transport as well as for all claims to accident if any occurs in transporting the components. The necessary transit insurance for the equipment up to destination shall be the responsibility of the Contractor and insurance cost shall be borne by the Contractor.

iii) **Disassemblyfordispatch**

After completion of required shop assembly shop tests and inspection the equipment shall be disassembled into minimum no. of sub-assemblies convenientfor transport and storage without damage to any parts of the equipment to the satisfaction of the Engineer-in-Charge

iv) **Unitmarking,matchmarkingandtransportationdesignation**

Each part of the cross regulator, head regulator and escape gates and their respective parts, hoists etc. which is to be transported as a separate piece shall be marked to show the unit of which it is a part and match marked to show its relative position in the unit to facilitate assembly in the field. Unit marks and match marks shall be made with heavy steel stamps and paints.

Each piece sub-assembly or package transported separately shall be labeled or tagged with transportation designation consisting of the specification number and themarknumberofsuchpieceortheno.ofpartsgroupedinsuchsub-assembliesor contained in package.

v) Weighing,packingandpreparationoftransportation

All assemblies or parts shall be packed by the Contractor in a secured manner in boxesorcratesandadequateskidsandliftingslingsprovidedwherenecessary.All

protruding pieces or long slender parts shall be adequately protected from damage. All exposed finished surfaces of the equipments shall be adequately protected from abrasion.. All packing shallbe allowed foreasy removal and checking at sites. Special precautions shall be taken to prevent rusting of steel and iron parts during transit. The methods proposed to be adopted for protection against moisture shall be subject to the prior approval ofthe Engineer-in-Charge. The Contractor shallprovide an wooden blocking to prevent deflection and vibration of all parts of the gates and hoists during transport handling and storage. All opening shall be covered and all parts shall be tightly coated with a rust preventing compound as specified. Rubber seal shall be dismantled after shop assembly and shall be transported separately. They shall be rapped and boxed to protect them from any element which would adverselyaffecttheirsize,shapeorphysicalpropertiesbeforetheirfieldassemblyto the gates. The gates, hoists shall be prepared for transportation so as to permit minimum amount of field assembly.

Allprojectingplatesetc.shallbekeptinshapeintimberoranglesboltedtothem.All straight bars and plates except small pieces shall be transported in convenient bundles, temporarily bolted or bound together. All slander pieces shall beadequately supported and blocked. All bolts, nuts, washers, plates under 0.3m and generally such small article as may be selected shall be tacked in a strong case and made secure for transportation to site. All bolts and nuts of different sizes shall be packed in separate bags each having a label indicating the contents of the bag. All packings shall become property of the Engineer-in-Charge

All oils shall be drip drained from hoists an all connection for piping and valves shall be metal plugged orotherwise closed watertight and dust tight to the satisfaction of the Engineer-in-Charge

vi) **MANUFACTURERS'NAMEPLATE**

The Contractor shall be permitted to attach a metal plate indicating his name, address etc.onequipmentat suitable locationsapprovedbytheEngineer-in-Charge. Cast lettering except pattern number will not be permitted on any of the casting. Suitable name plates shallbe providedinthecontrolledcabinetsandotherlocations where necessary. The name plates shall be made of laminated material suitable for engraving, shall be opaque and consist of black lettering over white background or white lettering over black background. All the name plates shall be in English language.

vii) Each case or packing shall be clearly marked with name of work and the items to which the contents pertain and shall contain a packing list which will also include similar details. Copies ofthe packing listshall also be sent to theEngineer-in-Charge by registered post for record.

viii) **MaintenanceandOperationInstructions**

OnesetofthefollowingmanualsinEnglishshallbefurnishedbytheContractor alongwith the respective equipment at the time of transport.

1) Technicalanddesign data

2) Generaldescriptionofmain components
3) Operatinginstructions.
   a) General
   b) Specific(Dealingwithanyusefulfeaturesofsafetyprecautions)
4) Maintenanceandrepairinstructions
5) Lubrications
6) Materialsandpartidentificationlist
7) Adjustments
8) Twosetsofdrawingsas-builtand
9) Listofallspecialtoolsrequiredtofollowcorrectlytheservicingprocedurealong with a set of such tools.

After the final approval, the Contractors hall complete the submitted documents inorder to constitute 6 complete approved sets of maintenance and operationinstructions. All these instructions shall be written in English.

1.9.3 All the fabricated components shall be in the custody of the Contractor for work under this tender till they are taken over by the Engineer-in-Charge in final installed form. These components shall be stored on suitable platforms and shall be supported in a manner which will not cause damage / distortions or bendings due to their own or superimposed weight. All components shall be protected from all sides against rustings or any other deterioration which may affect their performance. The machined parts and other precision components of hoists and sills etc. shall be stored in godown or a closed shade with proper locking arrangement as directed by the Engineer-in-Charge

The Contractor should make all arrangements at his own cost for establishing his field store / workshop. All other facilities and arrangements required for storage of the components in the above stated manner and for proper watch and word of the component while in storage shall be provided by the Contractor at his own expenses. In case of any bending, deformations or any other injury occurs during storages, transportations and handlings before and during installations they shall be rectified to the satisfaction of and in a manner specified by the Engineer-in- Charge, without any extra cost. Decision of the Engineer-in-Charge shall be final and binding.

9.9.4 Notwithstanding anything stated in these clauses, the Contractor shall be entirely responsible for loss, damage or depreciation of stores during transport, handling,storage or installations. Separate payment shall not be made for transport and storageof the equipments as per the requirements of these specifications and all costs for the same shall be deemed to have included in the rates tendered for in the items of BOQ.

1.10 INSTALLATION,TESTINGANDCOMMISSIONING

1.10.1 GENERAL**:**

1) The items covered under the scope of the work also covers installations, operational trials and commissioning of the various equipments and components to be furnished underthiscontract.TheContractorshallcarryoutinstallations,testing,operationaltrials etc.aspertherequirementsofcontractspecificationsandconditionsofapproved

drawings and as directed by the Engineer-in-ChargeHe shall ensure that all equipments and components furnished by him under this contract are properly installed, tested and commissioned and shall be wholly responsible for the satisfactory performance of the same.

2) Not less than 45 days prior to commencing any erection, the Contractor shall submit to the Engineer-in-Charge:
    a) Detailed programme of erection prepared in accordance with relevant provisioninthese tenderdocuments.Heshallalso indicate themethods and procedures intended for transport, handling and installing the equipments and components to be furnished under this contract.
    b) Erection drawings indicating the identification of the components and their relative positions, field welds and connections and any other relevantdetails.
3) The Contractor for the work under this tender shall fully co-operate and work inclose co-ordination with the Contractor for construction of other related works of the project and other appurtenant work.
4) The Contractor shall at his own expense provide to install bracings and temporary supports, fixtures etc. necessary for safe transport, handling, erection and testing of the various components and equipments to be furnished under this contract. The platforms, scaffoldings, false works, erection aids and other facilities required for accurate installation and inspection and testing of the equipments and components supplied shall also be provided by the Contractor at his own expense.
5) The reference lines, centre lines of openings and lebels having relations tocompleted civil structures shall have to be established on site by the Contractor soas to facilitate installation at proper locations. Installation in the field shall be done by bolting and / or electric arc welding, or by any combination of these as shown on the approved drawings or described in these specifications and the Contractor shall be prepared to perform this class of work. The requirements “Welding”, “Bolting” etc. stipulated under relevant foregoing clauses shall apply to all weldings, boltings etc. performed during installation.
6) The Contractor shall keepposted at the project site his one senior qualified engineer and foreman having adequate experience in fabrication and installation of gates and hoists and mechanical equipments. The Contractor s’ crew for the work shall also be experienced in the type of work involved under this contract.

1.10.2 EMBEDDEDPARTSANDGATES

1) All the embedded parts, gates and hoists shall be accurately assembled and installed in lines, levels and plumbs as shown on the approved installation drawings and as directed by the Engineer-in-Charge.All match marks shall be followed carefully, while installing these partsmembers shall not be overstressed. Hammering that will injureordistortthememberswillnotbepermitted.Bearingsurfacesandsurfacesto be in permanent contact shall be carefully cleaned before the members are assembled or installed. The work shall be performed duly adhering to the tolerance stipulated.
2) The Contractor shall furnish erection gauge with each type of gate and the sameshallbeusedtocheckthealignmentofgateframeforrequiredtolerances.The

anchorbolts shall be locatedaccurately andshallbe heldrigidly inpositionwhilethe concrete in the structure is being placed. Frames and guides shall be placed in position and be adjusted accurately to exact position and alignment by means of adjusting nuts and turn buckles on the anchor bolts or by means of erection beams. Exceptional care shall be taken to ensure that all frames and guides are installedsuch that the gate sealing surface of each frame is even and true and lies in a true plane and that bearing surfaces of the tracks and gate guide on each frame lies inthe same plane, so that, when slide gates are installed the gate seal and seats will bear evenly without leakage, all these operations being to the satisfaction of the Engineer-in-Charge

3) After the second stage embedded parts are erected, aligned and secured properly and rigidly by the Contractor, the Contractor shall provide and place 2nd stage concrete for their embedment after all necessary field trials or as directed by Engineer-in-Charge. It is to be insured by the Contractor that the gates are operational to the design requirements after 2nd stage concreting. The Contractor shall provide and fix all necessary dressings, supports etc. and ensure that 2nd stage embedded parts are not damaged or their alignment is not disturbed due to the placement of 2nd stage concrete.
4) Unless otherwise directed by the Engineer-in-Charge the gate leaves shall not be inserted before curing of the 2nd stage concrete. Sealing strips and seals shall be cut accurately to the required length and shall be attached to the gates as shown onthe approved drawings or as directed. The Contractor shall locate carefully holes to be drilled in the sealing strips. The seal clamps shall be used as templates for drilling holes in the rubber seals where required. At joints, the end of the seals shall be cut so as to butt evenly. All gates shall be raised and lowered several times and all adjustments shall be made to the satisfaction of the Engineer-in-Charge. Each set of gate shall be tested for satisfactory operation and leakage by lowering and raising the same in their respective grooves.

1.11 INSPECTION:

The inspection of all gates their accessories, shall be carried out in accordance with Indian Standard recommendations for inspection, testing and maintenance of fixed wheelsand slide gates part-II, inspectionand testing at thetimeof erection part-III – IS:7718.

1.11.1 INSPECTION**ATTHETIMEOFINSTALLATION:**

1. Itshallbeensuredthatsillbeamiscorrectlypositionedinlevelandlocation.
2. The parts to be embedded, i.e., track plates, guides, seal, seats shall be checked when all these parts are in final position from bottom to top of the groove. Check shall be carried out both in location and levels, with respect to sill beams already established in position. Each part shall be checked first individually and thereafter relatively to other parts.
3. The track plates and seal seats shall be in true alignment. The alignment of track plates and seal seats shall be checked at 300mm. intervals from bottom to top sideof the gate / stop log opening. Alternatively, diagonal checking or any other satisfactory method can be adopted for checking the alignment.

4. After checking the track plates and seal seats on both sides it shall be ensured that they are in their respective planes.
5. Guideandguideshoesshallbecheckedfortruelocationandalignmentfirstindividually and then relatively.
6. Groovecornerprotectionanglesshallbecheckedfortruelocationandalignment.
7. The following critical dimensions shall be checked at intervals 300mm from bottom to top of the groove for embedded parts.
   (a) CentretoCentredistanceoftrackplates.
   (b) Centretocentredistanceofsidesealseats.
   (c) Facetofacedistanceofguides.
   (d) Facetotrackplatestofaceofsidesealseatand
   (e) Faceoftrackplatetocentrelineof guide.
8. Eccentricity provided to gate for its fine adjustment in the grooves, shall not be accounted for while erecting parts to be embedded.
9. The groove concreting shall be done only after satisfying all these details including field trial and keeping proper record thereof. Recheck of alignment of embedded parts shall be done after concreting.
10. Itshallbeensuredthatthereisoffsetof jointswhileextendingtheembeddedparts.
11. All the gates shall be inspected on site before lowering them in the respective grooves. Overall dimensions shall be checked to ensure that the respective gates match correctly in the respective grooves.
12. The following critical dimensions shall be checked at an interval of at least 300mm., wherever applicable for gate.
    (a) Centretocentredistancebetweenthrustpadtreads.
    (b) Centretocentredistancebetweensideseals/bases.
    (c) Facetofacedistancebetweenguideshoes/ rollers.
    (d) Faceofsealbasetopadtreadsand
    (e) Centrelineofguideshoes/rollertopadtreadinzero position.
13. Seals and seal base shall be checked to ensure that they are coplanar. All pads shall be adjusted to ensure that pad treads are in proper alignment.
    Sealboltsshallbetightenedadequatelyanduniformly.
15. To check the effectiveness of seal, actual seal interference shall be compared with that provided in the design.
16. It shall be ensured that installation of the various parts of the hoisting arrangements along with gates has been done to specified locations and alignment, particularly in respect of correct positioning and attachment of stem of the gates as well as hoists.
17. Connections like shaft couplings, connection of stem rods to the gates and hoists, connection of stem links, connection of hoist components to the base shall be checked.
18. It shall be ensured that intermediate supports for the stem rods are provided at the required levels and permit free movement of stem rod for the entire gate travel.
19. Itshallbeensuredthatelectricinstallationshavebeenproperlyearthed.
20. The hoists provided for the operation of the gates shall be independently tested when not connected tothegates toensure satisfactory workings. The hoists shallbe kept running for a sufficient period so as to ensure independent working. Bearings shall be checked to ensure that there is no undue friction.

1.11.2 INSPECTIONAFTERINSTALLATION Atanappropriatestage(asdecidedbythe Engineer-in-Charge) after installation of respective gates the Contractor shall give field tests as directed in these specifications The Contractor shall at his own expenses makeall arrangements and provide all necessary equipments, materials, tools, tackles and labour necessary for carrying out the said field tests. The inspection after installation shallcoverfollowingpointsandanyotherpointconsiderednecessaryby theEngineer-in-Charge

1. Drain holes of the components of the gates shall be so checked that they do not get clubbed with silt causing accumulation of water in the horizontal girders.
2. Inspection of gates shall be carried out to detect defects, if any, after erection and when the canal is full. The gate shall be operated up and down several times tomake sure that they function well, without vibrations.
3. Inspection, after erection shall consist of visual inspection of exposed surfaces of embedded parts, sill beams, seal seats, gate leaves, hoisting equipments, hoist supporting structures and checking of important dimensions. In case of inaccessible parts necessary inspection shall be carried out with the help of arrangements to be provided by the Contractor at his expense.
4. Inspection shall be carried out for connection, for structures, gate, tightness of all fittings, soundness of the welds, leakage through gates, lubrication of all bearings, guide shoes, machineries and equipment, wear and tear, corrosion, sealing, pittingof all metal work and machineries (soundness of metal).

1.12 FIELDTESTS:

1.12.1 Fieldtestsshallbeforallthegatesandshall include

1. Operationaltestsin dry.
2. Operationstepswithstipulatedfullsupplylevel,and
3. Leakagetests.

The tests will be repeated, if necessary, until they are successfully carried out to the satisfaction of the Engineer-in-Charge.

i) **Operationtestsindry**

Operational tests in dry will be carried out after completion of erection. The tests will include at least 2 complete traverses from the maximum raised position to the fullseated position. All adjustments, clearances etc. shall be checked and adjusted by the Contractor for proper operation.

ii) **Operationaltestswithfullsupplylevel**

Thesetestswillsimulatetheactualoperatingconditionsasearlyaspossible.Atleast one complete traverse shall be made from the fully closed position to the normal raised position as follows:-

a) Whenthegatesareclosed,raisethegatestotheirnormallyopenedpositionand
b) Lowerthegatestothefullyclosedpositions.

iii) **LeakageTests**

Leakage tests will be carried out with the gates lowered unto the sill. Before the observation for leakage, the gates will be raised and lowered suitably in order todislodge any debris it might have been lodged in the side and bottom seals. The leakage

then shall be measured and it shall not be more than the amount specified in the relevant code. Thetests shall be repeated if necessary, until they are successfullycarried out to the satisfaction of the Engineer-in-Charge. Leakage tests and operation tests will be carried out at the convenience of the Engineer-in-Charge after completion of other portionsoftheworkandwhenthecanalisatfullsupply level.However,theEngineer-in-Charge will have the right to carry out such tests when the canal is at a level lower than the full supply level. The Engineer-in-Charge shall also have the right to carry out the leakage tests by jetting water at 1.5 times the normal working pressure on the sealing position from bottom to top.

1.12.2 The Contractor, without claiming any extra cost or compensation, shall carry out all adjustments, modifications, which in the opinion of the Engineer-in-Charge based on the above mentioned field tests are necessary to ensure satisfactory performance of the equipment furnished under this contract.

TRASHRACKS

2.0 Trash racks are to be provided to eliminate entry of debris to the sump chamber of the pump houses of the project. It is proposed to provide trash racks at two places to effectively prevent any floating or submerged debris, both organic & inorganic entering the pump bellmouth. The primary function is to protect pumping equipment & appurtenances.

2.1 Designrequirements.

2.2 HydraulicDesignrequirements.

The net area of flow in any trash rack should be enough to allow the required flow with a velocity not more than 0.6 meters/sec. This is necessary to avoid any excess head loss by generating higher velocity through slots of the trash rack. Very close spacing to keep out small size floating debris or fish, may get clogged frequently necessitating clearing at closer intervals.

2.3 StructuralDesign

Structuraldesignofthetrashracksshallstrictlyfollowthestandardsasspecifiedin B.S. Code No. IS-11388:1995. (Re affirmed 2000) or latest. The size & shape shall be designed based on the openings of pipes/conduits for the intake & the opening of the entrance at pump bays.

2.4 Thetrashracksbeingofsmalldimensionsneedstobedesignedasremovablepieces, & bolted to embedded structural steel in face of the openings, to facilitate cleaning repairing, painting etc. during off season.

2.5 Selection of structural steel should be done as per requirement and specification as mentioned in the specification for gates, as per IS Codes applicable. Similarly manufacturing, transporting, painting & fixing, should be done as per specification made in previous chapter for gates.

SECTION IV

CIVILWORKS-CONCRETE,STEEL&ROADS

TECHNICALSPECIFICATIONFORCIVILWORKS

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CONCRETEWORKS

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1.6 Gradingandrelativeproportion
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CONCRETE

1.1 SCOPEOFWORK:

The work covered by this item shall consist of Cement Concrete for Sump well-cum-Pump house covered in this contract & other components of work like intake works, delivery chamber and bed concrete for pipes.

i) Furnishing all materials, equipment and labour for the manufacture, transport, placing and curing of concrete and performing all the functions necessary and ancillary thereto including the concrete to the required shape as per drawing.

ii) No extra payment will be made for the installation of this embedded metal work or for delays or for interruptions arising there from.

iii) Providingand removal of all form work comprising furnishing all materials, equipment and labour for the manufacture, transport, erection, keeping in place with necessary fixtures and supports oiling etc. complete.

iv) Necessarysamplingandtestsformaterialandconcrete,

v) Compensationforinjurytopersonsanddamagestoworkor property.

THE FOLLOWING SPECIFICATION WILL APPLY IN GENERAL OF ALL TYPES OF CONCRETE WORKS INCLUDING R. C. C. WORK.

1.2 CEMENT

Cement shall be obtained by the Contractor and conform to the Bureau of Indian Standard for Portland pozzolana.

1.3 SAND

SOURCEANDSIZE:

Sandusedforconcreteormortarshallberivercreeksandorcrushedtrappedstoneormixtures of both in specified proportion. The maximum size shall be limited to 5 mm and the sand shall be used on weight basis.

QUALITY:

Thesandshallconsistofhard,dense,durable,uncoatedsiliceousgrittymaterialsobtainedfrom rockfragments.Itshallbefreefrominjuriousamountofdust,claylumpssoftandflakyparticles, shale, alkali, organic matter, mica and other deleterious substance. The texture should necessarilybecourse,matching gradingspecifications. Themaximum percentageofdeleterious, substance in the sand delivered for use in concrete or mortar shall not exceed the following values.

	PERCENTAGEOFWEIGHT
MaterialspassingNo.200sieveB.S.orI.S.No.8 Averageopening0.0029	4%
Shale	1%
ClayLumps	1%
Coal	1%
Totalofotherdeleterioussubstancessuchasalkali, Mica coated grain, soft and flaky particles.	2%

The sum of the percentage of all deleterious substances shall not exceed 5 % by weight. The sand shall be free from injurious amounts of organic impurities Sand producing colour darker thanthestandardincolori-Metrictestfororganicimpuritiesshallberejected.

MECHANICALANALYSIS:

The sand shall be well graded and the sieve analysis shall conform to the following limits of gradation.

SieveA.S.T. M.No.	**EquivalentI.S.S.**	**Cumulativepercentageby Weight retained on sieve**
3/8	3/8	Nil
4	480	0to8
8	240	10to25
16	120	25to45
30	60	50to70
50	30	75to90
100	15	90to97

FINENESSMODULUS:

The sand shall have fineness modulus ranging between 2.60 and 3.00. The modulus shall be computed by addition cumulative percentage of sand retained on the 6th standard screen from No.4 to No.100 both inclusive (A.S.T.M. standard) or (480,240, 120, 60, 30, and 15sieves of the I. S. Designation) and dividing the sum by 100. Any deviation from the specification in respect of the gradation and the fineness, modulus shall not be permitted without the permission of the Engineer-in-charge.

ALLOWANCEFORBULKAGE:

If the collected sand is required to be washed or obtained after its washing is found to be moist, bulkage will be measured and allowed provided sand is stacked at site at least for 48 hours before use. Bulkage of such a stack will be measured regularly as directed by the Engineer-in-charge and allowed, according to these, observations. Observations for bulkage will be made as per Indian Standard Procedure and allowance will be made as under.

Bulkageobserved	**Allowancetobemade**
5to10	Nil
10to15	5percent
15to20	10percent
20to25	15percent
25to30	20percent
30to35	25percent
	30percent

1.4 COARSEAGGREAGATE.

QUALITY:

Coarse aggregate for concrete shall consist of hard dense, durable uncoated crushed rock and shall be free from injurious amount of soft, feeble thin elongated or laminated pieces alkali, organicmaterorotherdeleterioussubstances.Flakyandweatheredstonesshallnotbeused.

IMPURITIES:

The broken stone shall be free from dust and dirt and shall be washed if necessary to ensure thatallfacesor thestonesareperfectlyclean.Themaximumindividualpercentagesbyweight ofdeleterious,substancesofanysizeofcoarseaggregateshallnotexceedthefollowingvalues.

MaterialpassingthroughNo.150micronsIS. sievepercentbyweight.	
Shale	1Percentbyweight
Coal	1Percentbyweight
Softfragments	1Percentbyweight
Claylumps	1/4Percentbyweight
Otherdeleterioussubstance	1Percentbyweight

The sum of the percentage by weight of all the deleterious substances in any size shall not exceed five percent, by weight.

The aggregate containing impurities above the specified permissible limits shall be screened / wash/ or treated as directed before use in producing concrete.

GRADING:

Theapproximaterangeingradingofcoarseaggregateshallbeasunder,coarseaggregateshall be of such size as shall be retained on a mesh 5 mm.Sq.

Maximum sizeof aggregate	**Normal rangemm**	**Percentageofcoarseaggregate(mm)**				
		40to80	**20to40**	**5to20**	**10to20**	**5to10**
20mm	10to20	--	--	100	50to67	33to45
40mm	20to40	--	40to50	50to60	28to40	18to30
80mm	40to80	20to366	16to36	35to44	10to30	13to29

Thegradingbetweenthelimitsspecifiedaboveshallbesuchasshallproduceadenseconcrete of the specified Proportions and consistency that will work readily into position without segregation and without the use of excessive water content.

The use of gravel fraction left behind sieving river sand for winning fine aggregates shall be permittedinthebendingof coarseaggregateif askedforaftersuitableexperimentsandwithout rate variations.

SIZE:

The maximum size of coarse aggregate for a particular grade or concrete shall be as large as possible but normally not greater than 1/4th of minimum thickness of the concrete member providedthat inthe case of R.C.C.this size present no difficulty to surroundthe reinforcement

thoroughlyandfillupthecornersoftheformworkfullyandislessthantheminimumcoverby6 mm.

For heavily reinforced concrete members such as ribs of beams, etc. the maximum size of aggregateshallberestrictedto6mmlessthantheminimumclearlateraldistancesbetweenthe reinforcement bars or6mm, Less thanthe coverwhicheveris smaller.

Generallyamaximumsizeof20mmshouldbefoundsatisfactoryforreinforcedconcretework.

Thegradingbetweenthemaximumsizeandminimumsizeof5mmshallbesuchastoproduce adenseconcreteof'thespecifiedproportionandconsistencythatwillworkreadilyintoposition without segregation and without the use of excessivewater content.

The Contractor shall at all timesmaintain a minimumstorage of all grades oftheaggregate for the days requirements at work site failing which the work may not be commenced. The contactorshallfurnishrepresentativesamplesofaggregateproposedforuseintheworkatleast two months before aggregates are required for use.

1.5 WATER:

Water used in concrete shall be clean and free from objectionable quantities of silt organic matter, alkali, salt and other impurities which are likely to be injurious. The turbidity of water formingshallnotbemore,than200partspermillionandshallpreferablybelower.

1.6 GRADINGANDRELATIVEPROPORTION:

Gradingoftheaggregates(fineandcoarse)broughtonthesiteshallbedonebythecontractor and shall be got approved from the Engineer-in-charge. The grading of sand and coarse aggregate is liable to be modified beyond the limit specified above to suit local condition in ordertoobtainrequiredstrengthandworkability.The gradingaswellasrelativeproportionof sandandcoarseaggregate areliabletobechargedatthediscretionoftheEngineer-in-charge,in ordertoproducedenseconcreteofrequiredstrengthwhichcanbeworkedreadilyintoposition withoutsegregationinagivenratioofcementandtotalaggregate(sumofvolumeofsandand coarse aggregate). No compensation is payable for adjustment in relative proportion and grading of aggregates.

1.7 MIXVARIATION:

Cementvariationintheconcretemixisnotliableforcompensation

1.8 DESIGNMIX:

TheratiooftheVolumesofthefineandcoarseaggregatemaybevariedwithinlimitof1:1.5to 1:2.5 as directed by the Engineer-in-charge to suit the maximum size of coarse aggregate the grading, density, workability and strength without extra cost.

The quantity of water shall be just sufficient, but not more than sufficient to produce a dense concrete of required workability for its purpose. An accurate control shall be kept on the quantify of mixing water. An allowance shall be [Trade for surface moisture present in the aggregate whencomputing watercontent as indicatedinLS.456-2000.

Exact proportions in which the materials are to be used for different part of the work shall be determined by carrying out mix design to obtain the specified strength of the concrete. The designofmixshallbesubmittedbythecontractorandgotapprovedfromEngineerinchargeat least one month before commencement of the work. The design may be changed at any given time at the discretion of the Engineer-in-charge during progress of the work. The samples of aggregates and cement and the resulting concrete as well as the concrete mix design shall be tested as per relevant I.S. code method. The tests shall be made by the contractor at frequent intervalsasdecidedbytheEngineer-in-charge,soastosecuretherequiredworkability,density, impermeability, strength & economy.

All the materials going in each batch of concrete shall be weighed before use. The amount of eachindividualsizeofaggregateenteringeachbatch ofconcreteshallbedeterminedbydirect weighing. The amount of water shall be added after weighing or volumetric measure. All measuring equipments shall be calibrated correctly and certificate from the competent authority shall be obtained as and when demanded by the Engineer-in-charge. All Measuring equipments shall be so designed and operated that the combined inaccuracies in feeding and measuringthematerialswillnotexceed,oneandhalfpercentforwaterorcementandtwoand halfpercentforeachsizeofaggregate.Anybatchofconcretenotsatisfyingthisrequirementis liable to be rejected. No cement older than 60 days from the date of dispatch from the manufacture shall be used on the work. The cement to be used shall be in the order of its receiptsothatnostockremainsunusedfordurationlongerthan60days.Cementolderthan60 daysshallberemovedfromsiteasperthedirectivesofEngineer-in-charge.

The ingredients of concrete shall be properly mixed in mixers, designed so as to positively ensureuniform distribution ofallthecomponentmaterialsthroughthemassattheendofthe mixing period. The mixing of each batch shall continue about one and half to two minutes depending upon the revolutions per minute of the mixer and experience after all materials except for the full amount of water are added in the mixer. The minimum mixing period specified above assumes proper control of the rotation of the mixer and of introduction of the materials, including water. The mixing shall be increased at the discretion of the Engineer-in-charge when the charging operation fails to produce concrete of the required uniformity of compositionandconsistencywithinthebatchandfromthebatchtobatchContractorshallnot be entitled for any extra payment for such increase in mixing time. Excessive mixing requiring theadditionofthewatertopreservetherequiredconcreteconsistencyshallbeavoided.Ifthe mixingandchargingoperationsaresuchthat therequireduniformityoftheconcreteisobtained inshortermixingtimethantheminimumspecified,withoutsacrificeofneededworkability„the mixing time maybe shortened under orders of the Engineer-in-charge. Mixing shall be by Mechanical means only.

Materials corresponding to one bag mix or half bag mix (depending upon the mixer capacity) shallbeplacedin'theskipinsequenceofmetalcementandsand.Theskipshallbeemptiedinto the drum andspecified quantity ofwateraddedtomaterialindrum.

Thefollowinggeneralprinciplesshallbefollowedinoperationofmixing.

1) Theingredientshallhefedintothemixersimultaneously.
2) A portion of water (between 5 and 10 percent) shall precede and an equal quantity shall followintroductionoftheothermaterials.Theremainderofthewatershallbeaddeduniformly and simultaneously with the other materials.
3) Careshallbetakenthatmixingofconcreteinthemixerisuniform.

CEMENT:
The cement shall be procured- in standard bags as received from the manufactures and is to conform to the specifications laid down by the Bureau of Indian Standards (Vide their specification No. I.S./8112 of 1989 for Portland cement).

1.9 TESTSFORCEMENTCONCRETE.

A) STIPULATEDCRUSHINGSTRENGTH :
The crushing strength in Newton per square millimeter on works cubes at 28 days for each nominal mix shall be as under

Nominalmix	Equivalent ISSmixes	Preliminarylab testat28days (N/mm2)	Stipulatedcrushingstrengthin works tests	
			At 7 days (N/mm2)	At 28 days (N/mm2)
1:1:2	M-25	32	17	25
1:1:5:3	M-20	26	13.5	20
1:2:4	M-15	20	10	15
1:3:6	M-10	13.5	7.5	10
1:4:8	M-7.5	10	5	7.5

B) PRELIMINARYLABORATORYTEST:
Preliminary tests of cubes shall be carried out in the laboratory well in advance of commencement of work. These tests should indicate adequate margin over the stipulated strength.

C) WORKSTESTONCONCRETE:
TestsforcrushingstrengthshallbemadeonstandardcubesaspertherelevantIndianStandard Specifications. For works tests, samples shall be taken on the job as and when directed. For workstests,samplesshallbetakenonceforevery30cubicmeterofeachtype-ifconcretelaid andatleastthreetimesaday,ifoutputismorethan75cubicmeter.Thesamplesforworktest is defined as a set of three cubes. The materials required for the samples (concrete, cement, sandandcoarseaggregate)andmouldasdirectedbyEngineerinchargeshallbesuppliedbythe Contractor free of cost and the collection of samples, casting of cubes and testing shall be carried out by the YEPL at the cost of Contractor.

STANDARDOFACCEPTANCE:

Notasinglesampleofworktestcubesshallhaveattheageof28days,acrushingstrengthless thanthestipulatedcrushingstrengthofconcrete.TheEngineer-in-chargemayathisdiscretion occasionallyacceptthecrushingstrengthofasample,whichislessthanthestipulatedstrength but which is equal to or more than 85 % of the stipulated, strength. Each sample of work test cubes shall assume to represent 30 M3 concrete and amount of corresponding quantity of concreteshowingcrushingstrengthlessthanstipulatedstrengthshallberecoveredasunder.

Crushingstrength.	Amounttoberecovered(Recoveryrate)
1) Equaltoormorethan95%	Nil.
2) Equal to or more than 90 % but less than 95 %	5%ofrateofConcretein current Schedule of rate.
3) Equal to or more than 85 % but less than 90 %	10%ofrateofConcrete in current Schedule of rate .

TherecoveryrateshallbeapprovedbytheSuperintendingEngineer.

Ifthecrushingstrengthfallsbelow85%ofthestipulatedcrushingstrengththenthequantityof concrete represented by these samples shall be removed and redone by the contractor at his cost.Unit foracceptance orthese tests willbe oneworkingseason.

In addition to the 28 days strength tests, the Engineer-in-charge may at his discretion take 7 days strength tests and or 3 days (accelerated curing) strength tests and fix up the relation betweensuchstrengthand28daysstrengthafterstudyingtheactualvaluesrealized.Ifanytime thetestsi.e.7daysor3days(acceleratedcuring)strengthindicatethatthestrengthmaynotbe achievedasspecifiedbytheEngineer-in-charge,heshallhave,authoritytosuspendtheworkof laying concrete until the reasons for low strength have been investigated and corrected. The contractors shall comply therewith without such suspension of work being made a reason for anyclaim.TheEngineer-in-chargemayathisdiscretionalsoordersuspensionoftheworkwhen the variation in the strength of the individual work test cubes from average of the set is in his opinion excessive. The contractor shall comply with such suspension until the reason for the variations are investigatedand corrected and such suspension shall not be accepted as reason for any claim.

The average crushing strength shall not be less than stipulated crushing strength for each nominal mix as given below:

Grade	Nominalmix	Preliminarytest Crushing strengthat28 daysN/sq.mm.	Crushingstrength at7days N/sq.mm.inwork test.	Crushingstrengthat28days N/sq.mm.inwork test.
M-25	1:1:2	32	17	25
M-20	1:1:5:3	26	13.5	20
M-15	1:2:4	20	10	15
M-10	1:3:6	13.5	7.5	10
M-7.5	1:4:8	10	5	7.5

D) SLUMPTESTS.

Inordertotestheconsistencyofthemixedconcrete,slumptestshallhavetobemadebythe Contractor when and where required by the Engineer in charge, as per Indian Standard Specification.TheallowableslumpshallbedecidedbytheEngineer-in-charge,dependingupon the location of the concrete.

In the case of reinforced concrete work, the workability shall be such as the concrete will surround and properly grip all the reinforcement. Water cement ratio will be such as will give concretejustsufficientlywettobeplacedandcompactedwithoutdifficulty.

Concrete shall have a consistency such that it will be workable in the required position and in the case of R.C C. flow around reinforcing steel also.

For vibrated concrete slump shall range between 2.5 cm. To 5 cm. The slump shall be the less permittedby workability.The slumpshall be determinedas detailedinAppendix 'G'of LS.456-1978 and maintained throughout the concreting operation.

1.10 FORMS

GERNERAL

Formtoconfinetheconcreteandshapeasrequiredshallbeusedwherevernecessary.Theform shall have sufficient strength and rigidity to hold concrete and to withstand the pressure of rammingandvibrationwithoutexcessivedeflectionfromtheprescribedlinesthemoresowhen the concrete is in vibration. The Contractor shall have to get the design and drawing of the centering approved from the Engineer-in-charge before erection. Form work shall be of any of the following types.

a) Woodenshutteringwithsteelplateslioringorplywoodshuttering.

b) Steelshuttering

ForworkscostingmorethanRs.OneCrore,onlysteelshutteringistobeused.Howeverasper needofsite,woodenshutteringwouldbeallowedonlyifitisfreefromwarpingandafabricated true to line and shape. The decision of the Engineer-in-charge as to the suitability of wooden shuttering as per (a) above to be used by the contractor will be final and binding on the Contractor. The surface of all forms in contract with concrete- shall be clean, rigid, watertight andsmooth.Suitabledevicesshallbeusedtoholdcorners,adjacentendsandedgesofpanelof other forms together in accurate alignment.

DESIGN

The detailed designs of the formwork and false work shall be prepared by the Contractor and gotapprovedbytheEngineer-in-chargewellintime.Suchanapprovalhowever,willnotrelieve the Contractor of his responsibility for the adequacy and strength of the formwork and false work.

Forms shall be as designed and constructed as in the removable in sections without damaging thesurfaceoftheconcreteandwithfacilitiesofremovalinascendingorderwithoutdisturbing the remaining forms required to be removed later.

MATERIAL.

Theformsandfalseworkshallbemadeofwoodormetal Thetimberfromwhichtheformsare preparedshouldpreferablybypartiallyseasoned.Itshallbefreefromsag,shakes,looseknots, wormholesorotherdefects.Theplanksandscantlingsshallbesawn,straightandalledgesand planesshall bestraightandfreefrom warps.Partiallyseasonedsoftwoodisgenerallypreferable for formwork as it is difficult to drive nails in hard wood. The dimensions of scantlings should conformtothedesign.Thestrengthofthewoodshallnotbelessthanthatassumedinadesign.

Metal form steel sheets of the designed gauge strengthened with framing of angle or other sections shall be used.

Woodenformsmayalsobelinedwithinthinsteelsheetorplywoodtogivetherequiredsurface orfinish.

FABRICATION.

Thetimberplanksandscantlingsofthedesigneddimensionsshallbeusedintheformworkwith appropriatespacingofstuds,yokes,joists,girders,etc.asprovidedinthedesigns.Alltimbersin contactwithconcreteshallbroughtononefaceandtwoedges.Thejointsshallbemademortar tight.Thismaybedoneeitherbyprovidingtongueandgrooveorrebatedjointorbycaulkingor nailingtotheconstruction operations.Thenutsandboltsheadsinsidethe formworkadjoining the concrete shall be countersunk. The formwork shall allow furnished concrete to have a smooth surface and conform to the shapes, lines and dimensions shown on the plans and true to line and grade. The effect of vibration shall be taken into account in the design and fabrication of the form and false work.

TREATMENTOFTHEINNERSIDESOFFORMS.

Before placing concrete the inner side of the forms which come in contact with the concrete shall be coated with mineral oil or any other suitable materials approved by the Engineer-in.-chargewhichwillprevent adhesionofconcretetotheformsbutwillnot discolorthe concrete. When oil is used it shall be applied before reinforcement is placed. Care shall be taken to see that reinforcement does not come in contact with coating or chippings. Saw dust and other rubbish shall be removed from the Interior of the forms before concreting.

FALSEWORK

Falseworkshallbebuiltonfoundationorbaseofsufficientstrengthtocarrytheloadswithout settlement. False work.which cannot be found on solid footing, must be supported by piles or other similar devices. False work shall be designed to carry the full loads including that due to construction operation coming upon it.

ERECTIONANDREMOVALOFFORMS

The false work and form work shall be erected with an eye for absolute safety of theformwork and concrete work before and after pouring concrete. Watch should be kept to see that the behavior of centering and form is satisfactory during concreting. Erection should also be such that it would allow removal of forms in proper sequence without damaging either the concrete or the form to be removed later.

If there is failure of false work and / or form the Contractor shall be responsible for all the consequent damages to work, injury to life and damage !o property and make good the damage at his cost.

i) Before placing concrete, the surface of form shall be oiled with a suitable no staining oil such as raw linseedoil soas to prevent sticking ofconcreteand facilitate the removal of form.

ii) The oil shall cover the form fully and evenly without excess over drip. Care shall betaken to prevent oil from getting on the surface of the construction joints and on reinforcement bars. Special care shall be taken to oil thoroughly the forms strips for narrow grooves so as to prevent swelling of the forms and the consequent damage to concreteprior toorduringremovalofformsImmediatelybeforeconcreteisplaced,care shallbetakentoseethatallformsareinproperalignmentandthesupportsandfixtures are thoroughly secured and tightened.

iii) Where formforcontinuoussurfaceisplacedinsuccessiveunits,theformshallfittightly overthecompletedsurfacesoastopreventleakageofmortarfromtheconcreteandto maintain accurate alignment of the surface.

iv) Forms shall be left in place until their removal is authorised and shall then be removed with care so as to avoid injury to concrete.

v) Removalofformsshallneverbestarteduntiltheconcreteisthoroughlysetandhardened adequately to carry its own weight, beside the live lead, which is likely to come on the work during constructions. The length of time for which the forms shall remain in place shallbedecidedbytheEngineer–incharge,withreferencetoweatherconditions,shape position of the structure or structural member and the nature and amount of dead and live loads.

Innormalcircumstancesformsshallbestruckaftertheexpiryofthefollowingperiod:

a)	Walls columns and vertical faces of all structuralmembersbe decided by the Engineer-in-charge	24to28hoursasmay
b)	Slabs(propsleftunder)	3 days
c)	Beamsoffits(propsleftunder)	7 days
d)	RemovalofPropsunderslabs	
	1. Spanningupto4.5m	7 days
	2. Spanningover4.5m	14days
e)	Removingofpropsunderbeamsandarches	
	1. Spanningupto6m	14days
	2. Spanningover6m	21days

NOTE: The number of props left under, their size and disposition shall be such as to be able to carrythefulldeadloadoftheslab,beamorarchasthecasemaybetogetherwithanyliveload likely to occur during curing of further construction.

In no case farms shall be removed until there is assurance that removal can be accomplished without damaging the concrete surface. No loads will be allowed to damage the concrete surface.Heavyloadshallnotbepermitteduntiltheconcretehasreacheditsdesignedstrength-The forms shallbe removedwithgreat cautionandwithout harming the structure orthrowing heavy forms upon the floor.

REUSEOFFORMS ETC

Forms required to be used more than once shall be maintained in serviceable conditions and shall be thoroughly cleaned and smoothened before reuse. Where metal sheets are used for lining, the sheets shall be placed and maintained on the forms with minimum amount of wrinkles, humps or other imperfections. All forms shat be checked for shape and strength before reuse.

INSPECTION

The forms and false work will be inspected, checked and approved by the Engineer-in-charge before concreting commences. But this will not relieve the Contractor of his responsibility for strength and safety of form and false work.

1.11 PLACINGCONCRETE

PLACING

Concreteshallbeplacedonlyinlocationswhereauthorisedandnoconcreteormortarshallbe placed until formwork, installations of embedded parts, preparation of surface or necessary clean up has been approved.

ROCKSURFACE.

Rock surface upon or against which concrete is to be placed, shall be prepared as specified in section excavation for foundation

MASONRYSURFACE.

1. Masonry surfaces on which or against which concrete is to be placed, shall be cleaned thoroughly with water jets.

2. Iftheoldlayerofmasonryisrequiredtoberemoved,itshallbebackfilledwith concrete along with upper concrete layer at no extra cost.

CONCRETESURFACE.

Before laying of concrete the surface of the concrete in day to day work, shall be cleaned by a wirebrushandjetsofwater,sothatthesurfaceisthoroughly cleanedandwettedbutpoolsof water are to be avoided. If the old concrete surface has remained exposed for more than two weeks, it shall be prepared by chipping to a depth of two centimeters and the surface coated orcoveredwithalayerofcementmortar(1:2)foradepthof5to8cm.Thecostofsuch

preparation and also the cost of cement mortar shall be borneby Contractor. The concrete removed for roughening shall be at Contractor's expenses.

ALL SURFACES.

i) Thecleanedrock,masonryorconcretesurfaceshallbeappliedwithcementwith cement slurry and then cement mortar coat.

ii) The first few batches of concrete may, contain half the regular size of coarse aggregate without any extra claims.

iii) ThecostofsuchpreparationworkshallbebornebyContractor.

TIMEFORUSE.

All concrete shall be placed directly in its final position within thirty minutes of mixing, Any concrete, which has become so stiff that proper placing cannot be assured without re-tempering shall be wasted at contractor's expenses. All surface of forms and metal work includingreinforcementbarsthathavebecomeencrustedwithdriedmortarofgroutconcrete previously placed shall be cleaned of all such mortar or grout before surrounding or adjacent concrete is placed.

METHODOFPLACEMENT

Before starting placing of concrete, it should be made certain that the transporting andplacing equipment is clean & in proper order and that equipment along with the operating staff is arranged to deliver the concrete in the final positions without undue delays and objectionable segregation. The methods and the equipment used for transport and placing of concrete shall be such as will permit the delivery of concrete of the required consistency into the work without objectionable segregation, porosity or excessive loss of workability.Excessive segregation from whatever cause shall be prevented in handling and placing operation by avoiding or controlling lateral movement of the concrete as in dumping at an angle depositing continuously at one point and allowing the concrete to flow. Concrete shall not be dropped from excessive heights and free fall should be kept to a minimum. Concrete shall be deposited in continuous horizontal layers in a thickness of approximately 30 cm in normal work to 45 cm. For mass concrete except that nothing herein shall be construed to permitplacementoftheadditionalhorizontallayersofmassconcretebeforetheentireareato be concreted is covered by previous layers. On flat, horizontal surfaces, where congestion of steel near the forms makes placing of concrete difficult, a mortar of the same cement sand ratio as used in the concrete shall be first deposited to cover the forms and shall stand included in the unit rate of concrete before the entire area to be concreted is covered by previous layers.

RATEOFPLACING.

Concreting shall continue without interruption until the structure or section is completed or until satisfactory construction joints can be made. Location of construction joints shall be as directed by the Engineer-in-charge. Concrete shall not be placed, faster than the placing crew cancompactitproperlyInplacingthinmembersandcolumnsprecautionsshallbetakenagainst toorapid placement,which mayresultin movementor failureof theformsduetoexcessive

lateralpressure.Anintervalofatleast12hoursandpreferably24hoursshouldelapsebetween the completion of columns and walls and the placing of slabs, beams or girders supported by iteminordertoavoidcrackingduetosettlement.Allconcreteshallbeplacedinapproximately horizontalliftsnotexceeding1.25meterinthickness perday.Concreteinarches shallbe done instripsextendingfromonepiertoanother.Nothroughjointsshallbekeptinthespan.
CONCRETINGATNIGHTTIME.

Ifconcreteistobeplacedatnight;adequatelightingarrangementsshallbemadeas,directedby the Engineer-in-charge,

CONCRETINGDURINGRAINS.

WhenconcretingIs required tobedoneorcontinuedwhileitisrainingitshallbe seenthatthe concrete is not damaged due to rain while it is being transported and placed. After placing the greenconcreteitshallbeadequatelycoveredforaperiodof24hourswhenitwillbecapablefor being cured by splash of water. The surface of fresh concrete shall be maintained on a slope sufficient for resulting self-drainage of the rainwater. The work shall however be discontinued when the rain is so severe that water collects in pools or washes the surface of the fresh concrete and it is not possible to provide adequate shelter.

1.12 COMPACTION

GENERAL

In all concrete works required number of vibrators with stand by in working condition shall be keptreadyatsiteaspertheinstructionsoftheEngineer-in-charge.

All concrete shall be vibrated by mechanical vibrator of approved type so as to ensure dense concrete. Hand tamping and rolling shall not be used for compaction of concrete except in specialcircumstanceswiththeexpresspermissionoftheEngineer-in-charge.Whenimmersion typevibratorsareusedtheyshallbeusedverticallyatabout45cmapart.Thevibratorsshallbe inserted to the full depth of the newly laid concrete layer. The concrete shall be thoroughly compacted during depositing to get a dense concrete and thoroughly worked in to the edges and corners of the form work and also along its faces and around reinforcement in the case of RCC by means of suitable tools such as trowel and rods to get a good finish without honey combing. The vibrator shall however, not vibrate concrete, which has commenced its final set. Special care shall be taken to see the vibrator touching the reinforcement of embedded pan doesnotdisturbtheconcretebelow,whichhasconcerneditsfinalset.Theconcreteshallnotbe vibrated excessively so as to cause segregation.

Eachlayerofconcrete,forsurfaceswhichisrequiredtobesmoothandforallsurfaceswhichwill bepermanentlyexposedtotheweatherandforallsurfacesnexttoembeddedmetalworkshall be workedandvibratedbymechanicalvibratorofapprovedtype only so astoobtainconcrete ofmaximumdensityandimperviousnessandtoassureclosecontactoftheconcretewithforms, reinforcement bars and other embedded parts. If the methods of transporting and placement havebeenconducivetoairentrainmentsegregationorstiffening,theworkofcompactionshall receive special attention.

For concrete surfaces exposed to flow of water special precaution shall be taken to minimize and to prevent surface pitting and protrusions without resorting to over manipulation of the concretemixtotheforms.Noplasteringforgettingasmoothfinishshallbe permittedatthese locations. Any protrusion shall be ground smooth.

1.13 CURINGANDPROTECTION:

Allconcreteshallbeprotectedagainstinjuryuntilfinalacceptance.Exposedfinishedsurfaceof concrete shall be protected from the direct rays of sun for at least 72 hours after placement. Concreteshallbekeptcontinuouslymoistfornotlessthan21days.Constructionjointsshallbe curedinthesamewaysasotherconcreteandshallalsobekepimoistforatleast72hoursprior totheplacingofadditionalconcreteuponthejoints.Approximatelyhorizontalsurfacesshallbe cured by sprinkling, polnding, or by covering; or by damp sand or may be cured by the use of wet quilts or mats. Covering with wet jute bags shall be used to cure vertical surfaces. If damp sandorquiltingisusedforcuring,itshallberemovedcompletelylater.Shouldtheconcretethat hasbecomedryorpowderythroughneglectofcuringtheContractorshallrectifytheworkathis own extra cost. If curing arrangements by the contractor are not satisfactory the Engineer-in-chargemayinhisdiscretionengagelabourandprovidematerialandequipmentforcuringand recover expenditure thus involved from contractor.

1.14 FINISHING.

GENERAL

Only skilled workmen shall perform finishing of formed and unformed surface. All exposed concrete surface shall be cleaned of incrustations of cement mortar or grout. Unsightly stain shall be removed.

FORMEDSURFACES.

Surface of concrete finished against form shall be smooth, free from projections and filled thoroughly withmortar.Immediately uponremovalforms, allunsightly ridges.Shallbe treated properly.

DRYBATCHING.

Dry patching mortar shall consist of one part of cement to 2 parts of sand by volume and just enough water so that themortar so used, will stick togetheron being mouldedinto a ball by a slight pressure of hands and will not exclude water when pressed but will leave the hands damp. The mortar shall be placed in layers of not more than 2 cm thickness. After being compacted each layer shall be roughened by being scratched to provide an effective bondwith the succeeding layers. The last or finishing layers shall be smooth to form a surface continuous with the surrounding concrete. All patches shall be bonded thoroughly to the surface of the chipped area and shall be sound and free from shrinkage cracks.

FINISHINGPERMENANTLYEXPOSEDSURFACE.

Except as otherwise specified or directed all permanently exposed concrete surface and other waterway surface requiring durability under water (except the outlet) shall be finished in the following manner. Immediately upon the removal of the form the surface shall be wetted and all surface pits and air bubbles filled by rubbing mortar composed of cement and fine sand in proportion (1:2) in to the pits burlap so as to secure a uniformly dense and smooth face.

The rubbing shall be performed in such a manner as to leave the surface free from mortar not used for filling the pits. Should the filling operation be unduly delayed and the surface of the pits becomes coated with dirt or other contaminating materials, they shall be thoroughly cleaned and washed and shall be maintained in a moist condition, until the mortar filling is placed. Such cleanings shall be done by means of air and water jets and chipping off brushing or other satisfactory means without damaging the surrounding, concrete. All operations in connection with the filling of surface pits shall be handled as, quickly as practicable to minimize the period during which the concrete and mortar filling are exposed to the drying. When the treatment of a surface has been completed the surface; shall be neat and have the same colour and texture as the adjoining concrete.

FINISHINGCONCEALEDSURFACE.

For exterior concealed surfaces below ground or back fill level or like surface not otherwise specified,nofinishisnecessaryexceptthatsandstreaksmetalpockets,honeycombingorother imperfectionswhichare of consequence inaffectingstrength,watertightnessorprotectionof reinforcing steel from corrosion, shall be corrected and repaired as prescribed for formed surface.

FINISHINGUNFORMEDSURFACE.

Unforrmedsurface shallbe finishedby one ormore ofthe operationof screeding, floatingand towelingof the surface shallbe done at propertime employingexperiencedmen, This shallbe just sufficient to produce the desired finish, screeding which gives the surface its approximate shapebystrikingoffsurplusconcreteimmediatelyaftercompaction.Thisshallbeaccomplished by moving a straight edge or template with a sawing motion across wood or metal strips that have been established as guides. Where the surface is curved special screed shall be brought truetoformandgradebyworkingitwithawoodenfloat.Ifacoarsetexturedfinishisdesiredor if the surface is to be steel trowelled a section or final floating shall be performed after some stiffeninghasoccurredandthesurfacemoisturefilmorshinehasdisappeared.Wheresmooth dense finish is *desired* floating shall be followed by steel trowelling some time after moisture film or shine has disappeared from the floated surface and where the concrete has hardened sufficiently to prevent fine material and water from being worked out the surface Excessive toweling particularly at early time shall be avoided.

CHIPPINGANDROUGHENINGCONCRETESURFACE.

Surface upon or against which additional concrete is to be placed shall be chipped and roughened to a depth not greater than 25 mm. Roughening shall be performed by chipping or othersatisfactorymethodsandinsuchmannerasnottoloosen.Crackorshatteranypartofthe concretebeyondtheroughenedsurface.Afterbeingroughenedsurfaceoftheconcreteshallbe cleanedthoroughlyof,allloosefragments,dirtandotherobjectionablesubstancesandshallbe sound and hard in such conditions as to assure good mechanical bond between old and new concrete. All concrete which is not hard dense and durable shall be removed to the depth required to secure a satisfactory surface.

DAMAGEDUETOFLOODSGOVT.NOTRESPONSIBLE.

In case of damageof anyof the concreteworks due to floods,Engineer will notbe responsible andwhatevercorrectivemeasuresarerequiredtobeadoptedshallbe done by the contractor at his cost.

1.15 NOMINALMIX.

The locations indicated in Column No.6 of the statement below are only suggestive. The nominal mix used for different components shall be as directed by the Engineer-in-charge according torequirement ofdetailed design. TheContractorshall notbeentitled forany extra claim on account of the changes in location.

Sl. No.	Nominal mix	Cement contentin	Maximum size ofaggregate in	Stipulatedstrength at 28 days on 15x15x5cm.Cubes (works tests) N/mm2)	Indicatedprobable location for use
1	2	3	4	5	6
1	1:1:5:3 M-20	400	20	20	R.C.C.slabs,beams vertical walls, through columns and ribs of cross drainageworks
2a)	1:2:4 M-15	363	20	15	Slabs,Krebsbeams
b)	1:2:4 M-15	330	40	15	Abutment,pier caps,dirtwalls
c)	1:2:4 (PCC) M-15	363	20	15	Wearing coat of bridges,canallining in approaches of structures
d)	1:2:4 M-15	330	40	15	Foundation of structuresonstate highway
3a)	1:3:6 M-10	230	20	10	Side template steps,cast-in-situ lining
b)	1:3:6 (PCC) M-10	230	40	10	Foundationof O.D.R. approach slabs,castinsitu side lining.
4)	1:4:8 M-7.5	170	40	7.5	Foundation of structuresother than state Highway.

M-30mixshallbeusedfordesignofwatertanks etc.

REINFORCEMENTSTEELWORKS

REINFORCEMENT

1.1 Scopeofwork.
1.2 Reinforcementbars.
1.3 Binding.
1.4 Distancebetweenbars.
1.5 Splicing
1.6 Cover.
1.7 Inspectionbeforeconcreting.
1.8 Anchorbars.

REINFORCEMENTBARS

1.1 SCOPEOFWORK:

The item shall include supplying bending and erecting in position steel reinforcement conforming to relevant Indian Standard Specification required for R.C. C. Works of Penstock Lining, Control Room & Power House Complex.

1.2 REINFORCEMENTBARS:

Steel reinforcement bars and fabrics shall be placed in the concrete as shown in the Drawingor as directed. Before steel reinforcement is placed in position the surface of the reinforcement shall cleaned of rust, scale, dirt and grease and other objectionable foreign substances (heavy flaky rust and Mill scale that, cannot be removed by firm rubbing with burlap or equivalent treatment is considered objectionable). The fact that early stage rust has not detrimental effecton bond shall not be used of asexcuse of careless handling and storage of steel. In storing bars of the same size, length shapes and grade shall be assembled in racks and marked distinctly. Before the reinforcement bars are fixed in positionit shall be verified that they are of specific size and bent in accordance with plans and specifications. They shall be accurately placed and secured in position by means of built in concrete block,metallicchair, hangers; spacers andother suitable devices, at sufficientlyclose Intervals, so that they will not sag between supports, nor be displacing the concrete or by any operation of the work.

Special care shall be exercised to prevent any disturbance of the reinforcement in concrete that has already been placed. The reinforcement after being placed in position shall be maintained in clean condition until it is completely embedded in concrete to prevent further damage to the concrete or unsightly rust stains on exposed concrete surface.

Reinforcement shall not be straightened or bent in a manner that will injure or weaken the materials.Barswithkinksorbendsnotshownontheplansshallnotbeused.Barsshallbebent to the shape and dimensions on the drawing or as directed, using a bar bender operated by handorpower,to attainthe properbendingradius.The radiusofbendshallnot be lessthan4 times the nominal size of the bar. Heating of reinforcement bars to facilitate bending will not normally be permittedwhen, however, suchheatingis permittedinthe case of large diameter bars,thetemperatureofthesteelshallnotexceedthecorrespondingtoacherryredcolour.

1.3 BINDING:

Wirefortyingreinforcementshallbeofsoilaridannealedsteel.Thewiremaybeof1.22mmto 1.63 mm and shall have to confirm to IS 1786:2008. Metal support and spacers shall be fabricated from non-corrodible metal. Dissimilar metals shall not be placed in concrete in intimate proximity with each other or be joined by a connector especially in the continued presenceofmoistureunlessitisknownthatgalvanicactionwillnotresult.

1.4 DISTANCEBETWEENBARS:

Thedistancebetweentwoparallelreinforcementbarsshallbeexceptasprovidedbelowinnot less than the greatest of the following distances.

a) Thediameterofeitherbar,iftheirdiametersareequal.

b) Thediameterofthelargerbar,iftheirdiametersareunequal.

c) 6 mm more than the nominal maximum size of the coarse aggregate comprised in such concrete.

Note:Agreaterdistanceshouldbeprovidedwhenconvenient.

The vertical distance between two horizontal main steel reinforcements or the corresponding distanceatrightanglestotwoinclinedmainsteelreinforcementsshallbenotlessthan12mm exceptataspliceorlapandexceptwhereoneofsuchreinforcementistransversetotheother.

The pitch of the main bars in a reinforced concrete solid slab shall be not more than three times the effective depth of such slab, or 300 mm whichever is less.

1.5 SPLICING:

Bar splices as indicated in the drawing shall only be allowed. The lapped ends shall be placed to ensure full bond on each bar. Splicing shall not be done in the region of maximum bending moment, and splicing of adjacent bars shall be avoided as far as possible.

Welding of bars for splicing may be allowed in place of lapping at the discretion of the Engineer-in-charge at approved locations. When welding is resorted, instead of lapping, the bars to be spliced shall be lap welded or butt welded by Electric arc welding. Ends of bars tobe spliced shall be cleaned of all dirt, scales, rust paint and foreign matter before welding. All welding shall confirm to the relevant Indian Standard Specification. Any weld will be considered un-satisfactory if it fails to sustain a tensile stress of at least 50 % of the tensile stress of the bar in which the weld has been mode. The Contractor shall make necessary arrangements, for carrying out the tests as directed by the Engineer-in-charge.

1.6 COVER:

Sufficient concrete cover shall be provided to protect reinforcement from corrosion or as indicated in the drawings. All protruding bars from concrete or masonry to which other bars are to be spliced and which will be exposed to action of weather for an indefinite period shall be protected from rusting by a thin coat of neat cement grout.

The thickness of concrete cover (exclusive of plaster or other decorative finish) shall be as follow,

a) At each end of reinforcing bar a cover not less than 25 mm a or less than twice the diameter of such rod or bar.

b) Foralongitudinalreinforcingbarinacolumncovernotbelessthan40rnmnorlessthan thediameterofsuchrodorbar. Inthecaseofcolumnofminimumdimensionsof180mm orunder,thosebarsthatdonotexceed12mmdiameter,25mmcovermaybeused.

c) Foralongitudinalreinforcingbarinabeamacovernotlessthan25mmnorlessthanthe diameter of such rod or bar.

d) Fortensile,compressiveshearorotherreinforcementinaslabacover,notlessthan12 mm.Norlessthanthediameterofsuchreinforcement.

e) Forallexternalworkforworkagainsteachfacesandalsoforinternalworkwherethere exists particularly corrosiveconditions, the cover, of the concrete shall be increasedby 12 mm.Beyondthefiguresgivenabove(atod)

Where because of splicing, the thickness of concrete in between reduces to less than the maximumsizeoftheaggregateaconcretewithreducedmaximumseeofaggregateshallbe usedso asto allowdevelopmentofbondinthespliceatcontractor'scost.

1.7 INSPECTIONBEFORECONCRETING:

No concreting shall be started unless the reinforcement as laid is finally checked arid certified by the Engineer-in-charge or his authorised representative, Before starting the concreting the contractor shall make certain that themeasurementsof the reinforcement placed in have been recorded and that the Engineer-in-charge certifies corrections of reinforcementused.Failuretodosomaymeannopaymentorpaymentatthediscretionof the Engineer-in-charge for the reinforcement concrete.

1.8 ANCHORBARS:

The cost of extra anchor bars provided as per instructions of Engineer in charge shall be borne by contractor.

ROADWORKS

ROADWORKS

1.1 GENERAL

1. Road shall be constructed to the lines, level and grade with sand and moorumfillhaving desired parameters of density cohesion, etc. so as to ensure the designed stability and performances of the whole road. The Quality Control Organization of the project may carry out requisite test for the suitability of construction materials well in advance and the contractor shall ensure that only approved materials are brought to place of fill and used for construction of Road.
2. The Contractor shall submit sequence of operation which he proposes to follow to the Engineer-in-charge and shall obtain approval to it prior to commencing work and shall adhere to the agreed sequence after modification if any by the Engineer-in-charge.
3. Themethods and plants and equipments to be used by Contractor is subject to placing of the layers for the road portion programmed for construction in the season shall be continuous and approximately horizontal. In case the whole length of road is not constructed simultaneously, the incomplete end of the road shall be kept at slope not steeper than 1 in 4.
4. No materials shall be placed in any section of the road until the road seat for that sectionhasbeendewatered,suitablypreparedandapprovedbytheEngineer-in-charge. All portions of excavation made for test pits or other sub-surface investigations, allholes, hollows,andallotherexistingcavitiesfoundwithintheareato becoveredand which extend below the established lines of excavation for road seats, shall be filledwith suitable earth fill of the corresponding zone of the road and suitably compacted.
5. Poolsofwatershallnotbepermittedinthefoundationforroadandsuchwatershallbe drained and cleared prior to placing the first layer of road materials.
6. The contractor shall construct and maintain good diversion in case the existing communication is disturbed. Precautionary measures such as night lamp, danger facing signals, diversion signals etc. shall be provided by the contractor at his cost to avoid accidents on the communication lines because of contracts activities.
7. Proper care shall be taken to avoid any interference with or damage to works of other discipline such as water supply, sewerage, electricity etc.
8. TheContractorshallatalltimecarry outworkinamannercreatingleastinterferenceto the traffic during execution. The Contractor shall provide andmaintain duringexecution a passage for traffic either along or as part ofexisting way underconstruction or a separate diversion road at his own cost.
9. Quality ofallmaterialsshouldbeapprovedby Engineer-in-chargepriortocollectionat site. If any materials brought to site is found inferior and rejectedshall be removed from site immediately by the Contractor at his own cost.
10. Construction traffic shall not be allowed to use the newly prepared surfacewithout prior permission from Engineer-in-charge. Any damage arising out ofsuch use shall however be made good by the Contractor at his own cost.
11. All measurementsunless otherwise indicated shall be recorded / computedto the following limit

(i) Lengthandbreadth–0.01m.
(ii) Height,depthorthicknessofearthwork,Subbaseandbasecourse-5mm.
(iii) Areas-0.01sqm.
(iv) Cubiccontent-0.01cum.

12. Works rejected by the Engineer-in-charge on ground of poor quality or workmanship shall be dismantled and redone by the Contractor at his own cost.
13. Complete stacking of materials like sand, moorum, H.G. chips as per requirement shall be carried out in 2Km. length before spreading, The collection shall always commence at one end and be carried continuously towards the other unless the Engineer-in-charge directsotherwise.

1.2 SETTINGOUTOFTHEWORK:

1. Before starting any work and during execution (if required) the contractor shall erectreference Bench Marks, reference lines and check profiles at convenient locations as per the direction of the Engineer- In-Charge. The centre line of the road and the reference line for all alignments for demarcation purpose shall be laid by properly dug-belling on the ground.
2. The Check profiles shall be located at 30M. apart or closer as directed by the Engineer-in-Charge so as to ensure execution of all slopes, steps and elevations, to the profile as indicated in the approved drawings. All important levels and all control points with respect to Bench Marks and reference lines shall be fixed and co-related by the Engineer-in-charge.
3. To ensure correctness of execution the edges of cutting, the lines of the road and those of spoil bank shall be marked carefully with pegs at close intervals. The pegs shall then be connected by stretching string from peg to peg and dug belling into ground along the strings. The lines so connected shall be corrected whenever necessary to provide a stream lined plan of the features. Special care shall be taken at curves to enssure uniform curvature of the alignment.Thelayoutofthestructuresshallhavetobegiveninappropriatemannerwith pegs & pillars.
4. All materials and labour for settings out works including construction of reference Bench Marks, reference lines check profiles and surveys, as may be required at various stages of the construction, shall be supplied by the contractor at his own cost. **The cost of such works shall be deemed to have been included in the costs of items for road work in schedule.**

1.3 PREPARATIONOFSITE

1.3.1 CLEARINGTHESITE

(a) The contractor shall clear of all tree stumps, bushes,roots, brushwood, rubbish of all kinds, loose stones and all other objectionable materials in the entire area required for setting out. The ownership of all the useful materials so removed from clearing site and or excavation shall rest with the department. The roots of the trees shall be grubbed to full depth. The contractor shall dispose off all such materialsas directed by theEngineer-in-charge.

(b) No separate payment willbe made to the contractorforcomplying the requirementsof clearing the site and all cost shall be deemed to have been included in the rates quoted in schedule for the items.

1.3.2 RECORDINGOFCROSSSECTION

Initialcrosssectionsshallbetakenatevery30mintervalorcloserdependingonnatureofthe

ground upto sufficient distance outside the limit if work. Levels on these cross sections shall be taken at 5 m. or closer intervals as directed by the Engineer-in-charge and recorded in the field and level books in the presence of the contractoror his authorised agent who shall sign the field book/level book in the token of acceptance. Thesec.s. shall form the basis of all future measurements and payments.

1.4 FOUNDATIONPREPARATION

1.4.1 SOILFOUNDATION

Soil foundation under the seat of road shall be scarified and loosened by means of a plough or other means to a depth of about 15 cm .to 20 cm .to the satisfaction of the Project Manager. Roots and other debris turned up during scarifying shall be removed from entire foundation area for the fill. Before placing of fill materials, the stripped surface of the road is to be initially compacted. The firstlayerof fill for the road shall be of depth of 10 cm to 15 cm and shall be carefully placed, ensuring uniform compaction and a satisfactory intimate bond between the foundation soil and fill materials. Heavy rubber type rollers or vibratory rollers may be used for compaction. Power Road Rollers shall be used for compaction of impervious soil and preferably vibratory type roller shall be used for compaction of all other soil.

1.5 BORROWAREA

1.5.1 GENERAL

All materials required for the construction of road shall be obtained from borrow areas duly approved by the Project Manager. The contractor has to arrange borrow area for necessary testing and approval of Engineer-in-Charge to borrow sandy soil, sand &moorum. Borrow pits shall be operated so as not to disfigure/disturb the appearance of any part of the work or any other property.

1.5.2.PREPARATION/STRIPPINGOFBORROWAREA

All areas required for borrowing sand / sandy soil / moorum for road shall be cleared of all tree stumps, roots, bushes, rubbish and other objectionable materials. Borrow areas shall be stripped of top soil, and any other objectionablematerials tothe required depthas directed by the Project Manager. The work may be done manually or with suitable machine. Stripping operations shall be limited only to designated borrow areas. Materials from stripping shall be disposed of in exhausted borrow areasor in the approved adjacent areas as directed. Particular care shall be taken to exclude all organic matter from the materials. The cleared areas shall be maintained free of vegetable growth during the progress of the work.

1.5.3.HAULROADSANDAPPROACHROADS

Construction and maintenance of approach roads and haulage roads will be the responsibilityof the contractor. The department will have full right of way to those roads for inspection purposes. Proper road sign as directed have to be provided for safety. For haulage of road materials, the contractor shall construct ramps and haul roads of sufficient width along the shortest but most practical route and shall maintain and illuminate them to a satisfactory manner. Watering of the haul road shall be done by the contractor as often as necessary to prevent raising of dust, formation of cuts and consequent deterioration of the surface. Whenever service roads meant for public thorough fare traverse through or run close to the borrow areas, the contractor shall direct his excavation and haulageoperation in such manneras to ensure uninterrupted use of the service road and safety to the public. At the haul roadand the service road crossing, the contractor shall install necessary check gates androad signs.

WEATHER CONDITIONS:Road materials shall be placed only when the weather conditions are satisfactory to permit accurate control of the moisture content in the road materials. Before closing work on road, the top surface shall be graded and rolled with a smooth wheeled roller to facilitate run off. Prior to resuming work, the top surface shall be scarified and moistened or allowed to dry as necessary and approved by the Engineer-in-Charge for resumption. The contractor shall provide suitable protection works to protect the slope from erosion due to rainwater. No payment whatsoever shall be made for providing such protection work and rectifying of monsoon damages.

1.5.4.WATERING

Adequate watering to the sand fills are to be done to facilitate proper compaction. Similarly water content to moorum is to be controlled for proper compaction. No compensation will be made to the contractor due to held up of work for rain, fog and moisture content in the working process.

1.6 COMPACTION

GENERAL

(a) Having decided on the filling materials to be used, standard compaction test shall be made on the materials proposed for road to indicate broadly which are the most suitabletypeofequipmenttobeusedandthemoisturecontentatwhichcompaction should be undertaken and also to determine the effects of soil moisture content, thickness of layer and number of passes.

(b) Havingdecidedonthethicknessoflayerandrangeofmoisturecontents,testsshouldbe made with different types of equipments available and the required number of passes should also be determined.

(c) Inallthiswork,thestateofcompactionshouldbemeasuredintermsofdrydensity.

(d) DensitytestsiffeltnecessarybyEngineer-in-Chargeshallbemadeafterrolling.Standard proctor density test shall be carried out at regular intervals to account for variations in the borrow area materials as well as that in situ excavated materials.

(e) Thecontractorshallsupplyallmaterialslabourmachineryandequipmentathiscostfor the work.

(f) No extra payment shall bemade forcompactionoperations asthis shallbe deemedto havebeenincludedinthepricebidinscheduleofQuantitiesfortherespectiveitemof work**.**

1.6.1 ROLLING

When each layer of materials has been prepared so as to have the proper moisture content uniformly distributed throughout the materials it shall be compacted by passing the vibrating roller or P. R .R .The exact number of passes for each layer to obtain specified density shall be designed by the field laboratory after necessary test. The layers shall be compacted in strips overlapping not less than 0.6 m. Rolling shall commence at edges and progress towards centre longitudinally. The rollers of loaded vehicle shall travel in a direction parallel to the axis of the road. Turns shall be made carefully to ensure uniform compaction. Rollers shall always be pulled. Density tests shall be made after rolling and dry density attained shall satisfy the compaction standards specified in relevant I.S. Codes.

1.6.2. COMPACTIONOFCOHESIONLESSMATERIALS

Wherecompactionofcohesionlessfreedrainingmaterialssuchassandandgravelisrequired,

the materials shall be deposited in horizontal layers and compacted to the relative density specified. The excavation and placing operations shall be such that the materials when compacted shall be blended sufficiently to secure the highest practicable unit weight and best stability. Water shall be added to the materials as may be required to obtain the specified density by method of compaction being used.The thickness of the horizontal layers after compactionshallnotbemorethan10 cm,ifcompactionisperformedby tampersandnotmore than 15cm, if by rollers.

1.6.3. DRESSINGOFSLOPES

The slopes of road shall be neatly dressed to lines and grade as shown on the drawing as the placing of fill progress, compaction shall extend over the full width of the road and materials in slopes shall be compacted as for the rest of the road. To ensure proper compaction of the edges, the cross section of the fill during construction shall be kept wider as directed by the Engineer-in-charge and cross section shall be dressed to the designed requirement after compaction for which no extra payment shall be made as it is deemed to have been included in unit bid pricefor item ofschedule of Quantities**.** Materials used to fill depression shall be ofsame type as used in the road and shall be thoroughly compacted and bonded to the original surface. Slopes shall be maintained until final completion and acceptance. Any material that is lost by rains, weathering or other causes shall be replaced at the cost of the contractor till completion of the works and taking over by the department.

1.6.4. SETTLEMENTALLOWANCES

(i) In the fill road, settlement allowances of 2% will be provided. Accordingly extraheight shall be provided but payment for design height will be made**.** The base width of theroad will not be increased to maintain the design slopes indicated in the drawing for the additionalheightassettlementallowances,butthefollowingprocedurewillbeadopted.
Settlement allowances will be calculated at various levels where the slopes is to be changed and the elevations including settlement allowances will be derived keeping the road widths of the designed levels unchanged. The edges of road at the increased elevations (including settlement) when joined with the point where the slope has changed earlier bellow, shall give the slope to be adopted for constructions.

(ii) If the road is raised in more than one season, provision for settlement shall be made in the last season's construction as described above.

1.7 MATERIALS

1.7.1 MOORUMANDSAND

The moorum shall have plasticity index not less than 6 as determined in accordance with I.S. 2720.Itshallbefreefromallrubbish,dustandorganicmaterialsaswellasclodsofclay/ black cotton soil. The moorum should be granular and gritty.

Sand shall consist of hard, dense, durable and uncoated silicious gritty materials. Sand to be used shall be natural as obtained from river bed from specified quarries. It shall be free from all rubbish, dust and organic materials as well as clods of earth loam and other deleterious substances.

1.7.2 STONEAGGREGATE

METAL

Thehardgranitecrusherbrokenstonemetal shallbeobtainedfromquarriescontainginghard,

tough, sound, durable stone of close texture, free from decay and weathering. Pieces of the stone shall be angular and roughly cubical in shape. Round, elongated or flaky materials shall be rejected. The size of the metal shall be well graded as per specification.

Sample metals, collected from the quarries shall be got tested by the Contractor at his cost in thelaboratory.Thetestresultsshallconform to thestandardrequirementlaiddownformetal to be used for this work.

The physical requirement for standard size metal shall conform to the test results as per IS:2386.

Thegradingrequirementofcoarseaggregatesshallconfirmto IRCspecification.

17.3 CHIPS

Stonechipsshallconsistofregularfragmentsofcleanhard,toughanddurablerockofuniform quality throughout by crushing granite rock, and shall be free of elongated and flaky pieces, soft and disintegrated materials, and vegetable or deleterious matter. They shall satisfy the physical requirements set-forth as under.

Test	ISforTestMethod	Requirements.
(i)LosAngelsAbrasionvalue	IS:2386(Part-IV)	35% Maximum
(ii)Aggregateimpactvalue	-do-	30% Maximum
(iii)Flakinessindex	IS:2386(Part-I)	30% Maximum
(iv)Strippingvalue	IS:6241	25% Maximum
(v)WaterAbsorption	IS:2386(Part-lll)	2%Maximum.

Sizeofstonechipsshallbeasunder:

(i) For premix carpet 20mm to 12mm size: Passing 20mm sieve and retained on 10 mmsieve.

(ii) Forprecoatedsealcoat6mmanddowngradedsize:passing10mmsieveandretainedon 2.36mm.sieve.

(iii) Samplesof stone chips collectedfrom the quarries shallbe got testedby the Contractor at his cost inlaboratory. The test results shall confirm to the standard requirement as per BIS.

(iv) Controlonquality ofmaterialwillbeexercisedby theEngineer-in-chargeby carryingout the following tests at frequencies shown against each.

Type of construction material Test Frequency : Chips for carpeti) Aggregate impact value - Onetestper100M^3ofaggregateandsealcoat.ii)Flakinessindexofaggregate–1testper 100 M^3 of aggregate iii) Stripping value and water absorption - initially, one set of 3 representative absorption test of aggregates from specimens for each source of supply. Subsequently when warranted by changes in the quality of aggregates.iv) Grading of aggregates - One test for 100 M^3 of aggregates.

1.7.4 MEASUREMENTS:

Thematerialssuchassand,moorum,and crusherbrokengranitemetalsareto beseparately stacked at approved stack yard beyond trafficable berm in standard stacks of 1.5mX1.5mX1m. Accounting deduction of voids, each such stack is to be measured and paid as 1 cum.

1.7.5 BITUMEN

Bitumenof80/100gradeconformingtoBISasapprovedbytheEngineer-in-charge,in

writing shall be utilized in the work. Procurement of the bitumen will be made by the Contractor at his own cost from reputed manufacturers on approval by the Engineer-in-charge. The contractor is to produce test certificate to be issued by manufacturer for each consignment separately.

1.8 CONSTRUCTIONPROCEDURE

1.8.1 SUB-BASEBELOWPAVEMENT

(i) Moorum and sand stacked separately shall be conveyed and mixed properly to make an admixture of moorum and sand in proportion as per direction of Engineer-in-charge.
(ii) The formation after excavation or trimming shall be dressed to required camber and grade.
(iii) The admixture of moorum shall be spread in sub base and also side shoulders in layers not exceeding 15cm. in thickness and should be adequately watered.
(iv) Immediately following spreading of moorum admixture rolling will be started with 10 tonne capacity vibratory roller. The rolling shall begin from edges and then progress gradually to centre, parallel to the centre line of the road and over lapping uniformly each preceding rear wheel track by one half width and shall continue until the entire area of the course has been rolled by the rear wheel. In case of superlevated portions rolling shall proceed from inner edge to the outer edge. Rolling to continue till the admixture of moorum is thoroughly keyed. During rolling sprinkling of water is to be done as required for a dense compacted mix layer.
(v) The rolled surface to be checked transversely and longitudinally and any irregularities, ruts and soft yielding places be corrected by loosening surface, adding or removing amount of admixture moorum and rolling entire surface to confirm desired grade and camber of 1 in 50 (not flater than 1 in 72).

1.8.2 I.R.C.GRADE-IANDI.R.C.GRADE-IIIMETALING

A) SPREADINGOFCOARSEAGGREGATE

i) I.R.C.Grade-IIImetal(size40mmto25mm.)shallsatisfycriteriadescribedundersub-head criteria “materials" in preceeding paragraph

ii) StackingforGr.-IIIshallbedoneafterthespreadingofGr.-Imetal.

iii) The surface to receive I.R.C. Gr-I or Gr.-III water bound macadam course (metaling) shall be made free from dust and other extraneous material.

iv) Therespectivegrademetalsshallbespreaduniformlytoachievecompactednominal thickness of 11.5cm. and 10 cm for I.R.C. Grade-1 and I.R.C Grade-III metalingrespectively.

v) The spreading shall be done from stacks along theside of the roadwaysor approved stock yards. In no case shall aggregates be dumped in heaps directly on the surface prepared for the metaling nor shall hauling over un compacted or partially completed base be permitted. No segregation of large or fine particles shall be allowed. The surface of the aggregates shall becarefullycheckedwithTemplatesandallhighorlowspotsremediedbyremovingor

addingaggregatesasmayberequiredbyhandpackingthesametopropergradeand camber.

vi) The bunds of earth or moorum one on either side shall be made along the outer edge of metaling prior to or simultaneously with spreading of metal. In addition whereever required turf edging are to be provided. These bunds and turf edging are required to prevent loose metal from spreading out beyondwidth of road to be metalled.No extra payment will be made for the bunding or turf edging as the same are deemed to be included in the unit rate of respective items.

vii) Thecourseaggregateshallnormallybespreadmorethan3daysinadvanceofthe subsequentoperation.
viii) Spreadingofmetalshallproceedonly200m.inadvanceofrollingoperation.

B) CONSOLIDATION

(a) Immediately following the spreading of the coarse aggregates, rolling shall be started with vibratory roller of 8 to 10 tonne capacity or equivalent vibratory roller.Theweightoftherollershalldependuponthetypeoftheaggregateand shall be as indicated by Engineer-in-charge.

(b) Except on super elevated portions where the rolling shall proceed from inner edge to outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller moving forward and backward. The roller shall then move inwards parallel to the centre line of the road, in successive passes uniformly lapping preceding tracks by at least one half wheel width.

(c) Rolling shall continue until the aggregate is thoroughly keyed and the creeping of the aggregate ahead of the roller is no longer visible. During, rolling slight sprinkling of water may be done, if necessary. Rolling shall not be done when thesub-gradeissoftoryieldingorwhenitcausesawavelikemotioninthesub-grade or sub-base course.

(d) The rolled surface shall be checked transversely and longitudinally with Templates and any irregularities corrected by loosening the surface, addition or removing necessary amounts of aggregates and re rolling till the entire surface conforms to desired camber and grade. In no case shall use of screenings be permitted to make up depression.

(e) Moorum as blinding material shall be applied, successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water, the resulting slurry swept in with hand broomsor mechanical brooms to fill the voids properly, and rolled, during which water shall be applied to the wheels of the rollers, if necessary to wash down the blinding materials sticking to them. These operations shall continue until the resulting slurry after filling the voids, forms a wave ahead of the wheels of the moving roller.

(f) After final compaction of water bound macadam course, the road shall be allowedtodryovernight.Nextmorninghungryspotsshallbefilledwith

screenings or binding materials as directed, lightly sprinkled with water, if necessary & rolled .No traffic shall be allowed on the road until the macadamhas set. The Engineer-in-Charge shall have the discretion to stop hauling traffic from using the completed water bound macadam course if in his opinion it would cause damage to the surface.

(g) Materialwhichcrushedexcessivelyduringcompactionorbecomessegregated shall be removed & replaced with suitable aggregate.

(h) Itshallbeensuredthatshouldersarebuiltupsimultaneouslyalongwithwater bound macadam courses.

C) CONSUMPTIONOFMATERIALS

Consumptionofmaterialforspecifiedthicknessofpavementincaseofboth I.R.C.Gr.Iand I.R.C.Gr.IIImetalingshallbeasfollows:

ITEMOFWORK	I.R.C.Gr.I	I.R.C.Gr.111
Overall(Nominal)thicknessoflayerlaid	115 mm.	100 mm.
Compactedthickness	90mm	75mm.
Consumptionof metal	0.115cum/sqm	0.100cum/sqm
Consumptionofmoorumasblinding material.	0.028cum/sqm	0.025cum/sqm

1.8.3 PREMIXCARPETANDSEALCOAT

(a) This work shall consist of laying an open graded carpet of 25mm thickness in a single course and 6mm thick pre-coated seal coat composed of suitable small sized aggregate premixed with bituminous binder on a previously prepared approved base.

(b) Thequalityandgradingofmaterialsshallsatisfyprovisionsundersub-headmaterials.

(c) Carpetshallnotbelaid duringrainy weatherorwhenthebasecourseisdamporwetand when the atmospheric temperature under shade is 160^{0} C or below.

(d) The underlying base on which the bituminous carpet is to be laid shall be scraped with wire brushes, swept clean with brooms and finally dust removed with sacks as found necessary.

(e) TackCoat

This work shall consist of application of a single coat of low viscosity bituminous material to under lying road surface duly cleaned preparatory to bituminous construction. The temperature of bitumen at the time of application shall be in the range of 160^{0} to 175^{0}C. Bitumen shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Project Manager. The rate of spread in terms of straight run bitumen shall be 1kg per sq.m. area for untreated water bound macadam surface. The binder shall be applied uniformly with the aid of sprayers. The tack coat shall be applied just ahead of bituminous construction.

(f) Mixing

Bitumen Mixers of approved type shall be used for fixing aggregates with the bituminous binder. The binder shall be heated to the temperature raising from 150^0C to 175^0C as approved by the Engineer-in-Charge, avoiding local over heating and ensuring a continuous supply. Aggregates shall be dry before they are placed in the mixer. After about 15 seconds of dry mixing the heated binder shall be distributed over the aggregates at the ratespecified. Kerosene to an extent of 4% to 6% of asphalt shall be provided by the Contractor according to the requirement at his cost. Mixingof binder with chips shall be continued until all chips are uniformly coated with the bitumen and a homogeneous mixture is obtained.The mix shall be immediately transported from the mixer to the point of use in suitable vehicles. Thevehicles employed fortransport shall beclean and be coveredoverin transit, if so directed by the Engineer-in-charge.

(g) Spreading

The mix shall be spread on the road surface with rakes to the required thickness andcamber, or distributed evenly with the help of a drag spreader, without any undue loss of time. The camber shall be checked by means of camber boards and inequalities evened out to prepare the surface to specified line, grade and camber.

(h) Rolling

As soon as sufficient length of bituminous material has been laid, rolling shall commence. When the roller has passed over the whole area once, any high spots or depressions that become apparent shall be corrected by removing or adding premixed materials. The rolling will be done with a set of 8 to 10 tonne two wheel tandem rollers or equivalent suitable pneumatic roller as approved by Engineer-in-Charge. The roller speed will not be exceeding 5km. per hour. The roller wheels shall be kept damp to prevent the mix from adhering to them but in no case shall lubricating oil be used for this purpose. Rolling shall commence longitudinally from the edges and progress towards the centre except that in super-levated portion, it shall progress from lower to upper edge parallel to the centre line of the pavement. The roller should proceed on the fresh material with rear or fixed wheel leading so as to minimize the pushing of the mix and each pass of the roller uniformly over laps not less than one third of the track made in the proceeding pass. Rolling shall continue until the entire surface has been rolled and all the roller marks eliminated. The contractor shall provide necessary labour for keeping the roller wheels damp during rolling so as to prevent the premix from adhering to the wheels and being picked up. The edges along andtransverse of the carpet laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate bitumen before the new mix is placed against.

b.Seal Coat

Pre coated seal coat of approved thickness shall be applied immediately after laying of the bituminous course of carpet. Before application the surface shall be cleaned free of any dust or other extraneous matter. Mixing of chips and bitumen, laying the mix to proper thickness and rolling will be done similar to procedure for premix carpet described above. Blinding of rolled asphalt surface with course clean sand at the rate of 0.003 cum per Sq.mof road surfaceareashallbedonebythecontractorathisowncostasthesameisincludedinthe

unitprice.

Traffic may be allowed only after final rolling when the premix material has cooled down to surrounding temperature.

ConsumptionofMaterial

	Material		**Consumption/ Sqmofroadsurface area**
A.	20mmthickpremixcarpet		
	1)20mmto12mmsizeH.G.chips		
	Nominal20mm	0.015Cum	
	-do-10mm	0.008Cum	
	Total	**0.023Cum**	0.023Cum
	2)Bitumen–VG-30Grade		
	Tackcoat-	0.907Kg.	
	Precoatingchips	1.270Kg.	
	Misc.andWastage	0.091Kg.	
	Total	**2.268Kg.**	2.268Kg
B.	6mmthickprecoatedsealcoat.		
	1)6mmanddowngradedH.G.chips		0.006Cum
	2)Bitumen–80/100grade		
	Precoatingchips	0.680Kg.	
	Misc.andWastage	0.010Kg.	
	Total	**0.690Kg.**	0.690Kg.
	3)Sand(forblinding)		0.003Cum

(i) The shouldersor bermsoneither side ofthepavement overtheembankment tobe constructedwithrolledmoorumlayerinconformitywiththelines,gradesandcross sections as per approved drawing and as directed by the Engineer¬in-charge.

(ii) Moorumshallbeconveyedfromtheroadsideheapsorfromstockyardandspreadonthe prepared base to lines and grade.

(iii) Rollingwillbedonewith8to10tonnecapacitythreewheeledvibratoryrollersasper similar procedure laid for sub base.

SECTIONV-A

TECHNICALSPECIFICATIONFORPUMPS

&

ELECTRO-MECHANICAL WORKS

TECHNICALSPECIFICATIONFORPUMPS

&

ELECTRO-MECHANICALWORKS

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Section-V

TECHNICALSPECIFICATIONFORPUMPSANDELECTROMECHANICALWORKS

1.0Introduction

1.1. Overview of the Pumping system envisaged in the Irrigation project under the cluster is discussed. The contractor will be able to identify the brief details of each item.

1.2. As the suction lift of pumps would be more than six meter, It is proposed to have Vertical TurbinePumpsinRCCbuiltPumpHousesnearertotheriver.Itslocationmustbesuchthatit shall be safe from the high flood conditions of the river.

1.3. From the intake arrangement in shape of intake wellor Intake wall suitable conduits shall be laid with proper gradient. Trash Rack arrangement for floating debris and silt cleaning has to be provided.

1.4. Thepumphousewillhaveproperventilation.

1.5. The control panels will be located in or nearer to the pump house Such that Pumps arevisible from the electric control panel/ PLCoperator.

1.6. The VT pumps are lubricated by external clear forced water.The details are covered in VT Pump specifications. The forced water pumps will be located in a suitable area of pump house outside pump house.These pumps will draw water from a RCC tank of 10,000 liters capacity.Thewaterfrom rising main is drawn in this tank and allowed to settle,beforebeing passed through filters etc.

1.7. The actual design of piping headers and instrumentation etc is not covered, since these will depend on actual design, and EPC contractors will have to prepare the lay outs and submit for approval. EPC contractor will be given the map showing the area to be irrigated by a specific pumping system and the, rate of discharge, at which, the pumps will deliver water in peak season. The EPC contractor has to carry out survey, locate the pump house site, decide piping route, and location of delivery chamber, collect data regarding max, min and high flood levels, compute friction losses etc before deciding head for each pump. Power System connectivity to the Pump house is also covered under the scope of contract.

1.8. The location of AIR valves and surge protection devices will be decided after carrying out surge analysis by EPC contractor.

1.9. **MOTORS**

VERTICALTEFC/CACAmotorsrequiredforverticalTurbinepumpsonlyshallbeprovided.

1.10. **DRAINAGEPUMPS**

Drainage pumpsshall beprovidedto dewater thesump beforestarting mainVT pumps.This is necessary because the sand and silt will accumulate in the sump because of still water during idling of V T pump. These pumps are part of sump cleaning system.

2.0 VERTICALTURBINE(V.T)PUMPS

2.1 GENERAL

V.T Pumps of required capacity for pumping design discharge at duty point head are necessary to be provided at the respective pumping stations of the project.The pump to pump spacing shall be provided as perCEA(Central Electricity Authority) guidelines.

The desired characteristics of the pumps are as follows.

i. The pumps to be rugged in structure both mechanically and electrically to withstand rough weather conditions, & designed to run with minimum maintenance as the installation points are in remote inaccessible places.
ii. The materials of construction for different components to be selected to withstandwear and tear.
iii. The pumping units should be easy to handle, & install, and designed to withstand normal variation in power supply.

2.2 PumpsinParallel

In each pump house, there shall be minimum two and one standbypump and maximum four pumps working in parallel as decided by the PD-um-CE.Number of pumps indicated in bid document is indicative only based on owner's preliminary study. Contractor should choose economical option

2.2.1 StandbyPump:Eachpumphouseshallhaveonestandbypump.
2.2.2 Pumpsinapumphouseshallbeidenticalinallrespect.
2.2.3 Contractor may choose similar types of pumps in all pump houses such thatthe pumpsareinterchangeableincaseof emergency,andleast quantityofsparescanbe stocked.
2.2.4 Themotorsfor theschemeispreferablyH.VMotorswith 6.6KV H.TSupplyhowever
V.T Pumps of smaller size may use Low voltage motors, where as for motors of,200 Kw and above shallbe operated with 6.6 Kv HT supply and below 200 Kw shall be operated with 415 V LT supply. Contractors must consider suitable step down transformers for each scheme.
2.2.5 RCC pump house structure is required for VT pumps so as to protect the motorsfromrain, wind, dust, etc.The VT pump house floor levelshould beabove Highflood level. The delivery piping for these may follow contour of the land.
2.2.6 Eachpumphousewillhavefollowingmajorcomponents
2.2.6.1 Pump house with suitable EOT crane, bay for maintenance, space forcontrol panel, sump for fore bay , ventilation system.
2.2.6.2 VTpumpswithHTorLTmotors,Externalforcedclearwaterlubrication system
2.2.6.3 Dewateringpumpsarerequiredtoremovesandandsiltfromthesump.

2.3 CodesandStandards:

The design, manufacture and performance of the V.T. pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality area where the equipment will be installed. The equipment shall also confirm to the latest applicable Indian Standards. In particular the equipment shall confirm to the latest revisions IS 1710 -Vertical turbine pump for clear cold, fresh water.

2.4 DesignRequirement:

2.4.1 The equipment shall be capable of developing the required total head at rated capacity for continuous operation. The total head discharge curve shall be continuously rising towards the shut off with highest shut off point. Pumps shall be identical and shall be suitable for parallel operation with equal load division. Impellers shall preferably be of non over- loading type.Pumps shall run smoothly without undue noise and vibrations. The magnitude of peak to peak vibration at slip will be limited to 100 microns(or as per IS) at the bearing housing.Pumps normally will be SINGLE STAGE vertical turbine type and suitable for the service condition stipulated in most efficient manner.

EPC Contractor may decide to install booster pumps in the system to achieve the economical option of running and capital cost. The Booster pumps can be HORIZONTAL SPLIT CASE/END SUCTION Coupled sets/submersible pumps in casing pipe. Feasibility with Economical consideration of running two pump houses with all facilities and control has to be decided. Required Pump start stop logics (interlocks) shall be provided between main Pumping Station and Booster pumping station(If required). Time leg shall be provided to start Booster pump after starting of main pumps to ensure sufficient water is available at Booster pump suction.

2.4.2 **Duty Point Pump Head:** The contractor shall have to account for all losses (in entry, strainer, bellmouth, bowl assembly, column pipes, discharge tee etc/) while designing the pumps in addition to head loss in delivery pipe, valves, fittings, rising mains and velocity head beyond discharge flange of discharge head / pumps casing etc. areto be calculated taken into account while designing pump.

2.4.3 **Duty Point Efficiencies:** The DUTY POINT efficiency shall be guaranteed by the EPC contractor along with other parameters.Overall efficiency shall be above 80% for each pumping installation.

2.4.4 **Head Range and Parallel Operations:** The pumps will satisfy the head requirement as per the system resistance curve, while operating in solo and in any combination up to maximum Nos. of duty pumps in parallel. The Pumps should be suitable for operation in head range of 10% above N.W.L. and 25% below N.W.L.

2.4.5 **Power Margin:**The specific gravity of water is to be taken as 1.03 while calculating power for the pumps. The pumps shall be capable of operating in the range as mentioned above without being overloaded at any point and keeping a margin of at least 5%or more of power in the motor of pump over entire operating range and 10% at rated Duty point whichever is higher. Requirement of power at shut off should not exceedpowerrequirementatdutypoint.Thepumpshouldbecapableofstarting

against fully closedvalvewithout beingoverloaded atany point uptovalve fullyopen. The startingtorqueofeachmotor should be suchthat, all pumps should be capable of starting without any problem automatically from remote control system.

2.4.6 **PumpCharacteristics:**Thepumpcharacteristicsshallbeofstablenatureandsuchthat the efficiency is fairly steady for the water level variation. The maximum efficiency point will be nearer to the duty point and fairly constant for larger range on either side.The pumps should run smoothly from a lowest head to rated duty head, without cavitations and vibration. The variation in the efficiencies for any point of operation in the entire operating range should be minimum.

2.4.7 **NPSH Conditions (Net Positive Suction Head Conditions) :**NPSH required by pumps offered by the Contractor should be lesser by at least 0.5 meters than N.P.S.H.A. at duty point and shall not exceed the N.P.S.H. available at any point of operation in the range with solo and parallel operations. The Contractor shall take following values of the corresponding parameters for the purpose of calculation of N.P.S.H.At the site

a. Atmosphericpressure9.6Meterofcolumnofwater
b. Vapour pressure of water 0.6674 Meters column of water(at37.8 C Normal temperature)

2.4.8 **Speed:**Pumpspeedshouldbeasrecommendedbymanufacturer.

2.4.9 **Solid Handling Capacity:**The pump shall be suitable for pumping of raw river water containing silt, sand and suspended solids up to 20 mm size. The river water may contain weeds and other long roots etc, which may pass through trash racks. These may obstruct the pump impeller, diffuser and bearing holder spiders etc. Hence contractor should take special care to avoid such occurrences, while designing intake pipeContractor to get water analysis done and impellers and casings to avoid any damage due to abrasive material in raw water.

The Turbidity data of the river of Odisha Pollution Control Board and its analysisshould be carried out by contractor.

2.4.10 **Classof Operation :**The pumps shall be suitable for nonstop continuous 24 hours operation without interruptions.

2.4.11 **No.of Starts :** Pumps shall be suitable, for two hot starts, and three cold starts per hour of corresponding motor.

2.5 **SumpModelTesting:**

Thecontractormustdesignthesumpsofeachscheme,toensurevortexfreeandcavitations free operations of the pumps. If required contractormay carryout sumpmodeltest/or carry out sump design by mathematical modeling, at his own cost for vortex free operation.During the operation if it is required, the contractor has to modify the sump at his own cost without affecting the operation of the scheme.

2.6 **DefinitionsofEfficiencies:**

For all purpose of this contract, the various efficiencies will have the same meaning and effect as defined in the IS 1710-(latest verson).

2.7 CharacteristicCurves:

The contractor shall furnish characteristic curves of pump. The contractorshall furnish along with his tender the characteristic curves soprepared, superimposed on system head curves for single and multi pump operation.

2.8 BowlAssembly:

Apumpbowlshallbeflangedwithmachinedmatchingfaces.Thesuctionbellmouthtobowl assembly,tocolumnandtodischargehead,i.e,alljointsshallbeflangejoints.Thebowlshall be capable of withstanding a hydrostatic pressure equal to twice the duty head or 1.5 times shut off head which ever is greater.

2.9 SuctionBellmouth&Strainer:

A cast iron bell mouth shall be fitted to the suction nozzle to limit the velocity to 1.5m/sec maximum. The suction strainer shall be of Stainless Steel AISI 304. Net opening area in strainer shall not be less than 2.5 times of entrance area of bell mouth. The shape and curvature of the bell mouth shall be designed to streamline the flow of bowl suction. The thickness of bell mouth shall not be less than 10mm.

2.10 Impeller:

The impellers shall be dynamically balanced so as not to cause any vibrations &cavitation during operation. The impellers shall be closed type and shall be made in one piece and securely fixed to the stainless steel shaft, to assure accurate adjustment of each impeller. The water passage will be finished smooth by hand. Balancing holes/ devices for reducing hydraulic thrust shall not be provided.

2.11 WearingRings:

Wearing rings shall be renewable type. These shall be held in place by screwing against rotation, press fit or locked with pins, flanged and screwed. Wearing rings shall be provided on both casing and impeller.

Hardnessofwearingringsshallbelessbyatleast50BHNthantheimpeller.

2.12 Shaft:

The shaft shall be of stainless steel and finished to the close tolerance at the impeller / bearing fixing sizes.

The designof the shaft shallalso take into considerationthecriticalspeedof theshaft,which shall be at least 20% above / below the operating speed.

The shaft shall be properly balanced so as not to cause any vibrations during operation. The pump shaft bearings i.e. bush bearings would be stainless steel, water lubricated. Extra long bearing shall be provided for suction and discharge bowls. The hardness of bush bearingshall be less by at least 50 BHN than that of shaft.

2.13 ColumnPipeAssembly:

Column pipes shall be of M.S. Fabricated heavy weight, flanged type each in 2 m length or less so that after complete erection of the pump/s the bottom of strainer shall be as per the CPHEEO Manual and length of strainer shall be adjusted accordingly. The total length of column assembly, bowl assembly, bell mouth and strainer shall be decided by the contractor based on the data collected after detail survey. The column assembly length (including column pipes, bowl, assembly, bell mouth and strainer) shall be adjusted considering, the pump floor, levels. A matching piece shall be provided if required. The stiffeners shall be provided to all pipe flanges. The discharge head/ tee and column pipe dia shall be same. The discharge head tee incorporate full diameter elbow.

2.14 LineShaft:

The shafts shall be of solid circular section, prepared from stainless steel machined and ground thoroughly and coupled with muff couplings. The shaft sections shall be provided withnoncorrosiveandabrasionresistingwearingsurfacesparticularlyatthelocationofeach guide bearing.

Lengthoflineshaftshallnotbemorethan2m.each.

2.15 LineShaftBearing:

These shall be designed to be water lubricated by external clear forced water, and shall be placed in bearing holders located in position at the joint of columns. Line shaft bearing shall be of cut less hard rubber designed for efficient water lubrication. The line shaft protection tubes shall be provided for holding line shaft bearings. The line shaft protection tubes shall be ofheavydutyseamlesstubes towithstand allmechanical and hydraulic forces exertedon it, with an allowance for corrosion and erosion. Composite design of line shaft materials and diameter and bearing centre shall ensure that the entire rotating assembly is brought from standstill to full speed without any vibrations and shaft deflection and to ensure that first critical speed is not within 80% to 120% of full speed.

2.16 DischargeHead&Motor Stool:

The discharge head shall be fabricated from M.S. and shall incorporate mounting flange for motor stool for solid shaft motor, stuffing box with renewable gland packing and tapping for pressure gauge mounting etc. The discharge head shall be of robust construction and shallbe designed to support entire load of pump assembly, water column and motor etc. andshall withstand all static and dynamic, torsion loads, hydraulic thrust imposed during operation from shut off to stipulated operating conditions and thrust due to change in direction of flow, without any vibrations. The delivery nozzle shall be above ground.

Discharge head with sole pads will not be accepted. The discharge head shall be installed on sole plate with ISMB frame and entire load of motor and pump shall be on the lower floor. Drain arrangement for gland leakage water shall be provided at bottom of discharge head with G.I. pipe. The base of the discharge head shall be sufficient to properly support the pump. The power shall be transmitted from motor to vertical shafting through a flexible coupling.Bothhalvesofthecouplingshallbemachinedallover,securelykeyedtotheir

respective shafts. The pins shall be of stainless steels. The arrangement of two halves shallbe suitable to check alignment and parallelism.

A self aligning thrust bearing shall be housed in the head gear adequately designed to accommodate entire weight of rotating parts and hydraulic through and shall be suitable for reserved rotation up to at least 150% normal forward speed. Bearing shall be designed for 40,000 hours life. The bearing shall be of oil lubricated type and shall be provided with oil level gauges and suitably positioned temperature probes. Two sets of adjustable contacts shall be provided one for an alarm and other for tripping the pump motor. This shall be connected to scanner panel so that digital temperature can be read out with alarm and tripping.

Motor stool shall be provided for mounting the electric motor. The motor stool shall accommodate the pump thrust bearing and pump motor coupling. The motor stool shall be robust construction and of fabricated mild steel and adequately sized with opening to work on the flexible coupling. Height of pump supporting girder/ channel, discharge head and motor stool shall be adjusted to have motor base at or marginally above panel floor level.

The pump shall be provided with non reversible ratchet to prevent them from rotation in reverse direction. Pressure gauge to each pump and manifold pipe shall be provided. Pressure gauge shall be 150 mm dial size and least count shall be 0.05, each pressure gauge shall be fitted with restrictor nozzle of brass and G.I. Pipe and U tube. Pressure gauge on manifold shall also be provided. All pressure gauges shall be installed in pump house on wall with necessary G.I. pipe connections from manifold to pump house. The pressure gauges shall be installed at suitable height so that the reading can be taken accurately.

2.17 SolePlate:

The M.S. sole plate arrangement shall be provided under the discharge head for precise horizontal and vertical alignment.. It shall be independent of base plate integral with the discharge head. The contact surfaces of the sole plate arrangement as under shall be machined for precise leveling and shall ensure vibration free operation of the pump.

CornerplatesandsoleframeSoleframeandsoleplateSoleplateanddischargehead.

All joints between machined contact surfaces shall be with nut bolts/ tapped studs/ bolts. The opening in the sole-plate/frame shall be of adequate size to pass the bowl assembly etc. very easily. M.S. base frame shall be anchored in the floor ensuring complete rigidity. Entire structural fabrication and foundation arrangement shall be designed and submitted for approval. M.S. plates shall be grouted on pump supporting R.C.C. beams provided in civil structure. The fixing of M.S. plates on the R.C.C. beams and subsequent anchoring of M.S. sole frame in proper level shall be the responsibility of contractor with all related works.

2.18 AutomaticAirReleaseArrangement:

An automatic air release valve of min 50 mm size shall be provided, to remove the air from column pipe during starting of the pump

NOTE:**Allaccessoriesrequiredforproperandsafeoperation,dismantlinganderectionand pump shall be supplied with heavy duty clamps for column and line shafts, one pair for each pump**.

2.19 ForcedWaterLubricationandCoolingSystem

The forced water lubrication system for transmission bearings and supply of cooling water to pump thrust bearing shall be provided. The river water shall be taken in a sump, from whereitshallbepassedthroughpressurefilter,byboosterpump.Thefilteredwatershallbe free of solids. The degree of filtration shall be 50 microns. There shall be standby booster pump.Asuitable10000 litersoverheadtankshallbeprovidedto supply lubricationwaterto pumps, in case failure of Forced water lubrication system. The system flow and pressure requirements should be as pump manufacturer's recommendations

2.20 MATERIALSOFCONSTRUCTIONFORV.T.PUMPS/BoosterPumps

Sl. No.	Description	Material
1.	Bellmouth,pumpbowls,suctioncasing anddischarge nozzle	Ni-C.I.conformingtoIS210grade20
2.	ImpellersforV.T.pumps&Booster pumps	StainlessSteelCD4MCu–BHN.220–270 with anti abrasive
3.	ImpellershaftsforV.T.pumps& Booster pumps	StainlessSteelAISI410
4.	ColumnPipes	MildsteelIS2062EFW/ERW pipes.
5.	LineShaftProtectiontubes	SeamlessM.S.
6.	Flexiblecoupling	ForgedsteelconformingtoIS3495
7.	WearingringsforV.T.pumpsand Booster pumps	Stainlesssteelasappropriate
8.	ColumnFlanges	MildsteelIS 2062
9.	NutboltsandwashersuptobottomofF discharge head	StainlesssteelAISIST304/316
10.	Line shaft	StainlesssteelAISI–410
11.	Lineshaftcoupling	StainlesssteelAISI–410
12.	Pumpshaft bearing	Cutlass Rubber
13.	Dischargehead	C.I.conformingtoIS210ormildsteel fabricated IS 2062
14.	BOWLbearings	Ni-CIconfirmingIS210orMildSteel fabricated IS 2062
15.	Strainer	GunMetal/StainlesssteelAISI304
16.	CasingofBoosterPumps	Ni-CIorgalvanized steel
17.	PressureFilters	C.I.conformingtoI.S.210grade20i Body and Flanges - M.S.fabricated iiFilter media - Gradedsand

2.21 MECHANICALFILTERELEMENT

Design duty	-Tobedecidedbypumpmanufacturer	
Degree of filtration	-	50 Micron
Endconnections	-	Flanged
Fluid	-	Water
Viscosity	-	1cp
FlowRate	-	Adequatewithsufficientmargin
DesignPressure	-	Adequate
Pressure Drop	-	0.2Kg/cm.sq.(Cleancondition)
Hydro test pressure	-	1.5 times of designpressure
Applicable Standard	-	I.S. 2825
Filtermedia	-	Strainertube

2.22 **PUMPSTARTING/CLOSINGLOGICANDINTERLOCKS(Thedataisgivenforproperdesign of control system**)

LOGICOFPUMP STARTING

Aftersinglepushbuttoncommand,followingoperationswilltakeplaceinsequence.

a. After starting of sump cleaning pumps, dewatering pumpshould berun for20minutes. De watering pump is required to run before starting of first pump motor, then after direct second pump can be started.)
b. Forced water lubrication system / pre lubrication starts after stopping dewateringpump.
c. After a time delay the main pump motors will start and capacitor cubicle circuit will be 'ON'
d. The pumps will be started in sequence, at an interval such that the subsequent pump starts after the previous pump has attained full speed.

LOGICOFPUMPCLOSING

i. ThemainpumpmotorswillstopandCapacitorscubiclescircuitwillbeOFF.
ii. Forced water lubrication and cooling system will be closed..(Force water lubrication system and cooling system is common for all pumps in the pumping station, so itwill get closed when all pumps are switched off)

INTERLOCKS

i. EachV.T.pumpswillnotstartiflubricationsystemandcoolinghasnotstarted functioningand developed required pressure/ flow.
ii. Controlandmonitoringofpumpset

iii. All stators of motors shall incorporate three manually closed (NC) thermal high temperaturesensors. Should the high temperature occur; the thermal switches shall open, stop the motor andactivate the alarm

iv. Thermalswitches shall be provided for motor bearings and pumpthrust bearing. Should high temperature occur, there will be Audio visual alarm.

v. Vibration monitors shall be provided at motor, should any abnormality occur, there will be audio visual alarm.

Note: Theabovecontrolsareinadditionto theregularprotectionssuchasO/L,low voltage,SP,ReverseRotation,lowwaterlevel,motor notpickingupspeedin predetermined time etc.

2.23 Drawings/DatatobeSubmitted

The pump manufacturer shall submit the following performance curves and Data along with his technical offer as minimum

i PumpDischargev/sTotalHeadCurve

ii PumpDischargev/sPumpPowerInputCurve

iii PumpDischargev/sMotorPowerInputCurveat50Hz.

iv PumpDischargev/sPumpefficiencyCurvePumpDischargev/sNPSHR

v.FamilyPerformanceCurve

2.24 NPSHR

i) PumpDischargev/sOverallEfficiencyCurve

ii) MotorefficiencyatFullLoad

iii) MotorefficiencyatRatedDutyPoint

iv) MotorPowerfactoratFullLoad

v) MotorPowerfactoratRatedDuty Point

vi) NoLoadCurrentof Motor

vii) MotorCurrentatdutyPoint

viii) GAdrawingforthepumpofferedwithfoundationdetails.

ix) WeightofPumpsetandrequiredminimumcranecapacity.

x) Weightofcomponent/assemblyweighingmaximumduringassemblinganddismantling

xi) PerformanceParameters

The pump manufacturer has to declare the performance parameters separately as Guaranteed Performance Parameters. These shall include Discharge, Head, Pump Efficiency and Overall Efficiency.

2.25 TESTING:

Allthepumpsshallbesubjecttofactorytestinpresenceof Engineer-in-Chargeorhis representative and third party appointed for the purpose.

The contractor shall arrange all required test equipment duly calibrated, Field performance test shall be witnessed by authorities for initial condition.

2.26 TestingatManufacturer'sShop

Allthepumpsetsshallbetestedandapprovedfortheircompleteperformanceat manufacturer's work before dispatch as per ISO 9906, Grade 2.

Thetestingshallbedonewiththejobmotoratratedvoltage,frequencyandspeed.

Theperformanceofthepumpshallbetestedatmanufacturer'sworkbeforedispatch. Following parameters shall be checked during pump performance testing.

i) Head

ii) Discharge

iii) Powerinputtothemotor

iv) Voltage

v) Current

vi) Frequency

vii) BearingTemperature(wherevertemperaturesensorsforthe

bearings are provided)

viii) Noise

A) FACTORYTEST:

Reviewofrawmaterialstestcertificatesandqualitycontrolprocedure.

1) HydrostaticTest:

Followingitemsshallbesttestedathydrostaticpressureequaltotwicedutyheador1.5 times shut off head of bowl assembly whichever is higher as per IS: 5120.

(a) Bowlassembly

(b) Dischargehead/tee

(c) 20%quantityofcolumnpipes.

2) PerformanceTest:

Thetestshallgenerallybecarriedoutasper IS9137.Classpumpsacceptabletestfor pumpsclass-C. The test shall be carried out at full speed, full load at manufacturers work.

Thetestshallcoverminimum6points,i.e.,

(a) Dutypoint

(b) 2pointsabovedutypoint

(c) 2pointsbelowdutypoint

(d) Shutoffhead

(e) Powerconsumptionatallabovepoints

(f) ZeroreadingconfirmationforV.notch.

The test shall be carried out only by the job motor which will be supplied under thiscontract. The test at reduced speed and reduced load will not be acceptable.

StripInspection:

All the pumps after completion of its performance test and as selected by the Engineer or Inspector at random will be offered for strip inspection and dimensional checking. The manufacturer/ contactor shall submit all required dimensional drawings of strip inspection.

Minimumpointsasundershallbechecked.

Conditionofallcomponentsparticularlybushes,bearingsandwearingringstoexamine undue rubbing, wear etc.

Hardnessofcutlessrubberbearing Dynamic

balancing of

(a) Impellers

(b) Flexible coupling

Clearanceandtolerancesbetween

(a) Wearingrings

(b) Impellershaftandbearings

(c) Impellershaftandkey

(d) Shaftandflexiblecoupling

(e) Keyandkeywayonshaftat(d)

2.27 NUMBEROFPUMPSTOBETESTED

1) ALLpumpsmustbetestedbymanufacturerswithlabmotorforperformancetest and certificates to be furnishedto owner
2) Hydrotestforallpumpstobecarriedoutforallpumps/componentsbypump manufacturer and certificates shall be furnished for approval

3) Thematerialtestcertificatesshallbefurnishedbymanufacturerforallcritical components
4) One pump of each type shall be tested with job motor and shall be witnessed by client's representative. It includes performance test, hydro test, strip test,verification of material test certificates and balancing certificates If identical pumps are provided in other pump houses the owner will decide the actual number of tests to be witnessed
5) The actual number of witness tests will be decided by client after proposal are received and before order is finalised
6) The contractor shall intimate the time of inspection/tests at works sufficiently advance so that the tests may be witnessed by the employer.
7) The witnessing of tests shall, however, not relieve the contractor of his responsibilities to fully meet the requirements of the specifications and guarantees.
8) Testreportsshallbesuppliedtotheemployer.Noshipment/dispatchofanyportion of the equipment shall be made till the test certificates for the tests conducted at the factory are approved by the employer in writing.

B) **FIELDPERFORMANCETEST*:***

The test shall be carried out as per IS: 9137 code of acceptance test of pump Class-C, in general and as started below in particular.

The purpose of the field test is not to ensure whether pump performance as regards parameter i.e. H.Q. & power etc. within acceptance limit as per IS: 9137. The purpose is to ensure that the pump performance is generally acceptable or otherwise. Final acceptance shall be as per following criteria.

i) As regards H-Q characteristic for acceptance it shall be checked whether motor isnotgetting overloaded within the specified head range.

ii) Flow measurement shall be taken by the flow meter to be provided by contractor. Calibration certificate from approved Govt laboratory shall be submitted.

iii) The head shall be measure with calibrated pressure gauge of accuracy 1% or better. Atleast3pressuregaugesshallbegotcalibratedfromtwodifferentinstitutionswith prior approval of the Engineer- in-charge. The calibration shall be point to point and not mere for percentage error. The gauge shall be fitted at suitable place from the discharge nozzle. It may be noted that pressure gauge shall be installed at least 2 timesdiameterawayfromdischargenozzleanddeliveryvalvebeplacedatleastfour times diameter away from discharge nozzle. Such conditions shall be simulated at site condition and no allowance for this deficiency shall be considered. The decision of Engineer-in- Charge shall be final.
iv) The input power to motor shall be measured by 2 wattmeter method. The watt metersshallbeofLaboratorygradehavingaccuracyofmin.0.5%andtheseshould be digital type.
v) Thespeedshallbemeasuredbynoncontacttachometerwithdigitaldisplay calibrated. The field test shall be taken with entire head range in such a mannerthat

it would cover at least 6 points (i.e. duty point, 2 above duty point, 2 below duty point and shut off). The guarantee for head and discharge shall deemed to be fulfilled as per clause.

vi) Tocheckstartingcurrentofpump&motortoensurethatstartingcurrentisasper tender requirement.

vii) monitorPowerfactorofthepumpmotoronloadtoconfirmPFcorrectionisupto 0.95aspertender requirement

viii) Sound level and vibration level measurement as per IS or manufacture recommended parameter.

The field performance test at site is absolutely essential as above (i) to (viii) and the manufacturer shall also be asked to attend the same.

3.0 SPECIALTOOLS,SLINGS,CONSUMABLESETC.

3.1 All necessary special tools and devices such as lifting devices erection and maintenance c. shall be included in the offer. The contractor shall submit a list of the above special tools, slings etc. inthetender. Any special reamers and bracing equipmentforall workstobe done in field/site shall be provided by the contractor.

3.2 Oil for the first filling of the pump lubrication system etc. shall be included in the offer. The quantity and technical particulars/brand of the oil to be used for lubrication of the motor bearings shall also be specified in the bid.

4.0 SPARES

Spare parts for the pumps and other equipment's is to be supplied by the contractor. All spare parts furnished **s**hall be interchangeable with and of the same materials and workmanship as the corresponding parts of the equipment.

5.0 Paint& Finish

Allexternalandinternalpartsshallbefinishedandpaintedwithepoxypainttoproducea neat and durable surface which would prevent rusting and corrosion. The contractor shall mentiontheshadeandcodenumberofpainttobeusedTheequipmentshallbe thoroughly degreased, and sharp edges and scales removed and treated with one coat of primer and two coats of enamel paint

MaterialTestCertificateofthevariouspumpcomponentsshallbefurnishedbycontractor

Annexure –

ITECHNICALDATASHEET

Sl.No.	Parameter	UOM	Value
PUMPPERFORMANCE			
1	Manufacturer	-	
2	TypeofPump	-	
3	Model	-	
4	RatedDischarge	m3/hr	
5	RatedHead	m	
6	PumpEfficiencyatDutyPoint	%	
7	OverallEfficiencyatDutyPoint	%	
8	BkW	kW	
9	Shut-off Head	m	
10	MaximumDischarge	m3/hr	
11	HeadatMaximumDischarge	m	
12	MaximumInputtothePumpoverEntireOperatingRange	kW	
13	PumpInputatShut-off	kW	
14	PumpInputatMaximumDischarge	kW	
15	NPSHRatDuty Point	m	
16	NPSHRatMaximumDischarge		
17	MinimumSubmergencerequiredforSafeOperation	mm	
18	MaximumpermissibleLiquidtemperature	^{o}C	
19	Speed	rpm	
20	No.ofstages	-	
21	Maxoutsidedia.Of bowl	mm	

Annexurell

Sl.No.	Parameter	OFFEREDBY BIDDER
MATERIALOFCONSTRUCTION		
1	Pump Casing	
2	Impeller	
3	Glandpacking	
4	Shaft	
5	Motorcasing	
6	Columnpipe	
7	DischargeElbow	
8	Lineshaftbearing	
9	Shaftprotectiontube	
10	Fasteners	
11	Foundation/GroutingFasteners	
CONSTRUCTIONOFPUMPSET		
12	TypeofPumpCasing	
13	Typeof Impeller	
14	TypeofThrustBearing	
15	InstallationArrangement-Deliverynozzleabovepumpfloor	
16	Seal Arrangement	
17	MotorCoolingArrangement	
18	Typeoflubricationforthrust bearing	
19	Typeoflubricationforshaftbearing	

Note:Lubrication for line shaftbearingis external forcedwaterlubricationwhichismandatory for all the pumps.

Annexure–III

DECLARATIONONTHEPRODUCTOFFERED

Sl. No.	Description	Declaration		Remarks
		Yes	No	
1	Pump manufacturer.			
2	Impellerbalanceddynamically			
3	Sealingwithglandpacking			
4	LineshaftlubricationArrangement/Designas per Specifications			
5	Interlocksforlubricationsystemprovided.			
6	CoolingoftheThrustbearingprovided			.
7	Wearingringprovidedforimpeller			
8	Bearingsareprovidedasperspecifications			.
9	Installationaccessoriesexactlyasper specifications			
10	MotorisSquirrelCageinductiontypeHT/LT as per specs			
11	TemperaturesensorforCOOLINGWATER OUTLETOFTHRUSTBEARINGLOCATEDIN PUMP			
12	GlandLeakageoutletpipingprovided			
13	Alltheperformancecharacteristicsasper clauseenclosed.			
14	Testing Facility at Rated Voltage, rated Frequencyandratedspeedavailableat manufacturer's work.			
15	AllmotorscanbetestedforRoutineandType tests at manufacturer's works.			

6..GENERALTECHNICALREQUIREMENTS–MECHANICALEQUIPMENT

SubmergedCentrifugalPumpSet:

Technical Specifications of Wet Installed, Submerged Centrifugal Pump sets **Technical SpecificationsofWetInstalled,SubmergedCentrifugalPumpsets.**

1. ThepumpsetshallbeofCompactUnitaryconstruction.Thepumpcasingshallbe ofhigh efficiency, bowl or volute Casing type with the Impeller mounted directly onto the Extended Solid Motor Shaft *(without any couplings).*
2. Thepump set should be Single / two Stage type i.e. it should have only one / two impeller(S) & one / two Casing – Two stages shall not be allowed (except for heads>90m). Pump Casing shall be high efficiency, Centrifugal Volute type.
3. The pumps are to be installed directly into the water body *(Canal / Sump / River or unscreened*

Jack well), so itmaysuckuplot of silt, clay, pebbles & vegetation. Hence it should be reliable &robust.

6.1. INSTALLATION

6.1.1. SubmergedCentrifugalPumpispreferablewhereavailableheadismorethan 12m. The pumpsshouldalwaysbesuitableforVerticalorHorizontal; Permanent or Portable Installation & be interchangeable between these modes throughouttheir workinglife time *(by suitable use of base frames/ auto coupling systems).*

6.1.2 The detailedscope of supply& mode of installationshall be as per the specific tender data sheets orasper instructionsof theEngineer-in-Charge.

6.2 PossibleInstallationArrangements.

6.2.1 VerticalPermanent;i.e.AutoCouplingSystem.

a) The pump set should be coupledto the rising mains by an AutomaticCoupling Systemwithinbuiltintegrallycastbend.Theautomaticcouplingsystemshould havea pedestal (whichisboltedontosumpbottombypregrouted foundationbolts)whichis permanentlybolted on to the rising mains with Guide pipe Arrangement.

b) Auto coupling design should be such that the lifting chain's hook can be engaged to the pump'sliftinghookwithouttheneedformantoenterthewetsumpto engagethe same.

7.0 PUMPANDDESIGN

7.1 Speed

7.1.1 Toachievebestefficiency, reasonablecost&yetlonglife, thespeedofthePumpsetshouldbesuchthattheSpecificSpeed(N_S)ofthepumps*(calculated asperforSingle Stage,SingleSuctionImpellerpumpsassumingdutypointas the best efficiency point);*

shouldnot exceed:

- *58foruptoDN100,*
- *70forpumpsuptoDN200,*
- *87forpumpsuptoDN300,*
- *106forpumpsuptoDN400,*
- *116forpumpsuptoDN500&*
- *125forlargerpumps.*

Where $N_S = \frac{rpm \times (Q m^3/s)^{0.5}}{(H m)^{0.75}}$

7.1.2 In addition to 7.1.1; Motors > 113 kW &/or with Pump's duty point flow rate > 100Lps shall be limited to not more than 1450rpm.

7.2 Thepumpshallbecapableofdevelopingtherequiredtotalheadatratedcapacity forits continuousoperation.Pumpsofparticularcategoryshallbeidenticaland shall be suitable forparallel operation.

7.3 Theheadcapacity(H-Q)curveshallbecontinuouslyrisingtowardsshutoff withthe highestatshutoff.Theshutoffheadshallbeatleast120%ofthe specifieddutypoint head.

7.4.The Impeller shall be of high efficiency MultiChannelEnclosedtype *(except for Specific Speeds90whereSemiOpenImpellersshallbeallowable).*

7.5 SUCTIONSTRAINER

7.5.1 The pump is fitted directly with a Suction Bell mouth to which is compulsorilyfitteda Heavy duty Strainer *(to avoid pick up of gravel,pebbles, vegetation, etc.)*

7.5.2 SizingoftheSuctionStrainershouldbeasper theLargerofthetwo:

7.5.2.1 Atthe dutypointflow, theSuctionVelocity(atStrainer Holes),shouldneverexceed 3.0m/s.

7.5.2.2 Atthedutypointflow,thetotalcumulativeSuctionAreaofal ltheStrainer Holesshould always be2.0 times the Impeller's Suction Eye Area.

7.5.3 However Large & Slow Speed pumps*(with Solid Handling Ability75mm&of Speeds1000 rpm)* may be offered without Suc*tion Strainer.*

7.5 .4 *Thepump'sminimumthicknessofsuctionstrainer*&maximumholesizeofsuction strainer should be as per below mentioned chart.

Table1:DesignofImpeller&Strainer		
PumpDeliverySize	**MinThicknessof Suction Strainer**	**Max.PermissibleHoleSize of SuctionStrainer**
DN25,DN32&DN 40	2 mm	Notmorethan4mm
DN50&DN65		Notmorethan6mm
DN80		Notmorethan8mm
DN100		Notmorethan10mm
DN125	3mm	Notmorethan12mm
DN150		Notmorethan14mm
DN200	5mm	Notmorethan21mm
DN250		Notmorethan30mm
DN300&DN350		Notmorethan40mm
DN400&above	7mm	Notmorethan50mm

7.5.5 The pumpsetshallbesuitableforstartingwithdeliveryvalveopenas wellas closedatanyoperatingpoint.Themotorshouldalsostart accordingly.Thepump set shall be capable of withstanding the accidental rotation in reverse direction.

7.5.6 Complete Performance Curve, Data Sheets, GA drawings showing InstallationSizes shall be submitted along with the Technical Bid.

7.5.7 Pumphavinglessthanminimumguaranteedefficiencyi.e.84%arenot acceptable.

8.(SUBMERGED)INDUCTIONMOTORENDDESIGN

8.1 The motor shall be of Squirrel Cage, Induction type, Resin Filled yet capable of Water Immersionup to20mwcforS1duty with IP-68 Protection – MotorswithOilorWaterfilledwindingsshallnotbeallowed. Itshall complyto IS9283(2013).

8.2 **RatedVoltageforL.VMotor:415Volt,50Hz(-5%to+3%)**

8.3.

ItswindingshouldbeofClass“**H**”insulation*(*withstandingwindinghotspottemperatureofupto185°C.)*whilethenominaltempriseof windinghotspotshould not exceed that of class “B”.i.e 130°C

8.4 ItshouldbewoundusingDualCoated,SuperEnameled;Copperwirewith high temperatureindexasperI.S.4800Part-13.PVC/Polypropylene–polyethyleneinsulation for winding wires shall not be allowed.

8.5 Motor's Insulation should be Vacuum Varnish Impregnated & Oven Baked to ensure a MoistureImpervious&MechanicallyRobustinsulation.DiporPourtypeAirDryVarnishing shall not be allowed.

ThePowerratingofthemotorshallbethelargerofthefollowing:

8.5.1 Motorratingshallbebelow200KwasperIS-325andratedfor415Volts.

8.5.2 115%ofthepowerinputtothepumpatdutypointataspeedcorresponding to the frequency of 50 Hz.

8.5.3 105%ofthemaximumpowerinputwhileoperatingsoloorinparallelwithin maximum and minimum system resistances corresponding to the speed at 50Hz.

8.6 MOTORCOOLING:

8.6.1 Thepumpsaretobeinstalledhorizontally,themotorcanbecooledjustby water immersion i.e. no jacketing is required.

8.7 MOTORPROTECTION

8.7.1 Thermal Overload Protectors *(BiMetallicOverLoadsensors)* should beembeddedin eachphaseofthestatorwindingtodetectoverheating&tripthemotor fromthe controlpanel in the event of thetemperature exceeding the safe operating limit *(above 130°C).*

8.7.2. TodetectprimaryMechanicalSeal'sLeakageaMoistureSensorshallbe providedinintermediatelyOilChamber*(&notin theMotor casingorelsewhere)*

–thisshalldetectwatermixinginoilbymodeofincreasedleakagecurrent fromthe moisture sensor.

8.8 CABLES

8.8.1 A watertight Cable Junction Box sealed from the motor shall be provided for the motor power and signaling cables.

8.8.2 The cable shall be brought directly out of thesubmergedmotorwithout joints, andshall beofsufficientlength,minimum10mtobeterminatedinanIP 67 junction box outside adjacent to the wet well & above the HFL.
They shall be sized in accordance with the electricityutility regulationsandBS 7671.

8.8.3 It should have Power as well as Control Cables of Dual Sheathed EPRS / PVC Armored typewithCopperCoreofrequiredsizeasperdetailengineering. Howeverthe Cross Section of the cable shall be ample enough to ensure a Voltage Drop of not more than 2% at actual site conditions.

9. SHAFT&BEARINGS

9.1 TheSolidShaftshallbesupportedbyheavydutyBallorRoller bearingswithaminimum **L10** lifeof75,000hoursinaccordancewithBS 5512.

9.2 ThebearingsshouldbePermanentlyGreasedwithPremium Quality,High Temperature,LongLifeGrease-thebearingshouldbeof MetricSeries&not Imperial ones.

9.3 OilLubricatedbearingsshallnotbeallowed.

9.4 In casethemotoristo bedriven viaaVFD,at least oneofthebearings*(DE or NDE)*should be CurrentInsulated to prevent “electric fluting damage” caused byHarmonics.

10. STUFFINGBOX/OILCHAMBER

10.1 Thepressurizedentryofwaterintothemotor*(fromthepump’svolute casing)*shouldbepreventedbyTwoseparatemechanicalsealsinmountedin aTandem mode within an oil chamber.

10.2 ThePrimary*(Inboard)*sealshouldbeofSiliconCarbideorTungstenCarbide facesto withstanderosivewearduetoanysiltparticles.TheSecondary (Outboard)seal should beofCarbonv/sCastChromeMolybdenumSteelor SiliconCarbideorTungsten Carbide– i.e.ThermallyUnstablematerialslike Alumina/AluminumOxide shall not be allowed.

11. **ENERGYCOSTLOADING:**

11.1.1.Applicable

12. TESTING

12.1 The pump sets shall be tested at the in accordance of ISO 9906 or IS 9137 or IS 5120*(Tolerance Class 2);* with or without VFD

12.2 IncaseofMNCpumpmanufacturernothavingadequatetestingfacilitywithin reasonabledistance(i.e.decidedbytheareaofoperationof theTPI);thepumps shouldbetestedattheAlternativeFacilities&Internal TestCertificatesshallbe submitted for review to the TPI. The customer may demand Field Testing of such *(unwitnessed)* pumps within 30 days of installation which the contractor/manufacturer is bound to offer at no extra cost.

12.3.PumptestingshouldbecarriedoutpreferablywithVFD;incasethepumpsets areto beusedwithVFDthenthetestinghastobeconductedcompulsorily withVFD *(to ascertain compatibility with VFD)*

Table2:MaterialsofConstruction		
Motor Casing,Oil Chamber&otherparts	CastIron*(FG260asperIS210orGG25orEN-JL1040)*	
Motor Cooling Jacket*(ifapplicable)*	SS202or304	
MechanicalSeals	Faces: • Primary(Inboard):SiliconCarbidev/sSiliconCarbide or TungstenCarbidev/sTungstenCarbide • Secondary (Outboard) :Carbon v/s Cast Chrome MolybdenumSteelorSiliconCarbideorTungsten Carbide	
	Elastomers: • All"O"ringsofVitononly • &Bellows ofeitherVitonORNitrile	
Fasteners	StainlessSteelorHotDipGalvanizedBHTAlloySteel	
Pump (Bowl/Volute) Casing		
	a) PumpswithHeadratings>40 m b) PumpwithHead ratings<40m.	a) DuctileCastIronorCast Steel*(SG 400/12 or EN-JS1050orGGG40orWCB)* *b)* CastIron*(FG260asperIS 210 or GG25 or EN-JL1040)*
SuctionBell mouth& miscellaneouspumpparts	CastIron*(FG260asperIS210orGG25orEN-JL1040)*	
Impeller&WearingRings (Casing & Impeller)	CastAusteniticStainlessSteel*(SS316orCF8Mor1.4406)* orBronze	
Pump-MotorShaft	StainlessSteel(SS410orSS430or1.4021or1.4460)* **LargerMotors(i.e.200kW) may besupplied with High Carbon*	
SuctionStrainer	StainlesssteelAISI304.	
PortableStand*(ifapplicable)*	MS(C15)FabricatedwithEpoxyCoating	

DATASHEETFORDRYMOTOR,WETINSTALLEDSUBMERGED CENTRIFUGAL PUMP SETS

1.	Application	Submerged Centrifugal pump is used forWaterIntake/&mountedinSump/ CanalHorizontallydependinguponthe siteconditions
2.	Typeofmotor	Squirrelcageinductiontypewith IP68enclosure
3.	NameofPumpingStation	-------
4.	RatedFlow	--------
5.	RatedHead	-------
6.	Speed(asdictated by	-------- -
7.	RatedkW(Suitable for pump as per previously outlined	--------
8.	No.ofunits.	---------
9.	Supplysystemfaultlevel	50KAfor1Sec(LV)/25KAfor3Secs
10.	Supplyneutral	Solidly-
11.	Ratedvoltage/	415
12.	No.ofPhases &	3Phase&50Hz.
13.	Supplycondition	Clause-4oftheSystemConditions(designparameters)
14.	Dutyconditionasper IS	S1suitableforconstantoperation
15.	Methodofstarting	MicroProcessorSoftStarterORFCMA soft
16.	Startingtorque&P ull Out	Sufficientenoughtostartthepump with delivery valve open and when other pumps are running. Sufficient to bring themotortonormalspeedinminimum
17.	ClassofInsulation &temp.rise by thermometer	Class“H”butTemperatureriserestricted to that of class “B” i.e. 75°C
18.	Ambienttemperature	45°
19.	**a)** Type of Cooling b) Degree of protection	Surface cooled by circulation of waterthroughjacketshell. IP68
20.	Cable details	3¼Cores(minimum¼coresrequiredas Earth)

21.	Shaftorientation. Horizontal /	PumpsetshouldbeSuitableforAnyposition– i.e.VerticalorHorizontalorInclined
22.	Typeofbearings	Ball/Roller/ThrustAntiFrictiontype
23.	BiMetallicThermalOver Load Sensor for Windingrequired?	Yes,oneineachphase;fortrip,alarming and indicating set to trip @ 130 °C
24.	Bearing Over TemperatureDetectors	Required for motors > 113kWBy Bi Metallic OverloadThermalSwitchessettoTrip@95°C
25.	Windingconnections	6Terminals
26.	Standardstobefollowed	IS325,8225,4889,4772,4029,4691,IS-8034, IS-9283 and other relevant Indian Standard or equivalentBSS.TestingasperISO9906orIS
27.	P.IValueofMotor	P.IValueshouldnotbelessthan2.

TechnicalDataSheetofSubmergedCentrifugal Pump sets

(Tobesubmittedalongwiththebiddocum e n t s)

Sl. No	Description	Particular
1	MakeofPumpset	
2	Model	
3	DesignCapacity	m^3/hr
4	TotalHead	Mwc
5	ShutOffHead	
6	RatedSpeed&Supply Frequency	
7	Noof Stages	
8	NoofCasing	
9	PumpEfficiency@dutypoint	
10	bkW@dutypoint	
11	Maximum Pump Inputthroughoutthe	
12	RatedMotorEfficiency	
13	OverAllPumpsetEfficiency@ dutypoint	
14	MotorInput@DutyPoint	
15	MotorRating	kW
16	ClassofInsulationofMotor	
17	FillofMotor	Air/Oil /Water
18	TypeofBearings&itsratedL**10** life	
19	TypeofLubrication&itsrated Life	

20	CableSize& MoC	Power Cables	mm^2x _Coresx Runs ——mm^2x Coresx
		Control Cables	mm^2x_____Coresx Runs
		Conduct or	Al /Cu
21	Pump'sSuction&Delivery Nozzle size	mm & mm	
22	SuctionStrainerProvided	Yes/No	
23	MoCofMotorRotorShaft		
24	MoCofPumpCasing		
25	MoCofImpeller		
26	MoCofImpeller'sWearingRing		
27	MoCofCasing'sWearing Ring		
28	WeightofPumpset	Kg	

13.0 TECHNICALSPECIFICATIONOFH.TMOTORSFORVT PUMPS

13.1 The specification covers the design, manufacture, testing at manufactures works, supply, delivery, storage at site;erection, testing and commissioning of Squirrel cage induction motors complete with instrumentation controls and safety devices, equipment for the cooling water system, lubricating system oil, water piping with valves, fitting and other accessories at each pumping station asdetailed in the Schedule of Requirements and as described in the various sub sections of the specifications. The scope of supply shall include spares for 15 years of operation of the pumping station, special tools and testing devices, all parts accessories etc. which are essential for construction, operation and maintenance of all themotors even though these are nor individually or specifically stated or enumerated. Corresponding components of all the motors and associated equipment and spares shall be of the same material, dimensions and finish and shall be interchangeable.

13.2 The motor shall perfectly match in respect of speed, runaway speed, moment of inertia, overload capacities, couplings and any other requirement with that of pump.

13.3 Standards

Sl. No.	Standard	Description
1.	IS325	Squirrelcageinductionmotors
2.	IS4691	Typeofenclosures
3.	IS900	Codeofpracticeforinstallationandmaintenanceofinductionmotors
4.	IS6362	Methodofcooling
5.	IS4029	Testingofinductionmotors
6.	IS2223	Dimensionsofflangemountedasinductionmotors
7.	IS2253	Designationsfortypesofconstructionandmountingarrangementsof rotating electrical machines.
8.	IS2254	Designationsofverticalshaftmotorsforpumps
9.	IS:4722	Rotatingelectricalmachines
10.	IS:4728:1975	Terminalmarkinganddirectionofrotationforrotatingelectricalmachinery.
11.	IS:6362:1995	Designationofmethodsofcoolingforrotatingelectricalmachines.
12.	IS:7816:1975	Guidefortestinginsulationresistanceofrotatingmachines.
13.	IS:12065:1987	Permissiblelimitsofnoiselevelforrotatingelectricalmachines.
14.	IS:12075:1987	Mechanicalvibrationsofrotatingelectricalmachines
15.	IS:4889:1968	Methodofdeterminationofefficiencyofrotatingelectricalmachines.
16.	IS:12802:1989	Temperaturerisemeasurementofrotatingelectricalmachines.
17.	IS:12824:1989	Typesofdutyandclassesofratingforrotatingelectricalmachines.

13.4 TechnicalParameters

1.	MotorRating	Aspertherequirementof Pump.
2.	Typeof motors	Totallyenclosed CACA.
3.	Motorduty	Continuous,S1
4.	Supply voltage & frequency conditions	Voltage:6.6k.v+10%to -10% Frequency:50Hz+3%to-5% Any Combination of above
5.	Insulationclass	ClassFandtemperatureriseasperclassB
6.	StartingMethod	SoftStarter
7.	Cableterminationdetails	Alconductor,XLPEinsulated,armoured6.6kV(UE)grade cable. Cableterminationboxprotectionclass IP 55.
8.	Spaceheater	230Vspace heater
9.	Bearingtemperaturesensing	Required
10.	Windingtemp.sensing	6Nos.requiredforeach motor
11.	Earthingconductor	GIstripasperthesizesspecified

13.5 DesignCriteria

Rating&Temperaturerise

a) **A**llmotorsshallbeofcontinuousratedtype

b) The motors shall be designed for maximum ambient temperature of 50 deg. C; with the temperature rise of the stator winding by resistance method over the ambient air temperature no exceeding 70 deg. C for both class B and class F insulation.

c) Aircooledmotorsshallbedesigned

d) In case of continuous operation at extreme supply voltage variation limits, the temperature rise limits as specified above shall not exceed by more than 10deg. C for motors of output up to and including 200KW.±10%

e) Each motor shall be assigned a maximum continuous rating (MCR) corresponding to this temperature rise.

f) Wherever the basis for motors ratings are not specified in the corresponding mechanical specification sections, maximum continuous motor ratings shall be at least ten (10) percent above the maximum load demand of the driven equipment under entire operating range as specified elsewhere including voltage and frequency variation.

13.6 SupplyConditions

a. The rated supply voltage, voltage & frequency variations in the supply are mentionedelsewhere. Motors shall be capable of delivering its maximum continuous rating with supply variations. The motor can start, run and operate satisfactorily under the extreme voltage conditions at site.

b. Allmotorsshallbeso designedthatthemaximum inrushcurrents,andlocked rotorandpullout torques developed by them at highest voltage and frequency limits do not endanger the motor and the driven equipment.

c. Induction motors shall be designed to be capable of withstanding the voltage and torque stresses developed due to the difference between the motor residual voltage and incoming supply voltage equal to 150% of the rated motor voltage during changeover of buses.

13.7 Torquerequirements

a. The accelerating torque at any speed with the lowest starting voltage shall be at least ten (10) percent of rated full load torque of the motor.

b. Thepullouttorqueatratedvoltageshallnotbelessthan205percentofthefullloadtorque.

13.8 No.ofstarts

Continuous duty motors shall be suitable for two starts in successionand three equally spread starts in an hour under the specified conditions of load, torque and inertia, with the motor initially at its normal running temperature.

13.9 Startingtime

a) For motors with stating time up to 20 seconds at minimum permissible voltage during starting,thelockedrotorwithstandtimeunderhotconditionathighestvoltagelimitshallbe at least 2.5 seconds more than stating time.

b) For motors with starting time more than 20 seconds but not exceeding 45 seconds at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 seconds more than the starting time.

c) For motors with starting time more than 45 seconds at minimum permissible starting voltage, the locked rotor withstand time under hot conditions at highest voltage limit shall be more than the starting time by at least 10% of the starting time.

13.10 Control

All HT motors shall be suitable for control through circuit breaker specified in HT panelspecifications.

13.11 EnclosureandMethodofCooling

The motors shall be of totally enclosed closed air circuit, air cooled machine mounted heatexchanger (CACA).

13.12 VibrationLevel&Noise Level

Thevibrationsasmeasuredatmotorbearingsshallbewithinthelimitsspecified inIS:12075/BS: 4999 Part - 142. The shall also be capable of withstanding the vibration produced by the driven equipment. Noise levels shall comply with IS:12065.

13.13 ConstructionalFeatures

13.13.1 General

a) Motor and its components (such as stator, rotors, end shields, terminal boxes, bearings and heat exchangers) shall be designed to be readily interchangeable as integral units for the same design and rating.

b) Allnonmetalliccomponentsusedshallbeofresistanttoflamepropagation.

c) All enclosures shall be designed to provide an effective sealing between the primary and secondary air circuits. All totally enclosed type of motors shall have suitable means of breathing

d) The cooling fans shall be capable of being connected for rotation in either direction and due care for cooling etc.,.

e) Allheavypartsof themotors shallbe providedwithnecessary arrangements suchas lifting lugs/eye bolts for lifting or handling during erection or overhaul.

f) All motor rotors shall be dynamically balanced. Rotors shall be so designed as tokeepthecombinedcriticalspeedswiththedrivenequipmentawayfromtherunning speed by at least 20%.

g) Space heaters shall be provided on motors to maintain the windings in a dry condition during periods of standstill. The heaters shall be suitable for use on a 240 volts, 50 Hz A.C supply.

13.13.2 WindingandInsulation

a) Winding insulation shall be and class F for HT motors. It shall be of proven high quality and reliability.

b) ForHTmotorstheinsulationsystemofstatorwindingshallbeoftheepoxytype.

c) The slot and overhang insulation of windings of HT shall also be based essentially on mica. Windings of HT shall be provided with stress control and corona protection. The anti corona protection shall be adequately earthed and be resistant to damage due to abrasion or vibration.

d) All windings insulation shall be non-hygroscopic, oil-resistant to flame propagation. All windings shall be impregnated and suitably processed to effectively seal them to prevent deterioration from adverse environmental conditions at site.

e) Stator coils and rotor bars shall be tight fit in their slots. Any stator slot packing used for winding of HT motors shall comprise of material impregnated with a conducting medium and shall be compatible with the system of stress control.

f) Allwindingoverhangsandleadsshallbeadequatelysupported,bracedandblocked.

g) Casewindingandalljointsshallbedesignedtogiveanadequatesafetyfactoronthe fatigue due to thermal and mechanical stresses, taking into account the specified starting and running conditions. All electrical joints and connections shall be of brazed or welded construction.

h) All HV motors shall be capable of withstanding a 1.2/50 micro second surge test voltage as per relevant standard.

i) All HV motors coils shall becapable of withstanding high frequency over voltagetest as per relevant standard.

Thehighfrequencyrangeshallbemutuallyagreedupon.Eachcoilofmotorshall be subject to the above specified voltage wave before making the final connections between coils.

j) Each coil of the HV motor shall be capable of withstanding the surges with a wave shape of 0.3/3 micro second to check the inter turn insulation withstand capability against switching surges as per relevant standard.

k) TemperatureDetectors

At least six nos. of simplex or duplex platinum resistance type embedded temperature detectors, evenly distributed around the stator, shall be provided forall HT motors. These shall be located at locations where high temperatures are expected during operation. Resistance of the temperature detector at zero deg. C shall be one hundred (100) ohms. Temperature detector and detector leadinsulation class shall be the same as stator winding insulation call. Detector leads, external to the slotshall be provided with a protectivecovering. These RTDS shallbe wired to PLC controls for monitoring temperature rise.

13.13.3 Bearings

a) Bearings shall be of anti friction type. Vertical motors shall have rolling type guide and thrust bearing.

b) Flow of shaft currents through bearing shall be positively blocked. In the case of pedestal mounted bearings, both bearing shall be insulated, andan earth bonding link shall be provided at the driving end. The link shall be removable for insulationtesting.Where the bearingsatemounteddirectly in the motor end frames, the non drive end bearing shall be permanently insulated. It shall be possible to carry out maintenance without damaging the insulation.Alloilandwaterpopes,direct drivenoilpumps etc.shallbe insulated where necessary to prevent flow or any shaft current.

c) The bearings shall be designed to prevent ingress of dust and water shall be sealed against leakage of lubricant along the shaft. Sump-lubricating bearing shall be fittedwithtwooil rings,or other approved device running in oil bath of adequate capacity.

d) Temperature of lubricating oil as it leaves the bearing shall be not exceed 71 deg C.

e) AllHT motors bearing shall be provided with dial type thermometer with adjustable alarm contacts to monitor bearing temperature. Resistance temperature detector (RTD) shall also be provided, one (1) no. for each bearing. RTD shall be of duplex 3 wire type having 100 ohms resistance at zero degree centigrade.

f) Bearing shall comply with the relevant Indian or International Standards. The bearings housing shall be correctly packed with lithium based grease at the time of assembly. Construction shall be such that the bearings can be dismantled without risk of damage.

g) Lubrication shall be possible without removal of the guarding. All grease nipples, nipples, oil cups and dip sticks shall be readily accessible.

13.13.4 HeatExchangers

SuitableheatexchangershallbeprovidedforCACAmotors.Thespecialrequirementofventilation shall be provided considering site conditions and motor requirement, under various operating conditions

13.13.5 TerminalBoxesandAssociatedFittings

i) SeparateterminalboxeshavingIP55degreeofprotectionshallbeprovidedfor stator leads, RTD leads & space heaters,

ii) The cable boxes and terminations shall be designed to enable easy disconnection and replacement of cables. Leads from terminals to the windings shall be adequately sized and braced to withstand the heating and forces produced by maximum fault current. For single core cables, gland platesshall be of non-magnetic material.

iii) Terminals shall be suitable for receiving aluminum/copper conductor XLPE insulated cables. Motor shall be supplied with compression typetinnedbrass cable glands and Crimping type tinned copper lugs (conform to DIN 46329) for thetermination of cable. The neutral terminal block should be *phase segregated type*.

iv) A suitable provisionof releasing the pressure developed during faults shall be made. Terminal boxes shall be suitable for top and bottom entry of cables.

v) The distance between gland plate and the power terminal studs for HT motors shall not be less than 500 mm.

vi) HT motors Power terminal box as well as neutral terminal box shall have a phase separated construction. Motor terminal box shall be capable of being turnedthrough 180deg.

13.13.6 EarthingTerminals

Two independent earthingpoints shallbe providedinaccordancewith IS: 3043,onopposite sides of the motor for bolted connection.

13.13.7 RatingPlate

Inadditiontotherequirements ascalledfor GTC of Volume–IIandrelevantIS,therating plating plate shall indicate the following:

a) Maximum continuous ratting in KV and corresponding temperature rise, as applicable for cooling medium temperature specified in clause in 3.1

b) Bearing identification numbers (in case of ball/roller bearing and recommended lubricant.)

13.13.8 Paint& Finish

a) All external parts shall be finished and painted to produce a neat and durablesurface which would prevent rusting and corrosion. The equipment shall be thoroughly degreased, and sharp edges and scales removed and treated with one coat of primer and two coats of enamel paint shade no 692 as per IS :5. Motor fans shall also be painted.

b) All fasteners used in the construction of the equipment shall be either of corrosion resistant materialorheavy cadmium plate. Current carrying fasteners shall be either of stainless steel or high tensile brass or copper.

13.14 OUTPUTANDEFFICIENCYGUARANTEE

13.14.1 OutputGuarantees

The motor shall be guaranteed to be capable of giving its rated and maximum outputs without exceeding the temp. rise as defined in clause 3.0

13.14.2 EfficiencyGuarantees

The efficiency of the motor shall be guaranteed when delivering 100% of rated output at rated terminal voltages and for temp. limits of the windings specified above. The efficiency shall be determined according to IEC publication NO.34-2.

13.15 SPECIALTOOLS,SLINGS,CONSUMABLESETC.

All necessary special tools and devices such as lifting devices for stator, rotor, rotor pole and shaft, pedestalforstator/rotoretc.requiredforerectionandmaintenanceofthemotor,etc.thetender. Any specialreamersandbracingequipmentforallworksto bedoneinfield/sites hallbeprovidedby the contractor.

Oil for the first filling of the motor lubrication system etc. shall be included in the offer. The quantity and technical particulars/brand of the oil to be used for lubrication of the motorbearings shall also be specified in the bid**.**

13.16 SPARES

Spare parts for the motors and other equipments to be supplied by the motor contractor including excitation equipment, voltage regulator and unit control boards. All spare parts furnished shall be interchangeable with and of the same materials and workmanship as the corresponding parts of the equipment.

13.17 TESTINGDEVICESANDINSTRUMENTSFORTESTINGDURINGASSEMBLY/ERECTIONATSITE AND FOR ACCEPTANCE TESTS

All devices and instruments required for site testing of the motor and other associated equipment shall be provided by the contractor.

Similarly all instruments and devices required for the field acceptance tests for fulfillment of efficiency, output and temperature rise guarantees shall be provided by the contractor onreturnable Basis.

AdetailedlistoftheabovedevicesandinstrumentsshallbefurnishedwiththeBid,

13.17.1 TESTS

General

The tests on the motors and associated auxiliary equipments shall be carried out in accordance with the detailed schedule to be approved by the employer.

i. During manufacture, all necessary inspections and tests shall be made to the satisfaction of the employer so as to ensure the quality of materials, workmanship and adequacy of design and test reports/data shall be furnished for approval of employer.
ii. On completion of erection work at site, all equipments shall be tested to the satisfaction of the employer to demonstrate that the plant complies in every way with the specificationthat all guarantees have been met with and that equipment is suitable for commercial operation.
iii. Thecontractorshallintimatethetimeofinspection/testsatworkssufficientlyinadvanceso that the testsmay bewitnessed by the employer.The witnessing of testsshall,however,not relieve the contractor of his responsibilities to fully meet the requirements of the specifications and guarantees.
iv. Test reports shall be supplied to the employer. No shipment/dispatch of any portion of the equipment shall be made till the test certificates for the tests conducted at the factory are approved by the employer in writing.

RoutineTests

Following routine tests/checks on major components and accessories shall be carried out at workson each motor.

i. HVTestonstatorcoilsandstator sections.

ii. Staticfluxtestonunwoundstatorframeandcore assembly.
iii. Trialbuildupofrotorrim.
iv. Shaftassembly.
v. Calibrationofoverspeeddevices.
vi. Insulation,resistance testsforstatorandrotorwindings,bearings& embeddedtemperature detectors.
vii. Testsonexcitation&regulationequipment.

a) Measurementofresistances.

b) Measurementofinsulationresistances.

c) Visualinspection&wiringcheck.

d) Functionalchecksofelectronicmodules.

viii. Additionaltests,ifany,requiredforjudgingtheperformanceofmotoranditsauxiliaries.

TypeTests

The following type tests on the first completely assembled motor (of individual rating) and associated auxiliaries shall be carried out at work :

1) Temperaturerisetest.

2) DielectricTests

3) Excesscurrenttests.

4) Efficiencytests

5) Linechargingcapacity.

6) Bearingcurrents.

7) Determinationofcharacteristics.

8) MeasurementofDCresistanceofarmatureandfieldwinding.

9) Momentofinertiaofrotatingparts(GD^2)

10) Shortcircuitratios

11) Runawayspeedtest

12) Phasesequencetest

13) Testonstaticexcitationandregulationequipments.

i) Opencircuitsaturationcurve

ii) Heatruntodeterminethemaximumtempriseatratedandmaximum output .

iii) Excesscurrenttestatratedfullload.

iv) Adjustmentandcheckingofoverloadcomputation

v) Testtodeterminespeedofresponse.

vi) Teststodetermineceilingvoltage.

14) Inadditiontoabove,testsshallbecarriedoutonC.Ts,andallother auxiliaries.

Testsatsite

Thefollowingtestsshallbecarriedoutatsite:

1 Measurementofstatorwindingresistanceandrotorwindingresistance.

2 Measurementofstatorandrotorwindinginsulationresistance.

3 Alignmentofmotorrotorandpumpshaft.

4 Plvalueofmotor(Plvalueshouldnotbelessthan 2)

5 Automaticstartandstop test.

6 Quickandemergencystoptest.

7 Checking and commissioning of various other auxiliary equipments as per relevant standards.

8 Checking/testingofvariousotherauxiliaryequipments.

AcceptanceTests

Thefollowingacceptancetestsatsiteshallbeconductedbythecontractor.

i) VibrationTests

ii) BearingTemperatureTests

iii) Noise

However, the employer reserves the right to call on any third party to made field tests to determine whether any of the motor purchased under this meets the specification guarantees of efficiency, temperature rise, output etc. in such case the contractor shall cooperate and shall assume full responsibility for the operation and safety of their equipments during these tests.

DRAWINGANDDATA

Thefollowingdrawinganddatashallbesubmittedwiththetender.

1. The general arrangement and overall dimensions of motor showing position of main and neural leads, important elevations etc.

2. Drawingshowingthrustbearingandguidebearingassembliesetc,

3. Drawingshowingarrangementofaircoolers,airducts etc.

4. Diagramoflubricatingsystem,braking/jackingsystem.

5. Physical and schematic drawings of excitation system, automatic voltage regulator equipment, field discharge equipment and descriptive literature.

6. GraphsshowingpredictedcharacteristicsoftheMotor.

7. General layout drawing showing overall dimensions and layout and relative position of all auxiliaries, ducts, spaces for cables and piping, cooling water system etc.

SCHEDULEOFREQUIEMENTS

Vertical shaft induction motors complete with stator, rotor, and shaft having conventional type bearings in accordance with the specification. Each motor will be complete and equipped as follows (as per motor manufacturer's design):-

i) Anti-condensationheatersforthestatorwinding.

ii) Forced / Hydrostatic lubricating system complete with necessary pipe work, valves, filter, pump set etc. for lubrication of the bearings.

iii) Plugintypeoilcoolersforthe bearings.

iv) 1 set. Sole plates, foundation bolts, bolts, dowels etc. required for proper erection, leveling, alignment etc. of motor.

v) 1 set. Platform, stairs, walkways, handrails etc. for access to the bearings, slip-rings etc.

1SetCommon equipment

Equipment&devicescommonforallthemotorforeachPumpingStation:

i) Setofsparesfor15yearsoperationforallthemotors&associated auxiliaries.

ii) Setofspecialtools,slings&erectiondevices,consumablesetc.

iii) Setoftestingdevices&instruments.

iv) Equipmentforfieldacceptancetests(on-returnablebasis.)

All other items as covered in the specifications or required forcompleteness of the aboveequipments.

13.18 GuaranteedTechnicalspecifications/Data

The contractor may furnish all the data related to guaranteed technical specifications and relevant data

13.19 Erection

The work of erection of motors and its alignments with the pump including laying of foundations, grouting, Doweling and painting etc. shall be done by the Contractor at his own cost as per General and Misc. specifications' mentioned.

13.20 EmergencyStopSwitches

Emergency stop switches near the motors should be provided for switching off the motors in case of emergency**.**

13.21 Testing

One motor of each rating shall be type tested and all motors shall be routine tested at the supplier's works in the presence of engineer in charge or his representative. In addition to the above, shop tests and site tests should also be conducted on motors. The Schedule for Part-I, Part-II, Part - III and Part - IV for each of above tests i.e. type tests, routine tests, shop tests, and site tests follow as below.

TypeTestsOnMotors-Part – I

i. Noloadrunningofmotorandreadingofvoltage,current,powerinputandspeed.

ii. Reducedvoltage running up testat no load tocheckthe abilityofmotortorun upto full speedon no load in eachdirections of rotation with 1/√3 of rated line voltage applied to the statorterminal.

iii. Locked rotor readings of voltage, current, power input, and values and torque of motors. **(Note : This test may please be made at a reduced voltage.)**

iv. Fullloadreadingofvoltage,currentpowerinputandslip.

v. Temperaturerisetest.

vi. Momentaryoverloadtest.

vii. Insulationresistancetest(bothbeforeandafterthehighvoltagetest)

viii. Vibrationtest.

ix. Highvoltagetest.

x. Testtodeterminelosses&efficiencies.

RoutineTestOnMotors-Part-II

i. Insulationresistancetest.

ii. Highvoltagetest.

iii. No.loadrunningofmotorandreadingofcurrentinthethreephasesandvoltage.

iv. Lockedrotorreadingofvoltage,currentandpowerinputatasuitablereducedvoltage.

v. Reduced voltage running up test at No load to check the ability of the motor to run upto fullspeedon NO load, ineachdirectionofrotation, with1/√3 ofthe ratedLinevoltage applied to the stator terminals.

ShopTestsOn Motors-Part -III

i. Line out of motor and pump shafts including and fixing of coupling bolts and checking of bearing faces.

ii. Overrun test.

iii. Vibrationtest.

iv. Motorframedimensionalcheckandgeneralappearancecheck.

v. Generalappearanceofmainshaftanddimensionofthesame.

vi. Insulationresistance,dielectricandcoilresistancetestsofpoles.

vii. Dimensional check and general appearance check after assembly of complete motor andassembly of pump with motor.

viii. Efficiencytest.

ix. Measurementofairgaplength.

x. Highvoltagestest.

xi. Teststodeterminelossesandefficiency.

xii. Heat run test to determinethe temperature rise ofvarious parts including windings, bearings etc. of the motor when the machine is in operation continuously at the rated and over load output.

xiii. Dielectrictestofmotorwindings.

SiteTestsOnMotors- Part- IV

i. Measurementofresistanceofwindings.

ii. Insulationresistancetest(Before&afterH.V. test)

iii. Highvoltagetest.

iv. Measurementofairgap.

v. Noloadtest.

vi. Over-runtest

The motor and pump is to run continuously for 72 hours at full load and temperature of variousparts including winding, bearing etc. are to be observed. This test is to be carried out on each pump separately and measurement of discharge at rated head is to be measured.

i. Losses and efficiency of pump set are to be carried out on any two motors selected by theEngineer.

ii. Measurementofinsulationresistanceofwindings.

iii. Alignmentofmotorandpump shafts.

iv. Vibrationtest.

14.0 TECHNICALSPECIFICATIONOFL.TMOTORSFORVT PUMPS

14.1 The specification covers the design, manufacture, testing at manufactures works, supply, delivery, storage at site;erection, testing and commissioning of Squirrel cage induction motors complete with instrumentationcontrols andsafety devices,equipment , lubricatingsystem oil,The scope of supply shallincludesparesfor5yearsofoperationofthepumpingstation,specialtoolsandtesting devices, all parts accessories etc.which areessentialfor construction,operationand maintenance of all the motors even though these are nor individually or specifically stated or enumerated. Corresponding components of all the motors and associated equipment and spares shall be of the same material, dimensions and finish and shall be interchangeable.

14.2 The motor shall perfectly match in respect of speed, runaway speed, moment of inertiaoverload capacities, couplings and any other requirement with that of pumpMotor shall be designed for utimate requirement of head and flow.

Standards

Sl.No.	Standard	Description
1.	IS325	Squirrelcageinductionmotors
2.	IS4691	Typeof enclosures
3.	IS900	Codeofpracticeforinstallationandmaintenanceofinduction motors
4.	IS6362	Methodofcooling
5.	IS4029	Testingofinductionmotors
6.	IS2223	Dimensionsofflangemountedasinductionmotors
7.	IS2253	Designationsfortypesofconstructionandmounting arrangements of rotating electrical machines.

8.	IS2254	Designationsofverticalshaftmotorsfor pumps
9.	IS:4722	Rotatingelectricalmachines
10.	IS:4728:1975	Terminalmarkinganddirectionofrotationforrotating electrical machinery.
11.	IS:6362:1995	Designationofmethodsofcoolingforrotatingelectrical machines.
12.	IS:7816:1975	Guidefortestinginsulationresistanceofrotatingmachines.
13.	IS:12065:1987	Permissiblelimitsofnoiselevelforrotatingelectrical machines.
14.	IS:12075:1987	Mechanicalvibrationsofrotatingelectricalmachines
15.	IS:4889:1968	Methodofdeterminationofefficiencyofrotatingelectrical machines.
16.	IS:12802:1989	Temperaturerisemeasurementofrotatingelectrical machines.
17.	IS:12824:1989	Typesofdutyandclassesofratingforrotatingelectrical machines.

TechnicalParameters

1.	MotorRating	AspertherequirementofPump.
2.	Typeof motors	TEFC
3.	Motorduty	Continuous,S1
4.	Supply voltage & frequency conditions	Voltage:0.415kV+10%to -10% Frequency:50Hz+3%to-5% Any Combination of above
5.	Insulationclass	ClassFandtemperatureriseasperclassB
6.	StartingMethod	StarDeltaupto50kW SoftStarterforAbove50kW
7.	Cable termination details	Alconductor,XLPE/PVCinsulated,armored1.1kVgrade cable. CableterminationboxprotectionclassIP 55.
8.	Spaceheater	230Vspace heater

9.	Bearingtemperature sensing	Required
10.	Winding temp. sensing	6Nos.requiredforeach motor
11.	Earthingconductor	GIstripasperthesizesspecified
12.	Efficiencyclassmotor	IE-2(Minimum)

14.3 DesignCriteria

14.3.1 Rating&Temperaturerise

a) Allmotorsshallbeofcontinuousratedtype

b) The motors shall be designed for maximum ambient temperature of 50 deg. C; with the temperature rise of the stator winding by resistance method over the ambient air temperatureno exceeding 70 deg. C for both class B and class F insulation.

c) In case of continuous operation at extreme supply voltage variation limits, the temperature rise limits as specified above shall not exceed by more than 10^{o} C for motors of output upto and including 200 KW.±10% .

d) Each motor shall be assigned a maximum continuous rating (MCR) corresponding to this temperature rise.

e) Wherever the basis for motors ratings are not specified in the corresponding mechanical specificationsections,maximumcontinuousmotorratingsshallbeatleastten(10)percentabove the maximum load demand of the driven equipment under entire operating range as specified elsewhere including voltage and frequency variation.

f) The rated supply voltage, voltage & frequency variations in the supply are mentioned elsewhere. Motors shall be capable of delivering its maximum continuous rating with supply variations. The motor can start, run and operatesatisfactorily under the extreme voltageconditions at site.

g) All motors shall be so designed that the maximum inrush currents, and locked rotor and pull out torques developed by them at highest voltage and frequency limits do not endanger the motor and the driven equipment.

h) Induction motors shall be designed to be capable ofwithstanding the voltage and torque stresses developedduetothedifferencebetweenthemotorresidualvoltageandincoming supplyvoltage equal to 150% of the rated motor voltage during changeover of buses.

14.3.2 Torquerequirements

a. Theacceleratingtorqueatanyspeedwiththelowestartingvoltageshallbeatleastten (10)percentofratedfullloadtorqueofthemotor.

b. The pull out torque at rated voltage shall not be less than 205 percent of the full loadtorque.

14.3.3 No.of starts

Continuous duty motors shall be suitable for two starts in succession and three equally spread starts in an hour under the specified conditions of load, torque and inertia, with the motor initially at its normal running temperature.

14.3.4 StartingCurrent

The ratio of starting Current/rated current (MCR corresponding to the specified temperature rises) shall not exceed 6.

14.3.5 Startingtime

a. For motors with stating time upto 20 seconds at minimum permissible voltage during starting,thelockedrotorwithstandtimeunderhotconditionathighestvoltagelimitshallbe at least 2.5 seconds more than stating time.

b. For motors with starting time more than 20 seconds but not exceeding 45 seconds at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 seconds more than the starting time.

c. For motors with starting time more than 45 seconds at minimum permissible starting voltage, the locked rotor withstand time under hot conditions at highest voltage limit shallbe more than the starting time by at least 10% of the starting time.

14.3.6 Control

Allthemotorsshallbesuitableforcontrolthroughcircuitbreaker/MCCBasspecified.

14.3.7 EnclosureandMethodofCooling

ThemotorsshallbeoftotallyenclosedFanCooled,(TEFC).

14.3.8 VibrationLevel&NoiseLevel

Thevibrationsasmeasuredatmotorbearingsshallbewithinthelimitsspecifiedin IS:12075/BS:4999Part-142. The shall also be capable of withstanding the vibration produced by the driven equipment. Noise levels shall comply with IS:12065.

14.3.9 ConstructionalFeatures

a) Motor and its components (such as stator, rotors, end shields, terminalboxes, bearings and heat exchangers) shall be designed to be readily interchangeableas integral units for the same design and rating.

b) Allnonmetalliccomponentsusedshallbeofresistanttoflamepropagation.

c) **A**ll enclosures shall be designed to provide an effective sealing between the primary andsecondaryaircircuits.Alltotallyenclosedtypeofmotorsshallhavesuitable

means of breathing and of drainage to prevent accumulation of from condensation. Drain holes diameter shall not exceed 6mm.

d) The cooling fans shall be capable of being connected for rotation in either direction or due car for cooling etc. Specially where identical motors are to be provided for opposite direction of rotation, such as for a pair of conveyor without replacing or removal of fans or any other parts.

e) Motors shall preferably be capable of being connected for rotation in eitherdirectionwithduecareforcoolingetc.,speciallywhere identicalmotorsaretobe provided for opposite direction of rotation, such as for a pair of conveyor without replacing or removal of fans or any other parts.

f) All heavy parts of the motors shall be provided with necessary arrangement: such as lifting lugs/eye bolts for lifting or handing during erection or overhaul.

g) All motor rotors shall be dynamically balanced. Rotors shall be so designed as to keepthecombinedcriticalspeedswiththedrivenequipmentawayfromtherunning speed by at least 20%.

h) Spaceheaters

Internal electric heaters shall be provided on motors rated above 30 KW. Tomaintain the windings in a dry condition during periods of standstill. The heaters shall be suitable for use on 240 volts, 50Hz a.c. supply.

j) TemperatureDetectors

At least six nos. of simplex or duplex platinum resistance type embedded temperature detectors, evenly distributed around the stator, shall be provided forall HT motors. These shall be located at locations where high temperatures are expected during operation. Resistance of the temperature detector at zero deg. C shall be one hundred (100) ohms. Temperature detector and detector leadinsulation class shall be the same as stator winding insulation call. Detector leads, external to the slotshall be provided with a protectivecovering. These RTDS shallbe wired to PLC controls for monitoring temperature rise.

14.3.10 Windingandinsulation

a) Windinginsulationshallbe ofclassBorbetterforLTACmotors.Itshallbeofproven high quality and reliability.

b) All windings insulation shall be non-hygroscopic, oil-resistant and resistant to flame propagation. All windings shall be impregnated and suitably processed to effectively seal them to prevent deterioration from adverse environmental conditions at site.

c) Allwindingoverhangsandleadsshallbeadequatelysupported,bracedandblocked.

d) Cage windings and all joints shall be designed to give an adequate safety factor on thefatigueduetothermalandmechanicalstresses,takingintoaccountthe

specified starting and running conditions. All electrical joints and connections shall be of brazed or welded construction.

14.3.11 Bearings

a) Bearings shall be of roller type, except where motor speed and shaft loading dictate otherwise. Vertical motors shall normally have rolling type guide and thrustbearings. The latter may however be of Kingsbury tilting pad type where heavy axial loads are to be supported.

b) Temperatureoflubricatingoilasitleavesthebearingshallbenotexceed71degC.

c) Bearing shall comply with the relevant Indian or International Standards. The bearings housing shall be correctly packed with lithium based grease at the time of assembly. Construction shall be such that the bearings can be dismantled without risk of damage.

14.3.12 TerminalBoxesandAssociatedFittings

i) The cable boxes and terminations shall be designed to enable easy disconnectionandreplacementofcables.Leadsfromterminalstothewindingsshallbeadequately sized and braced to withstand the heating and forces produced by maximum fault current.

II) TerminalsshallbesuitableforreceivingaluminumconductorXLPE/PVCinsulated cables. Motor shall be supplied with compression type tinned brass cable glands and Crimping type tinned copper lugs for the termination of cable. The termination lugs shall conform to DIN 46329.

III) Clearance between the lugs/bare live parts of different phases and between lugs/bare live parts and earth shall be as per relevant standard. The terminal boxes shall be capable of withstanding a system fault level. A suitable provision ofreleasing the pressure developed during faults shall be made. Terminal boxes shall be suitable for top and bottom entry of cables.

IV) LTmotorterminalboxshallbecapableofbeingturnedthrough 360deginstepof90 deg.

14.3.13 EarthingTerminals

TwoindependentearthingpointsshallbeprovidedinaccordancewithIS:3043,onopposite sides of the motor for bolted connection.

14.3.14 RatingPlate

In addition to the requirements as called for in relevant IS, the rating plating plate shall indicate the following:

a) MaximumcontinuousratinginKWandcorrespondingtemperaturerise,asapplicable for cooling medium temperature as specified.

b) Bearingidentificationnumbers(incaseofball/rollerbearingandrecommended lubricant.)

14.3.15 Paint& Finish

a) All external parts shall be finished and painted to produce a neat and durablesurface which would prevent rusting and corrosion. The equipment shall be thoroughly degreased, and sharp edges and scales removed and treated with one coat of primer and two coats of enamel paint shade no 631 as per IS:5 for indoor motors and shade 632 as per IS:5 for outdoor motor. Motor fans shall also be painted to withstand corrosion.

b) All fasteners used in the construction of the equipment shall be either of corrosion resistant materialorheavy cadmium plate. Current carrying fasteners shall be either of stainless steel or high tensile brass or copper.

14.3.16 TESTS

a) All motors shall be subjected to routine tests. For all LT motors, type test report of the tests conducted in identical motors within last five years from the date of Latter of Intent shall be furnished. However for motors not type tested in the last five years, type tests need to be performed without any extra cost.

b) The tests shall be carried out as per applicable standards including all special tests. The list of routine tests and type tests are given below.

RoutineTest

a) VisualCheck

i) Markingonratingplates

ii) Appearanceandpainting

iii) Locationanddetailsofterminalboxesandaccessories

iv) Checkforphasesequenceandterminalmarkings

b) DimensionalCheck

c) Measurementofresistanceofwindingsspaceheater

d) Noloadtest

e) Lockedrotortest(Foraltheratingsofmotorsasper IS:4029)

f) Reducedvoltagerunningtestatnoload

g) Overspeed test

h) Vibrationmeasurementatratedspeedandratedvoltage

i) DegreeofprotectiontestforIP54&IP55enclosure

TypeTest

The following type tests on the first completely assembled motor (of individual rating) and associated auxiliaries shall be carried out at work

a) Allthetestsaslistedunderroutine tests

b) MeasurementofNoiseatnoload.

c) Momentaryoverloadtest

d) Fullloadtest

e) Pullouttorquemeasurement

f) **D**egreeofprotectiontestsfortheenclosurefollowedbyIR,HVandnoloadruntest.

g) Faultlevelwithstandtestforterminalbox.

h) MeasurementofNoloadstarting time.

When tests to determine the breakaway starting current of cage induction motors are taken atreduced voltage, due allowance shall be made for the effect of saturation and the estimated value of breakaway starting current at rated voltage shall be given on all test certificates.

COMMISSIONING CHECKS Commissioning checks should be carried out asper IS:900 and other relevantstandards.

MOTORPERFORMANCE			
1	Model	-	
2	RatedOutput	kW	
3	RatedVoltage	Volts/KV	
4	RatedCurrent	Amps	
5	RatedFrequency		
6	RatedPowerFactor At full Load AtDutyPoint At75%Load	-	

	At25%Load		
7	RatedSpeed	rpm	
8	Efficiency AtfullLoad AtDutyPoint At 75% Load At25%Load	%	
9	PermissibleVoltagevariation		
10	DOLStartingCurrent	Amps	
11	MaximumAmbientTemperatureforContinuous Operation	^{o}C	
13	PowerFactoratStarting	-	
14	MaximumTemperatureRiseatFullLoad	^{o}C	

15.0 DRAINAGEPUMPS

15.1 Thepumpsshallbedesignedfordutiesof30cubicmeter/hr.TWOpumpsareprovidedineach sump pump.

The pump set shall be single stage, submersible type, mono block, volute type driven by squirrel cage induction motor. The motor shall be an integral part of the pump set. It shall be a totally sealed unit suitable for completely as well as partially submerged condition. The pump shall operate continuously (S1 duty) even if the water level in the sump is low(motor portion not in submerged condition). The pump shall be suitable for reverse rotation and shall not have any adverse effect on the operation of mechanical seal orany other component.

Pump Casing

The pump casing shall be Gray Cast Iron asper ASTM – A 48 no.35 B/ EN1561-GJL-250 or FG260 as per IS 210 The pump casing shall be pressure tested at pressure twice the duty point pressure or 1.5 times theshut-off pressure, whichever is maximum. However, the minimum pressure shall be 10 kg/cm2.

Impeller

It shall be made of high chrome stainless steel grade CD4MCu as per ASTM A 351 orequivalent having hardness 220-270 BHN or more

Fasteners

All fasteners exposed fasteners exposed to pumping media shall be of stainless steelgrade AISI 304 / AISI 316 / Grade A2 of ISO 3506 or better.

Sealing

Each pump shall be provided with a tandem bi-directional mechanical shaft seal system consisting of two totally independent mechanical seal assemblies. The seal shall operate in a buffer fluid that lubricates and cools the seal.

MotorCoolingSystem

Motorsshallbedesignedtobecooledbythesurroundingpumpingmedia.

WearRing

A wear ring system shall be used to provide efficient sealing between the volute and suction inlet of the impeller

Theimpellerwearingringsshallbeofstainlesssteel,heat-shrinkfittedontothesuctioninletofimpeller.

Bearing

The pumps shall be provided with one support roller bearing and one two row angular contact ball bearingas main bearing.

Shaft

ItshallbemadeofASTM/AISI431.

SuctionStrainer

Each pump shall be supplied with a suitable stainless steel strainer at the suction of the pump set to keepthe coarse solids away from the pump set.

InstallationAccessories

Forpermanenttype installation,the pumpshallbeautomatically andfirmly connectedtothefloor/base.For transportabletypeofinstallationasuitablestand/baseframetypeofarrangementshallbeprovidedinsuch a way that in no case the pump will tilt.

Eachpumpsetshallbeprovidedwiththesuitablelengthofstainlesssteelliftingchain.

Motor

The motor shall be dry type squirrel cage induction motor suitable for the offered pump set. The rating ofthemotor shallbeherequiredpowerovertheentirepumpoperatingrangeAlso,themotorshallbesuitable for minimum 8 starts per hour.

Construction

It shall be submersible type with degreeof protection IP 68. The motor shall be designed for operation up to 40^0C ambient.

OperatingVoltageandFrequency

Themotors%shallbesuitableforoperationon415V,3phase,50HzJunctionBox.

Protections

All stators shall incorporate three normally closed (NC) thermal switches in series to monitor the temperature of each phase winding. Should high temperature occur, the thermal switches shall open, stop the motor and activate alarm.. Control and Monitoring

PerformanceParameters

The pump manufacturer has to declare the performance parameters separately as Guaranteed Performance Parameters. These shall include Discharge, Head, Pump Efficiency and Overall Efficiency

SECTIONV-B

ELECTRICALWORKSOFTHEPUMPINGSTATION

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9.0 ELECTRICALWORKSOFTHEPUMPINGSTATION

9.1 DESIGNCRITERIAFORELECTRICALEQUIPMENT

9.1.1 Introduction

The'DesignCriteria'ofelectricalequipmentcoverstheequipmentfor **MegaLiftIrrigationProject.**

9.1.2 GeneralPowerDistributionScheme

9.1.2.1 LoadRequirement

Thefollowingassumptionsshallbemadetoarriveattheloadrequirementofwaterpumpingstation

a. LoadFactor

I. Mainmotor : 0.9

II. Auxiliaryloadvalvemotors, etc : 0.9

III. Lightingload : 1.0

b. DiversityFactor

i. Mainmotor : 1.0

ii. Auxiliaryload,motorsetc : 1.5

iii. Lightingload : 1.20

iv. Power Factor of H.V. Motors : AsperManufacturers Catalogue

c. Efficiency of H.V. Motors : AsperManufacturersDataSheet (GTP)

d. PowerFactorofL.V.Motors : -do–

e. EfficiencyofL.V.Motors : -do–

f. Efficiency of Distribution transformer : -do-

(Note: Combined efficiency of Pump & Motor will not be less than 0.8)

9.1.3 PowerSupplyScheme

The source of power supply to pumping stations will be through dedicated 33 kV overhead lines from identified EHT Grid Substations and/ or connectivity with 33 KV DISCOM networks in an integrated manner.

9.1.3.1 6.6kVmainPumpmotors

Power supply shall be met from MSDSS having at least two 33K.V/6.9 K.V transformers of suitable ratings in pool concept model that shall supply to the project. It will have a station transformer of 33/.433 KV of suitable rating. Sizing of power transformers shall be based on logic mentioned at clause 6.0 of section-VII-A.

9.1.3.2 0.43kVmainPump motors

PowersupplyshallbefromDSS(6.6K.V/0.433K.Vor33K.V/0.433K.V)ascasemaybe,havingat

leasttwoTRFsofsuitableratings.Distributiontransformershallbesizedbasedonlogicmentionedat clause 6.0, section-VII-A. Further short circuit capability of DSS should be adequate to meet the starting impact of largest motor.

33kV system	*:*	*25KAfor3secorasperthefaultlevelcalculationstobe submitted by the bidder (whichever is higher).*
6.6kV system	*:*	*25KAfor3secorasperthefaultlevelcalculationstobe submitted by the successful (whichever is higher).*
0.433kVsystem	*:*	*50KAfor1secorfaultlevelcalculationstobesubmittedby the bidder (whichever is higher).*

a. While the power for mainHT pump motors issupplied at 6.6kV, for otherauxiliary loads such as DesiltingPumps,ButterflyValves,DewateringPumps,exhaustfans,lightingetc. shallbesupplied at 415 V (3 phase, 4 wire) through station Auxiliary transformer.

b. Power factor correction capacitors shall be provided and their capacity shall be adequate to correct the power factor of motors up to 0.95 at full load. "Design & economic location ofreactive power control" in 6.6 KV system whethergroup compensation at 6.6 KV bus and/or at individual 6.6KV motor end, is atechnologyplatform to bedecidedonstudies atdetailed engineering stage.

C.Suitablemeteringfacilityshallbeprovidedformonitoringpurposes.

d.Whereverthe33/0.433kVtransformer ratingisabove1000kVAbusductshouldbeused.

9.1.4 Protections

ALL the Protective relays including IDMT over current & earth fault, REF, motor protection relaysshall be numeric type only.Protection scheme for system connectivity shall comply with***Odisha Grid Code*** issued by OERC.

9.1.4.1 33kV Incomer

i. Inversetimephaseovercurrentrelays

ii. Inversetimeearthfaultrelay.

iii. Instantaneousovercurrentrelays

iv. Instantaneousearthfaultrelay

9.1.4.2 PowerTransformers

H.V.side(33KV)

i. TransformerBuchholz/gaspressure/OilSurgerelaywithalarmandtripcontactsasapplicable on Transformer capacity & shall comply with relevant ISS.

ii. Winding&Oiltemperatureindicatorswithalarmandtripcontacts

iii. DropoutFuse/breaker,basedontransformercapacity.

L.V.side(6.9 KV)

i. Inversetimephaseovercurrentrelays

ii. Inversetimeearthfaultrelay.

iii. Instantaneousovercurrentrelays

iv. Instantaneousearthfaultrelay

v. Restrictedearthfaultrelay(willtrip33kV Breaker).

vi. Standbyearthfaultrelay(willtrip33kV Breaker).

Distribution/AuxTransformers:

H.V.Side(33KVor6.6KV)

i. Transformer Buchholz/gas pressure/Oil Surge relay with alarm and trip contacts as applicable on Transformer capacity & shall comply with relevant ISS.

ii. Winding&Oiltemperatureindicatorswithalarmandtripcontacts

iii. DropoutFuse/breaker,basedontransformercapacity.

L.V.side(430V)

430V L.V.incomershall be provided withMCCB .All theother feederswill beprovided withMCCB's /MCB's.UnlessotherwisespecifiedtheSFUs/FSUsarenottobeprovided.

9.1.4.3 Motors

Motors(MainPumpMotors)

Comprehensivemotorprotectionrelayconsistof,

i. Thermaloverloadprotectionfortrip.

ii. Lockedrotorprotectionfortrip.

iii. Shortcircuitprotectioninallthethreephases.

iv. Instantaneousunbalancesinglephasingprotection.

v. EarthfaultrelayconnectedtocorebalanceC.T.fortripincaseoffaultinCapacitors.

vi. TemperaturemonitoringbyRTDelementsembeddedinstatorwindingsandbearing temperature indicators provided on both the bearing (with separate temperature scanner).

9.1.5 Metering

Thefollowingmeteringshallbeprovided.

a. Incomers(6.9kV)

i. Ammeterswithselectorswitch

ii. Voltmeterwithselectorswitch(InPTcubicle)

iii. Frequencymeter.

.

b. MainTransformers(33KVSide)

i. Ammeterswithselectorswitch

ii. Voltmeter

c. MotorFeeders:

i. Ammeterinallthethree phases

ii. MultifunctionMeterwithRS485port.

d. L.T.Incomer

i. Ammeterinallthethree phases

ii. Voltmeterwithselectorswitch

9.1.6 Switchgear

M.V.Switchgear(6.6kV,indoor)

M.V. switchgear shall be of sheet metal enclosed indoor type.Incoming and other outgoing feeders shall be provided with draw out type vacuum circuit breakers. The degree of protection for switchgear shall be IP4X for indoor installation.

M.V.indoorswitchgearcircuitbreakersshallbesuitablefor110VD.C.controlpowersupply.

a) L.V.Switchgear(indoor)

i. 415 V Power control centers, power distribution boards etc. shall be of fixed, compartmentalized Single front construction, excepting circuit breaker modules which shall be of draw out type and single front construction.

ii. ThedegreeofprotectionforswitchgearshallbeIP4X.

9.1.7 H.V.Motors(200KW& above)

a. MainPumpInductionmotorsshallbesuitablefor6.6kVthreePh,47.5-52.5Hzsupply.

b. H.V. motors shall beclosed air circuit air cooled (CACA) type. Temperature rise for air cooled motors shall be limited to $70^0$by resistance method for both class B and F insulation.

c. At least six resistance typetemp. detectors for the stator winding, each having D.C. resistanceof 100 Ohms at 0°C, embedded in the stator winding at locations where highesttemperaturesmay be expected shall be provided for H.V. pump motors.

d. H.V. pump motors, bearings shall be provided with dial type thermometers having two separate NO contacts, for alarm / tripping of the motor.

e. Each motor shall be provided with start/stop facility near the motor as well as on the panel, however, no power isolation near motor is envisaged.

9.1.8 Cables

The H.V. Power supply from main sub-station to the equipment shall be done by using aluminiumconductor,XLPEinsulated,PVCsheathedandarmouredtype.TheL.V powercables shall be aluminium/ copper conductor, XLPE insulated, and armouredtype.The controlcables shall be copper conductor only, minimum 2.5 sq.mm PVC insulated. PVC sheathed and armoured type. The cable above 4 sq.mm. should be of Aluminum Conductor.

a. Cable shall be flame retardant, low smoke (FRLS) type as per relevant IS/IEC. All HV power cable sizesshallbebasedoncontinuouscurrentcarryingcapacity (withdueconsiderationto de-rating factors), permissible starting (limiting to 15% drop) & running voltage drop (limiting to 5%drop) and short circuit rating of the system (25 KA as per technical specification).Cable sizeshall be calculated on fault clearing time of 0.5 second (breaker opening time).

b. ForL.V. incomers and L.V. outgoing Motor feeders, the fault clearing time shall be 0.5 second but the cable will be selected for short time rating of 1 sec.
MinimumandmaximumsizeofcableshallbeasperIS: 1554.

c. Rating factors for variation in ground temperature, variation in ambient air temperature, grouping of cables, depth of laying etc. shall be based on the cable manufacturer's recommendations/catalogues.

e. Motorstarting&permissiblevoltagedips:-

- Voltage dip on starting of largest LT motor shall be limited to 15% of nominal voltage at the motor terminal.
- Maximumallowablevoltagedropinanyfeederundersteadystateconditionshallbe maintained:-
  - Totalvoltagedropduringrunning: -6%
  - LTSStoMotor:-6%
  - LTSStoMCC:-2%
  - MCCtoMotor:-4%

f. The Bidder shall submit computer based software studies for selection of size for HT & LT Powercable.

9.1.9 D.C.PowerSupply

a. AsetofmaintenancefreerechargeablesealedleadacidbatteriesofadequateA.H.capacityshall be provided for control of H.V. switchgear in pumping stationsas well as 2 hours ofemergency lighting in main operating area and shall comply with relevant CEA General Guide lines for Substations & Switchyard and Relevant CEA Regulations.

b. Batteries shall be provided with float cum boost battery charger incorporating indicating lamps and annunciations.

c. AsectionalizedDCDBwithincomersshallbeprovided.

9.1.10 SafetyEarthing&LightningProtection

a. The soil resistivity of the plant area has not yet been measured. The same should be carried out during detailed engineering by successful bidder.

b. After soil resistivity measurement; length of conductor, no. of earth electrodes and no. of test pits shall be finalised.

c. Thematerialofearthingconductorswillbeasgivenbelow:

i. Conductors shall be Galvanised steel to prevent atmospheric corrosion The minimum rate of corrosionofsteelusedforearthingconductorshallbeconsideredas0.12mm peryearwhile determining the conductor size.

d. The maximum values of the earth fault current for the design of the earthing system shall be considered as below:

i.	33kV system	:	25kAorasperSubstationspecifications.
ii.	6.6kV system	:	25kA
iii.	415Vsystem	:	50KA

e. Faultclearingtimeforsizingtheearthingconductorshallbetakenasthree(3)seconds.

f. Maximum allowabletemperatureriseforsteelweldedjointswillbetakenas500°Candambient temperature as 50 ^{0}C.

g. Plant earthing system will be designed such that overall earthing resistance is less than one (1) ohm.

h. In case of different electrical systems operating at different voltages in an area/plant, the main earthing conductor for each system shall be decided on the basis of maximum fault current in that system.Earthingsystem fordifferentsystemsshallbe interconnectedby interconnectorsof maximum size conductor.

i. In outdoor sub-station area, main earthing conductors will be planned for most economic earthing of the equipment, keeping the potential gradients at earth surface within maximum allowable limit.Step and touch voltages shall be within permissible limit.Main earthing conductors in outdoor areas shall be buried min. 600 mm below finished ground level.Earthing

conductor around the building shall be buried in earth at a minimum distance of 1500 mm from the outer boundary of the building. Earth mat design shall be submitted at the design stage.

j. Main earthing conductors inside the building will be planned such that various equipment is connected to earthing system in most economical and reliable manner.

k. Earthingconductorsshallbeprovidedaroundtheoutsideedgeofswitchyardfenceatadistance of approximately 1000 mm and every alternate fence post shall be connected to the grid by one lead and gates by flexible braid to the earthed post.

l. Minimumadequatespacingbetweenrod/pipeelectrodesshallbeprovided.

m. The detail earthing calculation furnishing the step potential(Vs) and the touch potential (Vt)for outdoor switchyard should be carried out during detailed engineering by successful bidder.

9.1.11 PowerFactorImprovement

a. Capacitors for motor shall be provided with manual switching across motor terminals toimprove power factor up to 0.95.

9.1.12 SafetyClearances

Clearancesinelectricalroomsshall be:-

S.N	Clearance	Min.Distance(inmm)
1	Back clearance	1200
2	Frontclearancebetweendrawout/semidrawout panel boards	2500
3	Betweentwopanelboardsinstalledinarow	1000
4	Betweenfrontofpaneltothewalloftheroom	2000
5	Betweenthewallandendoftheswitchgear/MCC	1000
6	Backtoback clearance	1500
7	Backtofrontclearance	2000

Note:Inanyothercases,thelayoutshallconfirmtoprovideclearancesasper CEA(Measures relating to safety and Electric Supply) Regulations, 2010.

9.1.13 AutomationSystem

The project shall have automation system that shall provide advanced visualization and system control for quality & reliability. ***The outlet management system (OMS)Central control unit & SCADA has to be provided in PLC room of pump house***

1. General Philosophy:

Adequate and appropriate automation shall be designed and engineered using state-of-art and field proven technology to facilitate monitoring, control and all other functions associated with operation of pumping unit through user-friendly human-machine interface (HMI).

The automation system shall be designed with geographical & functional distribution of hardware in a multi-level hierarchy, viz. Level-0, Level-1 etc as applicable, to meet specific site requirements for monitoring, control, visualization & optimization of all major drives in the scheme unit.

The automation system shall be structured in general, considering the following hierarchical levels:

- Level-0:This level is also called field level. It is functionally responsible for generation, transmission & conversion of signal for input to the higher level equipments as well as signal based activation for the final control/ operation. Primary sensing elements, proximity switches, converters, microprocessors based intelligent system etc, are in domain of this level.

- Level-1: This level, also called supervisory level, is functionally responsible for supervision of the individual process equipment & function, control, visualization and regulation, guidance & optimization and control of process parameters to the desired level of perfection based on signals generated from field level.

  This level is also responsible for processing of signals for generating compatiblecontrol commands to control the process parameters by activation of the final control elements. This level is realized based on controllers & systems, input systems, data based units, data communication, visualization system (HMI stations) and interface units for connectivity to the other levels of automation system. In addition to routine MIS functions, advanced process optimization functions comprising special control algorithms,mathematicalcomputationsetc.willbeabletopermitdistributionof

controlanddataacquisitionfunctionsthroughouttheentirepumpingstations (Scheme).

TheLevel-1automationshallbasicallycomprise:

- AprogrammableLogicController(PLC)basedautomationsystem.

Modesofoperationshallbe:

A. Local: Localcontrol Station(LCS) shall be provided forall motors/ drives& shall have requirednumbersofpushbuttonsforoperationofdrives.HVmotorsshallbeprovided with hard-wired interlocking in MCC. However for fail safe operation, potential free contactofpushbuttonfromLCSandapotentialfreecontactoffieldsafetysensorshall be hard wired to MCC for safety reason. Drive cannot be started if the selector switchis in OFF position.

B. Remote: In remote mode, the equipment can be started from control room only. This mode is further divided into following three modes:

- Operatormode.
- Automode.
- Computermode

Oncetheremotemodeofoperationisselected,thenfromHIMwiththehelpofKey board/ mouse/soft keys above three modes of operation can be selected.

2. ApplicableStandards:

IPSS: 2-07-015-88	Modularprogrammablelogiccontrollers.
IPSS: 2-07-016-88	Specification for panels.
IPSS: 2-07-030-88	Guidelinesforapplicationsoftwaredocumentation.
IPSS: 2-07-036-93	Guide for supply of computer hardware manuals.
IS: 10118(Part 1to4)-1982	Code of practice for selection, installation and maintenance of switchgear and control gear.

IS:13947(Part1,5)-1993	LVswitchgear&controlgear.
IS: 12021-1987	Specification for control transformer for exceeding 1000 Volt AC.
IS: 8623 (Part 1)- 1993	Specification for low voltage switchgear & control gear assemblies.
IEC1131-2	SpecificationforProgrammableControllers.

Automation shall cover all specified aspects in the Bid document Section V-A (Technical Specification for Pumps & Electro-Mechanical works), Section V-B (Electrical works of the pumping Station). If any part, whole of specific aspect of equipment is not being covered under the above standards; the bidder shall specifically bring out such aspects to DoWR. Otherwise, the successful tenderer shall be liable to abide by the specific requirementof the purchaser at detailing stage without any additional cost to the Purchaser.

3. BasicParameters:

I. Memory

Typememory	CMOS/Ram(Min.16MB)withNi/CdorLibackupbattery foramin.Periodof24 hours.
Memorysizefor user	Ensurethat50%sparespacewillbeavailable.Itshall beprogrammerpossibletoaddmemoryincrementally if required later.

II. Processing Unit: The CPU will be 32/64 bit microprocessor. It will be modular construction and be plug-in type. It will be able to perform logic processing, timing counting, latching, comparing, retrieve, storage and arithmetic functions.

III. Minimumspeedacceptableis8Mbps.

IV. HMI:

EachdrivecanbecontrolledthroughHMI.HenceHMIshallbecapableoffollowing

- Displayingstatusinformationofalldrives/systemetc.

- Commandexecutionforstart/stop,settingofparametersforthesystem
- Reportgeneration
- Datalogging
- DynamicgraphdisplayofmimicSystemoverview
- Realtime/historytrendingetc,
- Eventloggingofcommands,parameterschangeetcexecutedfrom HMI.

V. Communication: Each motor controller unit shall communicate on the communication bus (Device net/ Mode bus/ Pofibus) with PLC directly or through data concentrator or any equivalent module/ converter.

Thecommunicationprotocol(bus) forMCCandpackagePLC shallbe same foreaseof communication.

9.1.14 Outletmanagementsystemwithcloudbasedcontrolsystem

1. Introduction:

OUTLETMANAGEMENTSYSTEM(OMS)WITHROTATIONMANAGEMENTSYSTEM(RMS)

Outlet Management System(OMS) should be provided at every approximate 20 Ha chak outlet and should be capable of measure, monitor and control the flow and pressure remotely from control centre. The distribution of water beyond outlet management system shall be carried by providing rotation management system capable to control approximate 2 Ha. by providing automatic ON/OFF valve suitable of 0.55 lps for ON/OFF as per need remotely from control centre. Further manual ON/OFF valve to be provided for every 1 Ha. Theoutletmanagementsystemandrotationalmanagementsystemshouldbeprovidedwith protective enclosure which shall not interfere in radio based communication and is to be approved by CE&BM,RBVN Basin, Brahmapur

All air valves on Rising main/Pressure main/Distribution system shall be provided in protectiveenclosureandshallhave remotepressuremonitoringsystemwithvandalismalert system.

The pumping system SCADA shall be capable of synchronizing with Cloud based control system used for outlet management system and rotational management system, Air valve monitoring system for smooth working of entire water distribution network. The radio frequency based RTU should be on license free band.

FiltrationSystem

PrimaryFiltrationSystem

The Primary Filtration system shall be at pumping station with multiple location at rising main or pressure main or branch distribution. The system shall be Online Automatic screen Filter with self-cleaning mechanism of 200 micron suitable for Project total flow rate along with isolation butterfly valve and manifold etc. completed (Primary Filter) as per relevant Indian or International standard and as directed by Engineer-in-Charge.

1) MinimumFlowRate:0.813LPS/Ha
2) FiltrationDegree:200Micron
3) SelfCleaningMechanism:ActivatedbyDifferentialPressureintheSystem.
4) NoofUnits-equalstonumberofPumpsorasperdesignrequirement.

The automatedfilterunit shouldconsistof heavy-duty automatic filters withself-cleaning mechanism and should be capable to a filter design discharge of pump. It should have capability to work for 22 hours continuously per day without any obstruction due to cleaning operation. It should be installed on the delivery side of Pump after the Pump Control Valve.

9.2. GENERALREQUIREMENTS–ELECTRICALEQUIPMENT

9.2.1 General

It is not the intent to specify herein all the details pertaining to the design, drawing, selection of equipment/materials, procurement, manufacture, installation, testing & commissioning, however, the same shall be of high standard of engineering and shall comply with all currently applicable standards, regulations & safety codes.

9.2.2 ScopeofWork

The scope of this specification covers establishment of Electrical System of Pump House to receive Power supply and distribute to Pumps.

The scope shall include, Design, engineering, manufacture, testing, and supply on FOR destination site basis, including transportation & insurance, storage, erection, testing and commissioning of the following equipment/items, complete in all respects:

- 33/6.9kV,33/0.43kV&6.6/.43Power/DistributionTransformers
- 33KVoutdoorswitchgear&indoorControl panel
- 6.6kVIndoorSwitchgearandcontrolpanels
- Softstarters
- Battery,Batterycharger&DCDB.
- 415VPMCC,ACDB
- 6.6kVPowerCablesandterminations
- LTpowercablesandcontrol cables.
- Marshallingkiosks/junctionboxes.
- Illuminationsystemincludinglightingpanels,poles,lightingfixtures&accessories.
- EquipmentEarthing&lightningprotectionforSubstation/Pumping stations through earth mate of adequate design.
- Cabletrays,supports,clamps&accessories
- Cableglandsandlugsforallthe cables.
- Miscellaneous items like Danger boards & other sign boards, rubber mats, Fire buckets, etc.

9.2.3 QualityAssurance,Testing&Inspection

All materials, components and equipment covered under this specification shall be procured, manufactured, erected, tested, and commissioned at all the stages, as per approved Quality Plan & from approved vendor.

All tests shall be conducted as per relevant IS/IEC/IEEE standards and shall be performed in the presence of Owner's representative, if so desired by the Owner. The contractor shall give at least 15 days advance notice from the date when the tests are to be carried out.

Equipment offered shall be of type tested and proven type. Type test certificates for test conducted earlier on similar rating shall be furnished. Routine tests shall be carried out for all the equipment as per applicable standards.

Copies of certified reports of all tests carried out at the works shall be furnished. The equipmentshall be dispatched from works, only after receipt of Owner's written approval of the test reportsand issuance of Material Dispatch Clearance Certificate (MDCC).

Routine tests & Acceptance tests shall be conducted for all the equipment in accordance with the agreed quality plan and as per the latest version of applicable IS for all the equipment. The charges for carrying out all the routine tests shall be deemed to be included in the bid price.

The general QA requirement is attached; the vendor is advised to go through the same before submitting the bid.

9.3 SoftStarter

9.3.1 Scope

It is a unitized equipment of proven design with valid type tests for both reactor & softstarter panel (short circuit & temperature rise test) from the approved soft starter manufacturer. The specification covers the design, manufacture, testing at manufactures works, supply, delivery, storage at site; erection, testing and commissioning of Soft Starters completewithinstrumentationcontrolsandsafetydevices.Thescopeofsupplyshallinclude spares for 5 years of operation of the pumping station, special tools and testing devices, all parts accessories etc. which are essential for construction, operation and maintenance ofthe switchgear even though these are nor individually or specifically stated or enumerated. Corresponding components of the Switchgearand associated equipment and spares shall be of the same material, dimensions and finish and shall be interchangeable. **The motor soft starter design shall be as per the IS 5553 [part 3] / IEC 60289/076 working on the principle 'series Reactor for current limiting of 3 Phase motor '**

9.3.2 TechnicalParameters

1.	Rating	SuitabletoMotor rating
2.	Connection	NeutralSide/LineSideAsperManufacturers recommendations for HT Motors LineSideforLTMotors
3.	TPbusbardetails	HighConductivityAluminiumgradeE91EforTP bus bar. Copper bus bar can be proposed.
4.	Max.Temp.ofbusbar	40^0Coverambient
5.	BypassDevice	VacuumContactor/breakerforHTandContactor /BreakerforLT
6.	CTdetails	Castresin,barprimarytype,1ACT
7.	Winding(incaseofnonelectronicsSoft Starter)	ClassofInsulationH&Temp.Riserestrictedto insulation Class B
8.	Core(Starter)	Siliron

9.3.3 OtherConsiderations

1. The Soft Starter for Pump motor will be of proven type and shall be installed on Line or Neutral side of H. T. Motor and on line side of LT motor.
2. The Soft starter shall be designed for Supply Voltage Variation of +10% to -10%& Frequency variation ± 5 %.
3. The Soft Starter shall be rated corresponding to the Motor Power & shall be capable of Operating satisfactorily with the Motor under the various loading & starting condition of the Motor over the entire Operating Range. The Soft Starter rating offered shall not be less than the rated KW of the Motor.

4. The Soft Starter shall reduce the starting current of the motor at least to 60% of the direct line starting current of the motor. The Soft Starter shall have a facility to further reduce the current if the motor & pump torque speed curved permit so. Calculation for reactance / impedance required to limit starting current shall be submitted accordingly it shall be measured during factory inspection.

5. The Soft starter shall control the starting torque in such a manner so as to effect smooth starting of the Motor Drive is achieved.

   Further line current reduction should be [if required] achieved by the use of dynamic compensator. *For further system current reduction a dynamic compensator [asper IS 13925] can be used to reduce the current up to 1.5 X FLC. Separate dynamic compensator foreach motor shall be provided.* **USE OF LOW VOLTAGE CAPACITORS FOR MEDIUM VOLTAGE / HIGH VOLTAGE SOFT STARTERS IS NOT ALLOWED.**

   MEDIUM VOLTAGE / HIGH VOLTAGE SOFT STARTERS SHOULD NOT HAVE ANY LOW VOLTAGE POWER DEVICES AS A PART OF KEY COMPONENT OTHER THAN CONTROL SWITCHGEAR.

6. The Soft Starter shall be providedwith suitably rated ammeter to indicate themotor current during starting.

7. The Soft Starter shall be so rated as to allow at least three starts equally spaced per hour or one hot start.

8. ThecontrolsupplytotheSoftStartershallbe110V.D.C

9. The Soft Starter shall be housed in a sheet steel enclosure of thickness not less than 14gauge and painted with corrosion resistive paint such as epoxy or Polyurethane. The Soft Starter Panel shall have an integral 300 mm high-fabricated pedestal to prevent water ingress.

10. Soft Starter unit shall have anti – condensation heater, complete with switch andthermostat. The heater shall have interlocking in such a way that it is switched 'OFF' when motor is in run mode.

11. SoftStarter shall have a built in facility for run mode bypass so that the incoming voltage to the motor is equal to the supply voltage.

12. The Soft starter shall be provided with specially programmed and calibrated PLC to control the starting process of motor through soft starter. PLC should monitor the complete starting process for errors, healthiness, and operational sequence of soft starter.

13. PLC should provide current based close loop starting process and should not work on timer based open loop control.

14. PLC should be equipped with enough digital and analog ports to control the complete soft starting process and continues monitoring.

15. TheminimumbutnotlimitedtoparameterstobemonitoredbyPLCare:

- interlockfailwithexternaldevice
- dooropen
- overtemperature
- numberofstartsandconsecutivestartlimit
- bypassdevicefail
- longstartingtime
- prematurecurrentfault
- numberofstartsandtimeforlifecycleofsoftstarter
- energysavingcalculationsandperformancecurveplottingetc.

16. The interface for soft starter should be through capacitive touch screen HMI of IP 65 Grade of 5.7" or higher size with at least 16 shade colour display or better.
17. The HMI should be capable of displaying all errors, warnings, status messages with accept and reset facility.
18. The HMI should be capable of plotting the starting performance curves along withenergy saving calculations with minimum 200 previous start histories.
19. completePLCconfigurationshouldbepossiblethroughHMI
20. The Soft Starter shall have suitable hour meter and operation counter for counting motor running hours & counting no. of start–stop operations of the motor.

9.3.4 Testing:

9.4.4.1 ShopTest

- Physicalinspectionfordimensionalcheck.
- Controlcircuitoperationcheck
- Insulationresistancetestbeforeandafterhighvoltagetest.
- Highvoltagetest.
- Temperaturerisetestforbypassdeviceatratedmotorcurrent.
- StartingCurrentmeasurement

9.4.4.2 SiteTest:

- Insulationresistancetest.
- Controlcircuitoperationtest.
- Testtodemonstrateachievementofstartingcurrentasperspecifications.

9.4 HTIndoorSwitchgear

9.4.1 Scope

The specification covers the design, manufacture, testing at manufactures works, supply, delivery, storage at site; erection, testing and commissioning of 6.6 kV Switchgear complete with instrumentationcontrolsand safetydevices.The scope ofsupply shall includespares for5 yearsof operation of the pumping station, special tools and testing devices, all parts accessories etc. which are essential for construction,operation andmaintenance of theswitchgeareven though these are nor individuallyorspecifically statedor enumerated. Corresponding componentsof theSwitchgear andassociatedequipmentandsparesshallbeofthesamematerial,dimensionsandfinishandshall be interchangeable.

9.4.2 Standards

Sl.No.	Standard	Description
1.	IS9920/9921	ACDisconnectors
2.	IS13118	GeneralrequirementsforCBforvoltagesabove1000V.
3.	IS3427	MetalenclosedSwGr& Cont.Gr(forV>1kV&<11kV).
4.	IS2516	Circuitbreaker
5.	IS2147	Degreeofprotection
6.	IS1248	ElectricalIndicatingInstruments.
7.	IS722	IntegratingACelectricmeters.
8.	IS2705	Currenttransformers.
9.	IS3156	Voltagetransformers.
10.	IS9046	ACcontactorsofvoltagesabove1kV,uptoandincluding 11 kV.
11.	IS5621	Insulators
12.	IS3231	ElectricRelays
13.	IS8686	Specificationforstaticrelays
14.	IS5082	Wroughtaluminiumandalloybars,tubes,rodsforElectricalpurpose.
15.	IS9385	HVfuses
16.	IS10118	Installationandmaintenanceofswitchgear.
17.	IS9431	Indoorpostinsulatorsoforganicmaterial
18.	IS11353	Guideforuniformsystemofmarkingterminals
19.	IEC-TC-73WG-4	Metaloxidesurgearresters

Sl.No.	Standard	Description
20.	IS375	Marking and arrangement for switchgear bus bars main connections and auxiliary wiring.
21.	IS5621	Insulators

9.4.3 Otherrequirements

1.1 Main panel shall be sheet steel dust & vermin proof indoor floor mounting type H.T. panel with bus bars, suitable for system voltage and duties specified for each stage completely assembled, wired, tested and painted with rust proof paint conforming to relevant I.S. The panel shall comprise of following incoming breakers. The degree of protection should be IP-52. Panel should have valid type tests including type test for bought out items.

9.4.4 Incomingbreakershallconsistoffollowing.

1. 6.6 kV 3 phase, 50 Hz draw out type Vacuum circuit breaker with A.C. motor charged spring closing mechanism and facility for remote operation.
2. 3 Nos. Three core current transformers of ratio rated **/1/1/1A one core for metering Class-I accuracy, 15 VA burden, Second core for protection class - 5P-10, 15 VA burden and Third coreof class PS.
3. 3Nos.singlephases,doublecorepotentialtransformerstobestar/starconnectedwithratio. 6.6 kV /√3 / (110V/√3). Core 1 will be Class - I accuracy and 100 VA burden and other for protection class 3P.
4. Trip,neutral,close,circuitbreakercontrolswitch.
5. IndicationlampsforON/off/AutoTripSpringChargedindication,ratedfor110VoltsD.C.
6. White indication lamp for trip circuit healthy indication suitable for 110 Volts D.C. and with Trip Circuit Supervision Relay
7. 96sq.mm.ammeterofsuitablescalewith3waysandON/OFFselectorswitch.
8. 96sq.mm.VoltmeterofsuitablescalewithwaysandON/OFFselectorswitch.
9. MultiFunctionMeterwithaccuracyclass1.0withRS485porttocommunicatethedatato Automation system.
10. Highspeedtrippingrelay.
11. A Triple pole inverse definite minimum time lag (IDMTL) relay (Numeric Type) with two element for over current protection and other element for earth fault protection with common instantaneous setting.
12. PTFuseFailureRelay
13. Cable termination arrangement with cable end box suitable for terminating XLPE cable coming from transformer.
14. Auxiliaryrelays,A.C.andD.C.fusesetc.asrequired.
15. Remote/Localselectorswitch(3Position),withlockingarrangement.
16. Space heater with interlocks to ensure that space heater is ON. When breaker is open and OFF when breaker is closed. Internal lighting should be provided in the panels.
17. Frequencyindicatorhavingrangeof45Hzto60Hz.
18. CountershowingNo.oftrippingmadebybreaker.

9.4.5 OutgoingFeedersforMotors

Eachfeedertohavethefollowing-

1. 6.6kV3phase,50HzdrawouttypeVacuumcircuitbreakerwithA.C.motorchargedspring closing mechanism and facility for remote operation.
2. 3Nos.doublecorecurrenttransformersofratiorated**/1/1AonecoreformeteringClass-I accuracy, 15 VA burden and other core for protection class - 5P-20, 15 VA burden.
3. Trip,neutralclosecircuitbreakercontrolswitcheswithtimelagarrangement.
4. IndicatinglampsforcircuitbreakerOn/Off/AutoTrip/SpringCharged
5. Indicationfortripcircuithealthyindicationsuitablefor110voltsD.C.andwithTripCircuit Supervision Relay
6. Indicationratedfor110voltsD.C.
7. IndicationforSoftStarterRUN/BYPASSmode.
8. Butter fly valve operation switches OPEN/CLOSE with indication lamps, indicatingvalve positions of Fully open and Fully close.
9. 96sq.mm.Ammetershallbewithsuitablescalewith3waysON/OFFselectorswitch.
10. Highspeedtrippingrelays.
11. NumericcomprehensiveMotorProtectionrelay.
12. Disconnectinglinksfordisconnectionofcableofcapacitors.
13. Cableterminationarrangement with cable endbox suitableforterminatingcables(for motor and for capacitor)
14. Remote/Localselectorswitch(3Position),withlockingarrangement.
15. AuxiliaryrelaysterminalsA.C.andD.C.fusesetc.asrequired.
16. Hourmeteroneforeachmotorpanelandsparepaneloperatingon230/110/V.A.C/D.C. Supply.

9.4.6 OutgoingFeedersforCapacitors

Eachfeedertohavethefollowing-

1. 6.9kV3phase,50HzdrawouttypeVacuumcircuitbreakerwithA.C.motorchargedspring closing mechanism and facility for remote operation.
2. 3Nos.doublecorecurrenttransformersofratiorated**/1/1AonecoreformeteringClass-I accuracy, 15 VA burden and other core for protection class - 5P-20, 15 VA burden.
3. Trip,neutralclosecircuitbreakercontrolsswitchwithtimelagarrangement.
4. IndicatinglampsforcircuitbreakerOn/Off/AutoTrip/SpringCharged
5. Indicationratedfor110voltsD.C.
6. Indicationfortripcircuithealthyindicationsuitablefor110voltsD.C.andwithTripCircuit Supervision Relay
7. Highspeedtrippingrelays.
8. ATriplepoleinversedefiniteminimumtimelag(IDMTL)relay(NumericType)withtwoelements for over current protection and other element for earth fault protection with common instantaneous setting.
9. Cableterminationarrangementwithcableendboxsuitableforterminatingcables.
10. Remote/Localselectorswitch(3Position),withlockingarrangement.
11. AuxiliaryrelaysterminalsA.C.andD.C.fusesetc.asrequired.

9.4.7 OutgoingFeedersforAuxiliaryTransformer

Eachfeedertohavethefollowing–

12. 6.6kV3phase,50HzdrawouttypeVacuumcircuitbreakerwithA.C.motorchargedspring closing mechanism and facility for remote operation.
13. 3Nos.doublecorecurrenttransformersofratiorated**/1/1Aonecoreformeteringclass-I accuracy, 15 VA burden and other core for protection class - 5P-20, 15 VA burden.
14. Trip,neutralclosecircuitbreakercontrolsswitchwithtimelagarrangement.
15. IndicatinglampsforcircuitbreakerOn/Off/AutoTrip/SpringCharged
16. Indicationratedfor110voltsD.C.
17. Indicationfortripcircuithealthyindicationsuitablefor110voltsD.C.andwithTripCircuit Supervision Relay
18. Highspeedtrippingrelays.
19. ATriplepoleinversedefiniteminimumtimelag(IDMTL)relay(NumericType)withtwoelements for over current protection and other element for earth fault protection with common instantaneous setting.
20. Cableterminationarrangementwithcableendboxsuitableforterminatingcables.
21. Remote/Localselectorswitch(3Position),withlockingarrangement.
22. AuxiliaryrelaysterminalsA.C.andD.C.fusesetc.asrequired.

9.4.8 BusCouplerbreakershallconsistoffollowing.

(Shallbeapplicablewheretherearetwodifferentsourcesof supply)

1. 6.6kV3phase,50HzdrawouttypeVacuumcircuitbreakerwithA.C.motorchargedspring closing mechanism and facility for remote operation.
2. Trip,neutral,close,circuitbreakercontrolswitch.
3. IndicationlampsRed/Green/Amberforcircuitbreaker.
4. On/Off/SpringChargedindication,ratedfor110VoltsD.C.
5. White indication lamp for trip circuit healthy indication suitable for 110 Volts D.C. and with Trip Circuit Supervision Relay
6. 96sq.mm.ammeterofsuitablescalewith3waysandON/OFFselectorswitch.
7. Highspeedtrippingrelay.
8. Auxiliaryrelays,A.C.andD.C.fusesetc.asrequired.
9. Remote/Localselectorswitch(3Position),withlockingarrangement.
10. Space heater with interlocks to ensure that space heater is ON. When breaker is open and OFF when breaker is closed. Internal lighting should be provided in the panels.
11. CountershowingNo.oftrippingsmadebybreaker.
12. Forcedwaterlubricationpumpstart/stopswitcheswithindicationlamps.
13. IndicationforDCFailure.

9.4.9 Annunciation

1. 1No.buzzersuitableforoperationon110volts D.C.
2. 1No.Bellsuitableforoperationon230volts A.C.

9.4.10 DetailedTechnicalSpecifications

9.4.10.1 VacuumCircuitBreakers.

TheBreakerunitshallhavetwomaincomponents:

a) Thetrolleyassembly

b) Thecradleassembly

Thetrolleyassemblymadeofsteelplatesshallbemountedonwheels.Thetrolleyassemblyshall be provided with:

- Thepole assembly
- Theoperatingmechanism

Thepoleassemblycomponentofthetrolleyassemblyshallhave;

i. Theinterrupterunitshavingvacuumnotlessthan10-5 Torr.

ii. Thetopterminalsforinterrupterunits,separatedbyfireretardanttypebarriers.

iii. Thecontactsofthebreakershallbesilverplatedcopperorsilverplatedcopper-chromium.

Theoperatingmechanismshallconsistof:

- Solenoidoperatingmechanism
- Controldevices

The solenoid mechanism operating on the electro-magnetic principle shall close or open the interrupter. The driving force of the closing electro-magnet shall be imparted to the operating shaft with a trip free link mechanism.

There shall be a heavy duty plug-in type earth contact/change over switch which shall make before the insertion of trolley assembly and break after the withdrawal of the same.

The cradle assembly made of steel plates shall be mounted on chassis and shall accommodate the trolley assembly.

Thecradleassemblyshallconsistof:

a) Copperterminalstoreceivethebreakercontact.

b) Railstoguidethetrolleyassembly.

c) Insulated safety shutter mechanism to make the shutter operation fully automatic depending on circuit breaker position.

a) EachBreakershallhavefollowingaccessories.
   1. Operationcounterstoregisternumberofbreakersoperations.
   2. Mechanicaloperatingdeviceformanualclosingandtrippingofbreaker.
   3. Deviceformanualchargingofclosingspring.
   4. MechanicallyoperatedRed`Trip'shroudedPushbutton.
b) ThereshouldbelockingfacilityinSERVICE,TESTandISOLATEDposition.
c) InTESTposition,theBreakerwillbetestedwithoutenergizingthepowercircuit.
d) Itshouldnotbepossibletooperatebreaker unlessitisfullypluggedIN,TEST orfullyisolated position.
e) ThoughtheBreakersaretobesuitableforelectricaloperationprovisionofmanualcharging, closing and tripping shall be made.
f) AllBreakersofidenticalcurrentratingsshallbeinterchangeable.

g) Chargingmotorandclosingcoilshalloperatebetween85 to 110 percentof110voltsD.C.supply and trip coil between 70 to 110 percent of 100 volts, D.C. supply suitable thermal protectionshall be provided for charging motor.

9.4.10.2 BusBarsandSupports

Bus Bars shall be of Electrolytic Aluminium and of ample in size. It shall be adequately supported on non hygroscopic, non-combustible fibre glass reinforced, plastic insulators. The Bus Bars up to incoming of breaker and also up to the outgoing terminals including all joints shall be fully insulated with heat shrinkable PVC sleeves. They shall be uniform and continuous throughout the length of Switch Board. The Bus Bars shall be extendable on both sides.

9.4.10.3 Wiring

Allcontrolwiringshallbeofadequatecapacity,andalloutgoingcircuitsshallbewiredupto terminal blocks, for external connections. Wires shall be properly colour coded and ferruled, to distinguish different circuits. They shall be neatly routed through PVC channel of adequate size. All control wiring shall be carried out with 1.1 kV grade, 2.5 sq.mm. PVC insulated wires.

9.4.10.4 Panels

The panel shall be indoor, free standing type, fully compartmentalised and properly ventilated. It shallbetotally enclosed,dustandverminproof.Itshallbepossibleto extendtheassembly oneither side, single front/ double front, depending upon site requirements. It shall be made out of least 10 SWG sheet steel suitably reinforced to provide flat level surface, resistant to vibration, and rigid during transportation and installation. Doors and removable covers may be of 14 SWG, sheet. Breaker compartment shall have front hinged door, with lock and key.

In case of breaker panel, fixed main disconnect contacts in panel housing shall be provided with automatic safety shutters, to cover the high voltage circuit means shall be provided to operate shutters by handle or knob, on the front of the panel. Shutter operating mechanism shall be interlocked with withdrawable truck, to prevent incorrect operation.

All panel surfaces to be painted/power coated shall be first chemically treated to remove all rust, scale, and then two coats of Zinc primer shall be applied. The colour of all panels shall be light Grey to shade No. 631 of IS-5 (or as approved by Engineer in Charge) with semi-glossy finish for the exteriorandbrilliantwhilesyntheticenamel,forinterior.Theotheralternativelikepowdercoatingis also acceptable.

9.4.11 Technicalparameters

a)	TPbusbardetails	HighConductivityAluminiumgradeE91EforTPbusbar,bare type, size shall be suitable for current rating shown on diagrams
b)	Min. Clearance	AsperIS/BSstandard(Min.90mm)
c)	EarthBus	50x 6Al strip
d)	Impulsewithstandvoltage	AsPerrelevantIS
e)	Powerfreq.Withstand–Voltage	AsPerrelevantIS
f)	ShorttimeRating	25kA(rms)for3second
g)	Max.Temp.ofbusbar	70 ^{0}C

h)	Feederdetails	Ratingsandotherdetailsareasperdiagrams
	Incoming/outgoingBreaker	Vacuum circuit breaker Control supply 110V DC
	Operatingdutycycle	Springchargemotor230VAC 0-3min-co-3min-co
i)	CTdetails	Cast resin, bar primary type, 1 A CT CTratio,burdenandclassasperSLD
j)	PT details	Castresin,singlephase,woundtype,110VPT PT ratio, burden and class as per SLD
k)	Relays	AllrelaysshallbeNumericType.
l)	SelectorswitchdetailsASforAmmeterwithR,Y,B,OFFpositionsandVSfor Voltmeter with RY, YB, BR, OFF positions	
m)	IndicatingMeterdetails	Movingirontype,90^0scale,forAM&VM, Suppressed scaleincaseofAM formotors AM dial range to suit CT primary current. VM dial range to suit PT primary voltage. Accuracy Class 1.0 ForotherdetailsreferSLD.
n)	Pushbuttondetails	Momentarytype,2NO&2NCcontactsof10A LED
o)	Indicatinglampdetails	type
p)	Controlfusedetails	HRCcartridgetypewithbase&carrier. contractor to select rating.
q)	Miscellaneousdetails	1. CTterminalsshallbeprovidedwithshortinglinkand earthing facility 2. Controlwiring-markedwithferrulenoatbothends. 3. PanelshallbeprovidedwithThermostatcontrolledspace heater & cubicle illumination. 4. Degree of protection -IP 4X (for indoorpanel) and IP52 (for outdoor)

9.4.12 NAMEPLATE

Thenameplatesofthecircuitbreakeranditsoperatingdeviceshall havemarkingas:

Manufacturer

Typedesignationandserialnumber

Rated voltage

Ratedfrequency

Ratednormalcurrent

Short circuit withstand capacity

Ratedshortcircuitbreakingcurrent

Rated supply voltage of closing and opening devices

Ratedsupplyfrequencyofclosingandopeningdevices

Tender Document Ref:

Operatingduty

Supply voltage of auxiliary circuits

Supplyfrequencyofauxiliarycircuits

Weights

Ratedoperatingsequence

Year of manufacture

9.4.13 Tests

The switchgear assembly & all other components, like circuit Breaker, Bus Bars, C.T. P.T. shall be tested for all Type and Routine tests, as per latest editions of relevant Indian Standard. In case, Type test reports on similar equipment are available then Engineer may waive these tests. All Routine tests as per relevant standard shall be conducted on the assembly and the various components.
All the above testing shallbe carried out for routine and type functionaltestatmanufacturers works in presence of Engineer or his representative.

9.4.13.1 Testing

H.T. Switch gear panel shall be tested for routine and type functional tests at manufacturer's works in presence of the Engineer or his representative Type test certificate shall be furnished.

i) Switchgearshallbemadeoutofsheetsteelincompartmentalizeddesignandshallbesuitablefor bottom cable entry on rear Side. The main incomer shall come from outdoor switchyard be through XLPE insulated Al conductoror fire retardantcable. The horizontal bus bar chamber shall be on the top.

ii) Additional6Nos.ofNO-NCcontactsshallbeprovidedthantherequirednumbers.

9.5 HT/ LT Capacitors

9.5.1 Scope

Thespecificationcoversthedesign,manufacture,testingatmanufacturesworks,supply,delivery, storage at site; erection, testing and commissioning of 6.6 kV / 0.433 kV Capacitors with instrumentation controls and safety devices.

Thecapacitorsarerequiredforfollowing

- To improve the power factor of motors (and in turn, improve the power factor of the system). This compensation may be individual/group or central based on optimal location studies of reactive compensation.
- Capacitors are provided to improve the power factor of the system when the motors are not running (as the power factor of the transformer, under no load condition, is very poor).

Thescopeofsupply shallincludesparesfor5yearsofoperationofthepumpingstation,specialtools and testing devices, all parts accessories etc. which are essential for construction, operation and maintenance of the capacitors even though these are nor individually or specifically stated or enumerated. Corresponding components of the capacitors and associated equipment and spares shall be of the same material, dimensions and finish and shall be interchangeable. The specification covers the design, manufacture, testing at manufactures works, supply, delivery, storage at site; erection, testing and commissioning of 6.6 kV capacitors complete with instrumentation controlsand safety devices.

9.5.2 Standards

Standard	Description
IS2834	Powerfactorimprovementcapacitors

9.5.3 Otherconsiderations

Capacitor across each motor shall be selected to improve the power factor up to 0.95 however care shall be taken that kVAR of capacitor shall not exceed magnetisingkVAr of the motor even if corrected power factor is less than 0.95.

The capacitors shall be provided in separate expanded metal housing with top completely covered with M.S. sheets. The capacitors shall be mounted on rigid framed structure. The bushings required for supporting I.S.2834 but shall also meet the requirement as per B.S.S. 1950 wherever these are applicable.

The capacitors shall be provided with earth terminals. The earth fault relay is included under H.T. panel. The one No. of CBCT to detect the earth fault required for earth fault relay shall be provided.

Eachcapacitorcubiclewillcompriseoffollowings.

1. BankofcapacitorsofsuitableKVARratingforeachmotortoimprovetheP.F.ofmotorto0.95.
2. HRCfusessuitableforoperatingvoltage.
3. Earthingterminals.

Clarification:Thecapacitorcubicleswillbeonenumbertoeachmotor.

1. HT Capacitors for power transformers shall be protected against over current by means of suitable breaker with adjustable over current Relays, which are adjusted to interrupt the circuit, when the current exceeds the permissible limits, specified in 5.3 of I.S.2834-1964. HT capacitors

forPowertransformersabove3.15 MVA,shall be considered atdetailed engineering stage,if client prefers so.

2. Suitabledischargedevicetobeprovided,

Thesizeandmethodofconnectionofcapacitorsshallbecheckedwiththemotormanufacturers. Contractor shall check with manufacturer regarding the provision of inductor coil.

CapacitorValueshallbeworkedsuchthatthepowerfactorwillimproveto0.95whenthemotor running at duty point.

Thecapacitorsshallbeprovidedwithlowlossdeviceandreducethevoltageto50Vwithin5 minutes.

9.5.4 Technicalparameters

	Quantityandoutput	Forindividualmotorandtransformer1No. each,
	Capacitorstarting	Alongwithmotorandonbusfortransformer
	Capacitortype	MPP
	Ratedvoltageandfrequency	6.6kVor0.433kV,3phase,50Hz
	Maximumovervoltagetheunitcapacitoris capable of withstanding continuously	110%

Testing

The capacitor will be tested in manufacturers works as per IS 2834-1964 in presence of the Engineer or his representative.

9.6 MetalEnclosedLTSwitchgear

9.6.1 Scope

The specification covers the design, manufacture, testing at manufactures works, supply, delivery, storage at site; erection, testing and commissioning of 0.415 kV Switchgear completewithinstrumentationcontrolsandsafetydevices.Thescopeofsupplyshallinclude spares for 5 years of operation of the pumping station, special tools and testing devices, all parts accessories etc. which are essential for construction, operation and maintenance ofthe switchgear even though these are nor individually or specifically stated or enumerated. Correspondingcomponents ofthe Switchgearandassociatedequipment andspares shall be of the same material, dimensions and finish and shall be interchangeable.

9.6.2 Standards

Sl.No.	Standard	Description
1.	IS3247	Switchgeargeneralrequirements.
2.	IS2516	Circuitbreaker
3.	IS8623	FactorybuiltassembliesofSwGr&Cont.Gr(forvoltages<650V).
4.	IS2147	DegreeofprotectionofenclosureforLVswitchgearandcontrolgear.
5.	IS1248	ElectricalIndicatingInstruments.
6.	IS722	IntegratingACelectricmeters.
7.	IS2705	Currenttransformers.
8.	IS3156	Voltagetransformers.
9.	IS10118	Installationandmaintenanceofswitchgear.
10.	IS3231	ElectricRelays
11.	IS8686	Specificationforstaticrelays
12.	IS5082	Wroughtaluminiumandalloybars,tubes,rodsforElectricalpurpose.
13.	IS9431	Indoorpostinsulatorsoforganicmaterial
14.	IS5621	Insulators
15.	IS11353	Guideforuniformsystemofmarkingterminals
16.	IS2544	Porcelainpostinsulators
17.	IS375	Markingandarrangementforswitchgearbusbarsmainconnections and auxiliary wiring.

9.6.3 OtherConsiderations

One sheet steel, totally enclosed, dust and vermin proof L.T. panel Board, suitable for indoor floor mounting with of suitable Amp. Aluminium bus bar and neutral of half the rating for operation on 415 V 3 Phase, 50 Hz. A.C. system, completely, assembled wired, tested and painted with rust proof paint for controlling L.T. supply to different auxiliaries of pump house. *The ACB / MCCB are to be installed in the panel; switch fuse units (SFU / FSU) are not permitted.*

Each panel shall consist of following item well installed and connected to suitable size of bus bars provided in the panel.

The main incomer from the transformer shall be through a 3 1/2 C XLPE / AYFY or BUSDUCT Cable with suitable termination at the bottom of the switchgear. The horizontal bus bar chamber shall be on the top whereas vertical bus bars shall be provided in bus alley at the front.

9.6.4 BriefSpecificationforACB& MCCB

9.6.4.1 AirCircuitBreaker

- Type :ManuallyOperatedfullyDrawouttype
- RatedOperationalVoltage :690V
- RatedInsulationVoltage :1000V
- RatedImpulseWithstandVoltage : 12 kV
- AlltheACBshaveMicroprocessorbasedprotectionReleasewithselfdiagnostic&test function. Following standard protections are available.

1. O/Lsettablefrom0.4……1xInwithtimedelay
2. SelectiveS/Cfrom1….10xInwithtimedelay
3. InstantaneousS/Cfrom1.5…..15xIn
4. EarthFaultfrom0.2…..1xInwithtime delay

9.6.4.2 MouldedCaseCircuitBreaker

- MCCBsareManuallyOperatedfixedtype
- RatedOperationalVoltage :690V
- MCCBswithMicroprocessorbasedProtectionReleaseshallhavefollowingsettings:
    - O/L:-0.4….1xInwithtimedelay
    - S/C:-1….10xInwithtimedelay
    - Inst.:-1.5…15xIn
    - E/F:-0.2….1xIn;Time:-0.1s…0.8s

AlternativelyThermoMagneticreleasewithadequatesettingrangecanbeproposed

9.6.5 AnIncomingFeederofSuitableAmp.RatingComprising of

1. Triple pole 415 Volts of L.T. ACB having 35 / 50 kA capacity and provided with thermal relayalong with shunt trip, magnetic release and auxiliary contacts etc. each comprising of following items will be installed and connected to suitable size of bus provided in the panel.
2. IndicationlampsRed/Green/AmberforON/OFFandAutotrippositionindicationsreceptively.
3. Current transformershaving ratiosuitable Amp. and V.A. rating Class-I accuracy for metering,Class – 5P20 accuracy for protection.
4. 1-96sq.mm.Voltmeterofsuitablescale.
5. 1-Voltmeterselectorsswitch3wayandON/OFF.
6. 1-96sq.mm.Ammeterofsuitablescale.
7. 1-Ammeterselectorswitch3wayON/OFF.
8. 1-MultifunctionmeterwithRS485 Port.

One sheet steel, totally enclosed, dust and vermin proof L.T. panel Board, suitable for indoor floor mounting with of suitable Amp. Aluminium bus bar and neutral of half the rating for operation on 415 V 3 Phase, 50 Hz. A.C. system, completely, assembled wired, tested and painted with rust proof paint for controlling L.T. supply to different auxiliaries of pump house. Each panel shall consist of following item well installed and connected to suitable size of bus bars provided in the panel.
The main incomer from the transformer shall be through a 3 1/2 C XLPE / AYFY Cable with suitable termination at the bottom of the switchgear in case the Transformer rating is less than 1000 kVA. The horizontalbus barchambershall beonthetop whereasvertical busbarsshall be providedin bus alley at the front.

If the transformer rating is above 1000 kVA, a bus duct of adequate rating is proposed. The bus duct is to be terminated on top (preferably) or bottom suitably.

9.6.6 Outgoingfeeders

- Wherever the main pump motors are of 0.415 kV, the adequate starters with protection are to be provided. The starter to be selected as follows

Upto5 kW -DOL Starter
Upto50kW -StarDeltaStarter
Above50kW -Soft Starter

PleasechecktheselectiontableattheendofthespecificationsofLTSwitchgear. Note:
THELINESIDECONTACTOROFTHESOFT STARTER SHOULD BESELECTED OFTHERATINGOF THE ***DIRECTONLINE(DOL)***.

- D.O.L. type push button operated reversible starters for individual Butterfly Valve control through actuator with 2 No. (Normally Open) + 2 NC (Normally Closed) auxiliary contacts, MotorsshallbeconnectedonthispaneIduly wiredthroughtheMCCBunit.SwitchforLocal/ Remote control operation should also be provided. Auxiliary relays, contacts, terminals etc. as required.

- SuitableratingMCCBsandstarters(whereverrequired)forallotherLTloads
- CableterminationglandsuitableforadequatecapacityArmouredPowerandControlcable.
- 1-MultifunctionmeterwithRS485Portoneachmotorfeeder

- Atleastthreeoutgoingsparefeeders

9.6.7 Technicalparameters

1.	TPNbusbardetails	HighConductivity Al gradeE91E for TPNbarebus bar,size shallbesuitableforcurrentratingshownonthe drawings.
2.	Min. Clearance	Phasetophase-25mm&Phasetoearth-20mm
3.	EarthBus	50x 6GI strip
4.	Powerfreq.Withstand	2.5kVRMS,50 Hzforoneminute
5.	Shorttime	50kA(rms)for1second
6.	Max.temp.ofbusbar	70 ^{0}C
7.	CTdetails	Castresin,barprimarytype,1ACT CTratio,burdenandclassasrequired,butmin.Burdenshould be 15 VA
8.	MCCBdetails	Suitableratingwithstaticrelease,U/V&currentlimiting feature
9.	Selectorswitchdetails	ASforAmmeterwithR,Y,B,OFFpositions. VSforVoltmeterwithRY,YB,BR,OFF positions
10.	IndicatingMeterdetails	Movingirontype,90^{0}scale,forAM&VM, AM dial range to suit CT primary current. VM dial range to suit PT primary voltage. Size 96 mm^2 for outgoing feedersAccuracy Class 1.0 Forotherdetailsrefer drawings
11.	IntegratingMeterdetails	MultifunctionmeterwithRS485 Port
12.	Pushbuttondetails	Momentarytype,2NO&2NCcontacts of 10 A at 240 V AC
13.	Indicatinglampdetails	7Wattsfilamenttypewithseriesresistance,
14.	Controlfusedetails	HRCcartridgetypewithbase&carrier. Contractor to select rating.
15.	Miscellaneousdetails	Control Wiring shall be with stranded copper conductor, PVC insulated,650Vgradewiresof2.5mm^{2}forCTcircuitsand1.5 mm^2 for other circuits. Controlterminalsshallbeof10A,1100Vgrade,clipontype with din rail mounting. CTterminalsshallbeprovidedwithshortinglinkandearthing facility

		Controlwiring-markedwithferruleNo.atbothends. AllboardsshallbeprovidedwithThermostatcontrolledspace heater & cubicle illumination. Degreeofprotection–IP5X(forindoorsystem)&IP52(for outdoor system)

9.6.8 Testing

The L.T. panel switch board shall be tested for routine, type and functional tests at manufacturers' works in the presence of the Engineer or his representative.

9.6.9 SelectionChartforStarters

9.6.9.1 SELECTIONCHARTFORDOLSTARTERS

MotorRating415V/3 Ph			RelayRange	Contactor	MCCB Rating
HP	kW	CurrentInA			
0.125	0.09	0.4	0.3-0.5	10A	2
0.16	0.12	0.45	0.3-0.5	10A	2
0.2	0.15	0.57	0.45-0.75	10A	2
0.25	0.19	0.75	0.6-1	10A	4
0.33	0.25	0.9	0.6-1	10A	4
0.5	0.37	1.2	0.9-1.5	10A	6
0.75	0.55	1.6	1.4-2.3	10A	6
1	0.75	2.1	1.4-2.3	10A	8
1.5	1.1	2.7	2-3.3	10A	10
1.75	1.3	3	2-3.3	10A	10
2	1.5	3.5	3-5	10A	16
2.5	1.8	4.8	4.5-7.5	10A	16
3	2.25	5	4.5-7.5	10A	16
4	3	6.4	4.5-7.5	10A	20
5	3.7	7.9	6-10	10A	20
5.5	4	8.5	6-10	10A	20
6	4.5	9	6-10	16A	25
7.5	5.5	11.2	9-15	16A	32

MotorRating415V/3 Ph			RelayRange	Contactor	MCCB Rating
HP	kW	CurrentInA			
10	7.5	14.8	9-15	25A	32
12.5	9.3	19	14-23	25A	50
15	11	22	14-23	25A	63
17.5	13	24	20-33	32A	63
20	15	29	20-33	32A	63
25	18.6	35	30-50	45A	80
30	22.5	40	30-50	45A	80
35	26	47	30-50	65A	100
40	30	55	45-75	65A	100
45	33.5	60	45-75	65A	100
50	37	66	45-75	80A	125
60	45	80	66-110	95A	160
75	55	100	66-110	110A	160
90	67.5	120	90-150	140A	200
100	75	135	90-150	140A	200
110	80	139	90-150	185A	200
125	90	165	135-225	185A	250
150	110	200	135-225	225A	315
175	130	230	180-300	265A	315
197	147	260	180-300	265A	400
200	150	275	180-300	325A	400
215	160	280	180-300	325A	400
225	168	300	270-450	325A	400
245	180	320	270-450	325A	400
270	200.55	340	270-450	325A	500

9.6.9.2 SELECTIONCHARTFORSTAR–DELTASTARTERS

MOTOR		CurrentinA		Relay	Contactor			MCCB
HP	kW	Line	Phase		Star	Line	Delta	
1	0.75	2.1	1.21	0.9-1.5	10A	10A	10A	4
1.5	1.1	2.7	1.6	1.4-2.3	10A	10A	10A	6
2	1.5	3.5	2.02	1.4-2.3	10A	10A	10A	6
3	2.25	5	2.88	2-3.3	10A	10A	10A	8
4	3	6.4	3.7	3-5	10A	10A	10A	10
5	3.75	7.9	4.6	3-5	10A	10A	10A	16
6	4.5	9	5.2	4.5-7.5	10A	10A	10A	16
7.5	5.5	11.2	6.5	4.5-7.5	10A	10A	10A	20
10	7.5	14.8	8.54	6-10	10A	10A	10A	20
12.5	9.3	19	11	9-15	16A	16A	16A	32
15	11	22	12.7	9-15	16A	16A	16A	32
20	15	29	16.7	14-23	16A	25A	25A	40
25	18.5	35	20.2	14-23	16A	25A	25A	50
30	22.5	40	23	20-33	16A	25A	25A	63
35	26	47	27	20-33	25A	32A	32A	63
40	30	55	31.8	30-50	25A	32A	32A	63
45	33.5	60	34.6	30-50	32A	45A	45A	80
50	37.5	66	38.2	30-50	32A	45A	45A	80
60	45	80	46.2	30-50	45A	65A	65A	100
65	48.5	87	50	45-75	45A	65A	65A	100

9.7 LTBus Duct

9.7.1 Scope

The specification covers the design, manufacture, testing at manufactures works, supply, delivery,storageatsite;erection,testingandcommissioningof0.415kVbusduct.Thescope of supply shall include spares for 5 years of operation of the pumping station, special tools and testing devices, all parts accessories etc. which are essential for construction, operation and maintenance of the switchgear even though these are nor individually or specifically stated or enumerated. Corresponding components of the bus duct andassociated equipment and spares shall be of the same material, dimensions and finish and shall be interchangeable.

9.7.2 Standards

No	Standard	Description
1	IS8623	BusDuct
2	IS5621	Insulators

9.7.3 Otherconsiderations

The Transformers shall be provided with a bus duct as required.The Bus-duct supporting arrangementshallbeplannedsuchthatremovalofanyonetransformershallbepossiblewhile other transformers remain in service.

9.7.4 Technicalparameters

a)	Application	TransformersecondarytoPMCC/PCC. Sheet
b)	Enclosurematerialandshape Type	steel, rectangular
c)	of bus duct	Non-phasesegregatedbusducts 3
d)	Numberofbusbars	phase & 1 neutral
e)	Rated Voltage	415V
f)	Rated Current	Aspertransformerrating 35
g)	Ratedshorttimecurrent&duration	/ 50 kA(rms), 1 sec.
h)	Installation	Partlyindoor&partly outdoor
i)	Maximumenclosuretemperature	65 ^{0}C
j)	Degreeofprotection	IP 55
k)	Paintingshade	632,asperIS5,enamel
l)	Mainbusbarmaterial	AL-ElectricalGradeE91E
m)	Number,size&materialofearthbus	2Nos.,50x6mm GIstrip

n)	Flexible	Copperfoilwithbi-metallicstrip
o)	Locationof flexible	Attransformerend
p)	Maximummainbusbar temperature	80 ^{0}C
q)	Enclosuresupport	Tobeprovidedsuitably

9.7.5 Testing

Altheroutinetestshallbecarriedout,asperrelevantstandard,inpresenceofEngineerinChargeor his representatives.

9.8 HTCables

9.8.1Scope

Thespecificationcoversthedesign,manufacture,typetest,testingatmanufacturesworks,supply, delivery, storage at site; laying the cable at site, testing and commissioning of 6.6 kV cables with terminations.

9.8.2 Standards

No.	IndianStandard	Description
	IS7098	XLPEinsulatedelectricCables.
	IS5831	PVCinsulationandsheathofelectriccables.
	IS3975	Mildsteelwires,stripsandtapesforarmouringofcables.
	IS8130	Aluminiumconductorsforinsulatedcables.

9.8.3 OtherConsiderations

TheHTcablesizingshallbebasedonfaultlevelof25KAorbasedonstudiesconducted,whicheveris higher.

Technicalparameters

Voltage grade	:	6.6kV(UE)gradelaidfrom6.6kVpanel to 6.6 kV induction motors
Impulselevel	:	IsperIS
No. ofcores	:	Threecore
Nominalareaof conductor	:	Asperthedrawingandrelated documents
Conductor	:	Aluminiumconductorcomplyingwith the requirements specified in I.S.
Typeof insulation	:	Crosslinkedpolyethylene(XLPE)
Shielding	:	Conductorshieldingandinsulation shielding
ArmouredorUnarmoured	:	Armoured
Cablestobeusedinearthedor unearthed system	:	Earthedsystem

9.8.4 Conductor

Theconductorshallbemadefromhighelectricalpurity Aluminiumofcircularshape.Conductor construction and testing shall comply with latest I.S.

9.8.5 Insulation

High quality XLPE insulating compound of natural colour shall be used for insulation and shall be chemically crossed linked by continuous vulcanisation process. The cables shall be manufactured with dry cure system. This shall comply with latest IS.

9.8.6 Shielding:

The XLPE cables shall be provided with both conductor shielding and insulating shielding. Both conductor shielding and insulation shielding shall be consist of extruded semiconductor compound. Additional insulation shall be provided with semiconductor tape and non-magnetic tape screen over the extruded insulation conductor shielding XLPE insulation and insulation shielding shall beextruded inoneoperation by a special process ensuring perfect bonding of inner and outer shielding with insulation.

9.8.7 OuterSheath

i) A tough outer sheath of heat resisting PVC compound shall be extruded over the non-magnetic metallic part of insulation screening. This shall confirm to latest I.S. The outer sheath shall be embossed with name of manufacture, voltage grade and year of manufacture after every 300/350 mm along the length of cable.

ii) Theoutersheathofthecableshallbeprovidedwithantirodent,antitermiteproperty.

iii) The outer sheath of the cable shall be marked with progressive length and cable at one meter interval at the time of manufacturing.

iv) The outer sheath of the cable shall have fire retardant low smoke property (i.e. FRLS) and shallbe tested for IEC 332-3category C.

9.8.8 Testing

The capacitor will be tested in manufacturers works as per IS 2834-1964 in presence of the Engineer or his representative.

9.9 LTCables

9.9.1 Standards

No.	Standard	Description
1.	IS1554	PVCinsulatedelectricCables.
2.	IS7098	XLPEinsulatedelectricCables.
3.	IS8130	Conductorsforinsulatedelectriccables.
4.	IS5831	PVCinsulationandsheathofelectriccables.
5.	IS3975	Mildsteelwires,stripsandtapesforarmouringofcables.
6.	IS1753	Aluminiumconductorsforinsulatedcables.

9.9.2 OtherConsiderations

Power cable shall be of Al conductor, whereas control and lighting cables shall be of Cu conductor. The minimum size of Al conductor cable shall be 4 mm^2 and Cu conductor cable of 2.5 mm^2.

Powercablesizingshallbebasedonthevariousde-ratingfactorsrecommendedbycable manufacturer, rated current, temperature rise of conductor and voltage drop.

ControlcablesofCTsshallbebasedontheVAburdenofCTandrelays,meters.

Technicalparameters

LT	PVC/XLPEinsulated,tapedPVCinnersheathandoutersheath650/1100V grade, with multi-stranded aluminium/copper conductor, armoured
CablesCablesel ection	Cableshallbeselectedconsideringfollowingpoints ➢ Currentratingoftheload ➢ De-ratingduetogroupingof cables ➢ Voltagedropasspecifiedatpara9.1.8(Cablesection) ➢ De-ratingfactorduetoambienttemperature. ➢ De-ratingduetodepthincaseofburiedcables

9.9.3 Testing

The capacitor will be tested in manufacturers works as per IS 2834-1964 in presence of the Engineer or his representative.

9.10 CablingSystem

The work covers detailed engineering work for preparation of cable schedule and cable termination schedule. This will comprise of detailed studyof various equipments / panel drawings, Co-ordination with manufacturers / suppliers and preparation of cable schedule giving the equipment interconnection references, preparation of cable termination schedules giving the terminals details core identification purpose etc.

Details about Engineering Work for preparation of cable termination schedules giving the terminal details core identification, purposes etc.

The cable schedule to be prepared after study of various drawings / diagrams shall contain the following details.

I. Sizeofcable.

II. Givingtheidentificationnumber.

III. Referencedrawingnumbers.

IV. Equipmentreferencei.e.(fromandequipmentsreference ..... to)

V. Purpose of interconnection, e.g. power supply alarm, annunciator, control metering trip and close inter locking etc.

VI. Approximatelengthsofcable.

VII. Incaseofsparecablestheterms`spare'shallbeused.

Cable termination schedule shall contain the following.

I. Cablenumber.

II. Equipmentreferencedrawing.

III. Equipmentterminalmarkingsforindividualcores.

IV. Apparatusreferencenumberofequipment.

V. Equipmentreference.

The contractor shall have to prepare thecable schedule in respectof all the power and control cable involved in the pump house and associated equipment.

The 6.6 cables shall be XLPE AL conductor type armoured and 1.1 kV cable shall be XLPE/PVC insulated AL armoured conductor type.

The work of providing and installation of cables shall be started only after the quality of Cables proposed to be provided is tested and approved by the Engineer-in-charges. The rejected lot of Cables shall be removed from the site. The decision of Engineer-in-charge in this regards shall befinal and binding on the tenderer.

The work ofwiring and cabling will be done as per the provision of Indian Electricity Act,1910,1948, 1956 and rules in existence from time to time and rules presently in force, and the contractor shall

be liable for any damage or accident or loss or injury due to faulty wiring or cabling or for non-observance of rules or Act mentioned above.

9.10.1 Installation

The cables shall be laid in trenches, Cellar, trays or conduits or buried in ground as specified in the cablelayoutdrawing.Thecabletrenchisapplicableonlyfor MSDSS/DSS.

In case of space constraints/ restrictions, cable shall be laid in walk able cable tunnel. Underground walkablecabletunnelsshallhavehydro sealingto preventwaterseepage.

Formulti-layerinstallation,overheadcablebridgeshallbeuseddependinguponnumbersofcableto be laid.

Cable routings given on the drawings shall be checked at site to avoid interference with structures, pipingandducting.Minoradjustmentsshallbemadetosuitthefield/siteconditions.

Allcablesshallbecarefullymeasuredandcuttotherequiredlength,leavingsufficientlengthforfinal connections to the equipment on both ends.

TheContractorshallascertaintheexactrequirementofcable,foraparticularfeeder,bymeasuringat site along the actual finalized route.

Cablesshallbelaidincompleteuncutlengthsfromoneitemofequipmenttoanother.

Cables shall be neatly arranged in the trenches, trays in such a manner, that criss-crossing is avoided andfinaltakeofftothemotor,switchgearisfacilitated.Arrangementofcableswithinthetrench,tray shall be the responsibility of the Contractor.

Powerandcontrolcablesshallbe laidondifferent traysinone trench.Cable shallbe laidfrom topto bottominorderofHTontoprackfollowedbyLTcablesandothercablesonlowerracks.

Allcablesshallbeidentifiedclosetotheirterminationpointbycablenumbers.Cablenumberswillbe punchedonaluminiumstraps,(2mmthick),securelyfastenedtothecableandwrappedaroundit.

Undergroundcablesshallbeprovidedwithcablemarkers.Thesecablemarkerpostsshallbelocatedat every 50 metres and every corner or change of direction.

All temporary ends of cables shall be protected against dust and moisture to prevent damage to the insulation.While layingcables, the ends shallbe taped withPVCtape.

Cablesshallbehandledcarefullyduringinstallationtopreventmechanicalinjurytothecables.Endsof cablesleavingtrenchesshallbecoiledandprovidedwithprotectivecoveruntilthefinalterminationto the equipment is completed.

Wherecablesrisefromtrenchestomotors,controlstations,lightingpanelsetc.,theyshallbetakenup in GI pipes (rigid, flexible) for mechanical protection up to a minimum of 600 mm above grade level. ThediameteroftheGIpipeshallbeatleast3timesthediameterofthecable.

Cableshallbecarefullypulledthroughconduitstopreventdamage.

If pipe sleeves installed are inadequate due to a greater number of cables being laid, then additional pipesleevesshallbelaid.Afterthecablesareinstalledandalltestingiscomplete,conduitendsabove gradelevelshallbepluggedwithsuitableweatherproofplasticcompound.

Wherecablespassthroughfoundationwallsorotherundergroundstructures,thenecessaryductsor openings will be provided in advance for the same.

At road crossings and other places where cables enter pipe sleeves an adequate bed of sand shall be given.

Cables installed above grade level shall be run in trays, exposed on walls, ceilings or structures and shall be run parallel to, or at right angles to, beams, walls or columns. The cables shall be so routed that they will not be subjected to heat.

Cables running along with structures will be clamped by means of GI saddles and saddle bars at a spacing of 300 mm.

Cable carrier system i.e. site fabricated ladder type cable trays and supporting steel shall be painted beforelayingofcables.Paintingshallhavetwocoatsofredoxideandonecoatof Aluminiumpaint.

For all outdoor buried cables a 3 metre diameter loop shall be provided at both ends before termination.

9.10.2 Termination

All LT XLPE/PVC cables shall be terminated at the equipment/panel by means ofdouble compression type brass glands and tinned copper lugs.

AllHTXLPEcablesshallbeterminatedattheequipment/panelbymeansofHTcableterminationkits.

Powercablecoresshallbeidentifiedwithred,yellowandbluePVCtapes.

Incaseofcontrolcables,allcoresshallbeidentifiedatbothendsbytheirterminalnumbersbymeans of PVC ferrules. Wire numbers shall be as per inter-connection diagrams, to be furnished to the Contractor.

Thecableshallbetakenthroughanadequatesizeglandinsidethepaneloranyotherelectrical equipment.

Cableleadsshallbeterminatedattheequipmentterminalsbymeansofcrimpedtypesolderless connectors.

Crimpingshallbedonebyhandcrimping/hydraulicallyoperatedtoolandconductingjellyshallbe appliedontheconductor.Insulationoftheleadsshouldberemovedimmediatelybeforethecrimping.

9.10.3 Testingofcables

Beforeenergising,theinsulationresistanceshallbemeasuredfromphasetophaseandphaseto ground.

9.11 EARTHINGANDLIGHTNINGPROTECTION

9.11.1 INTENTOFSPECIFICATION.

This specification is in tented to cover all the equipment of earthing and lightning protection, any item which is not specifically mentioned but required for successful and trouble free operation shall be in the scope of bidder.

9.11.2 CODESAND STANDARDS

All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date ofopening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the formershall prevail. All work shall be carried out as per the following standards and codes.

IS:513	Coldrolled lowcarbonsteelsheetsand strips.
IS: 802 (part-1I)	Code of practice for the use of structural steel in overhead transmission line tower: Fabrication, galvanizing, inspection &packing.
IS: 808	DimensioningofhotrolledsteelBeamColumnChanneland angle sections.
1S:1079	Hotrolled carbonsteelsheet&Strips
1S:1367(part-I)	Technicalsupplyconditionsforthreadedsteelfasteners. Introductionand generalInformation.
IS: 1367 (Part13)	Hot dip galvanized coatings on threaded fasteners.IS:
2062	Steel for general structural purposes.
IS :2309	Codeofpracticefortheprotectionofbuildingandalliedstructures against lighting .
IS: 2629	Recommended practice for hot dip galvanizing of iron & steel.
IS: 2633	Methodfortestinguniformityofcoatingonzinccoated·articles IS:
3043	Code of practice for Earthing .
IS: 6745	Methodsfordeterminationofweightofzinccoatingonzinc coated iron & steel articles.
IS: 9595	Recommendation for metal-ARC welding of carbon manganese steels.
IS: 2309	ProtectionofBuildingandalliedstructurefromlightning

Indian Electricity Act and Indian Electricity Rules:

Equipment complying with other internationally accepted standards suchas IEC, BS,USA VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above, In such a case, the contractor

shall . Clearly indicated the standard (s) adopted, furnish a copy in English of the latest revisionofthestandardsalongwithcopiesofallofficialamendmentsandrevisionsinforceas on date of opening of bid and shall clearly bring out the salient features for comparison.

9.11.3 GENERALTECHNICALREQUIREMENT

3.1 Galvanising

1. Galvanising of steel components and accessories shall conform to IS: 2629 & IS: 2633. Additionally galvanizing shall be uniform, clean, smooth, continuous and free from acid spots. Should the galvanizing of the samples be found defective, the entire batch of steel shall have to be regularized at Contractor's cost after picking.

3.1.2Theamountofzincdepositoverthreadedportionofbolts,nuts,screwsandwashersshallbe as per IS: 1367 (Part 13). The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified.

2. Welding

The welding shall be carried out in accordance with IS:9595. All welding procedure and welders qualification shall also be followed strictly in line with IS: 9595.

9.11.4 Installation

9.11.4.1 GeneralInstructions

1. Thecontractorshallmakehisownarrangementformoving/liftingalltheequipments/items into the respective buildings/erection sites.
2. Equipments/items shall be installed in a neat work manner so that it is leveled, plumbed, squared and properly aligned and oriented. Tolerance shall be as established in manufacture's drawings or as stipulated by the Employer. No equipment shall be permanently bolted down to foundation or structure until the alignment has been checked and found acceptable by the Engineer.
3. The contractor shall furnish all supervision, labour, tools equipment, rigging materials, incidental items such as bolts, wedges, anchors, concrete inserts etc. required to completely install, test adjust and fix the equipment.
4. Manufacture's drawings instructions and recommendations shall be correctly followed in handling, erecting, testing and commissioning of all items/equipments and care shall be exercised in handling to avoid distortion to stationary structures, the marring to finish, or damaging of delicate instruments or other electrical parts.
5. The contractor shall carry out all minor civil works such as welding, bolting, drilling, grouting, chipping, sealing, making openings, finishing's etc. as required for satisfactory execution of the work. All civil works associated with earthing and lightning protection are also in the Contractor's scope.
6. All care should be taken to avoid damage of galvanized/painted surfaces during installation. All damaged surface of galvanized or ungalvanised faces of steel structures,conduits,junctionboxes,traysetc.shallbebrushedupandshallbe

paintedwithredleadprimerpaintfollowedbytwocoatsofaluminum paint/enamel paint to the satisfaction of Engineer.

9.11.5 EarthingSystem

1. Earthing system shall be in strict accordance with 1S:3043 and Indian Electricity Rules/Acts/ CEA Safety Regulations, 2010 and Employer drawings.

2. The earth conductors shall be free from pitting laminations, rust. Scale and other electrical, mechanical defects. The material of the earthing conductors shall be as follows.

a) Conductorsabovegroundlevel - Galvanizedandbuiltuptrenches

b) Conductorsburiedinearth - Mildsteelrod

c) Earthelectrodes - Mildsteelrod

9.11.5.1 Thevarioussizesofearthingconductorsforvariousapplicationshallbeasbelow

	Equipment	Earthconductor Buriedinearth	Earthconductor abovegroundlevel&intrenches
a)	Mainearthgrid 40mmdiaMsrod		50x10mm GSflat
b)	6.6 KV switch gear /415V switch gear /MCC / 6.6 KV Motors		50x10mmGSflat
c)	415 V Distribution board / Transformer		50x6mmGSflat LT
d)	LTMotors		
	i) above160KW		50x6mmGS flat
	ii) 25KWto160 KW		25x6mmGS flat
	iii) 1KWto25KW		25x3mmGS flat
	iv) Fractional/HorsePowermotor		8 SWGGI Wire
e)	Controlpanelandcontroldesk		25x3mmGS flat
f)	Pushbuttonstation /JB		8 SWGGI Wire
g)	Earthelectrodes		40mmdiaMsrod3mtlong
h)	Columns, structure cable trays & and busducts enclosures		50x6mmGSflat
i)	Crane,railsrailtracksandother non-currentcarryingmetalparts		25x6mmGS flat

1. Metallic frame of all electrical equipment shall be earthed by two separate and district connections to earthing system, each of 100% capacity. Crane rails, tracks, metal pipes and' conduits shall also be effectively earthed at two points. Steel RCC columns, metallic stairs, hand rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing ensured by bonding the different sections of hand. rails and metallic stairs. Metallic sheaths, screens, and armour of single core cables shall be earthed at switchgear end only unless otherwise instructed by Employer. Every alternate post of the switch yard fence shall be connected to earthing grid by one GS flat and gates by flexible lead to the earthed post. Railway tracks withinthe plant area shall be bonded across fishplatesandconnectedto earthinggridatseverallocations.Portabletools,appliancesand welding equipment shall be earthed by flexible insulated cable.

2. EachcontinuouslaidoutlengthsofcabletrayshallbeearthedatminimumtwoplacesbyG.S flats to Employer's earthing system, the distance between earthing points shall not exceed 30metre.Wherever earthmat is not availablecontractorshall dothe necessaryconnections by driving an earth electrode in the ground.

3. Neutral connections and metallic conduits/pipes shall not be used for the equipment earthing. Lighting protection system down conductors shall not be connected to other earthing conductors above the ground level.

4. Connections between earth leads and equipment shall normally be of bolted type. Contact surfaceshallbethoroughlycleanedbeforeconnections.Equipmentboltedconnectionsafter being tested and checked shall be painted with anti corrosive paint/compound.

5. Suitable earth risers approved by Engineer shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of main earth conductor.

6. Connections between equipment earthing leads and between main· earthing conductors shall be of welded type. For rust protection the welds should be treated with red lead compound and afterwards thickly coated' with bitumen compound. All welded connections shall be made by electric are welding.

7. Resistance of the joint shall not be more than the resistance of the equivalent length of conductor.

8. Earthing conductors buried in ground shall be laid minimum 600 mm below grade level unless otherwise indicated in the drawings. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 15mm.

9. Earthing conductors embedded in the concrete floor of the building shall haveapproximately50mm concrete cover.

10. A minimum earth coverage of 30 mm shall be provided between earth conductor and the bottom of trench/foundation/underground pipes at crossings. Earthing conductors crossings the road can be installed in hume pipes. Wherever earthing conductors crosses on runs at lessthan300mmdistancealongmetallicstructuressuchasgas,watersteampipelines,steel reinforcement in concrete, it shall be bonded to the same.

11. Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding/cheating at interval of 1000mm and 750mm respectively .

12. Earth pit shall be constructed as per approved drawings. Electrodes shall be embedded below permanent moisture level. Minimum spacing between electrodes shall be 600mm. Earth pits shall be treated with salt and charcoal if average resistance of soil is more than 20 ohm metre.

13. On compilation ofInstallation, continuityofearth conductors andefficiencyof all bound and joints shall bechecked. Earth resistance atearth terminations shall bemeasured in presence of Employer's representatives. All equipment required for testing shall be furnished by conductor.

9.11.6 LightingProtectionSystem

1. Lightningprotectionsystemshallbeinstrictaccordancewith IS:2309

2. Lightning conductor shall be of 25x6mm GS ·strip whenused· above ground leveland shall be connected through test link with earth electrode/earthing system.

3. Lightning system shall be comprise of air terminations, down conductors test links earth electrode etc. as per the IS 2309.

4. Downconductors.

   a) Down conductors shall be as short and straight as practicable and shall follow a direct path to earth. Down conductor shall not be connected to other earthing conductors above ground level.

   b) Eachdownconductorshallbeprovidedwithatestlinkat1000mmaboveground level for testing but it shall be in accessible to interference. No connectionsother than the one direct to an earth electrode shall be made below a testpoint.

   c) Alljointsin thedownconductors shallbeof welded type.

   d) Down conductors shall be cleated on outer side of building wall, at 750mm interval or welded to outside building columns at 1000mm interval.

   e) Lightning conductor on roof shall not be directly cleated on surface of roof. Supporting blocks of PCC/insulating compound shall be used for conductorfixing at an interval of 1500mm.

   f) All metallic structures within a vicinity of two meters of the conductors shall be bonded to conductors of lightning protection system.

   g) The lightning protection system shall not be through cables, conduits and metal enclosures of electrical equipment.

   h) Lightningconductors shallnot pass through orrun insideGI Conduits.

   i) Testinglinkshallbemadeofgalvanizedsteelofsize25x6mm.

9.11.7 TESTS

Followingroutinetestshallbecarriedoutonalltheequipments,devices& materials supplied.

a) GalvanizingTests

Thequalityofgalvanizingshallbeinspectedvisuallyandshallbesmooth, continuous, free from flux stains. In addition following tests shall be conducted ..

a. Uniformity of coating-The coating of any article shall withstand for 1 minute dips in, standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal.

b. The quality of cadmium/zinc plating on items with screw threads shall be inspected visually and shall free from visible defects such as unplated areas, blisters and modules.

c. In Addition, the plating thickness shall be determined microscopically or electronically.

b) Welding

The Quality of welding shall be visually inspected, particular attention being paid to the following point.

The welded joints shall be continuous along its length on both sides and of uniform width and thickness. It should be free from blow holes.

i) Theweldmetalshellbeproperlyfusedwiththeparentmetalwithoutundercutting.

ii) The outside surface of the weld shall be clean. All slag shall have been removed. All weldingshall be regularly checked for cracking using magnetic particle inspection or their equivalent technique.

iii) Physicalanddimensionalchecksforallitems.

9.11.8 COMMISSIONING:

Thecontractorshallcarryoutthefollowingcommissioningtestsandchecksaftererectionatsite.In addition the contractor shall carry out all other checks and tests as recommended by the Manufactures.

a) Earthcontinuitychecks

b) Earthresistanceofthecompletesystemaswellassub–systems.

9.12 LightingSystem:LEDLightssuggestedasperapplicablecode.

9.12.1 ApplicableStandards

IS1913:1978**:**Generalandsafetyrequirementsforluminaries IS

2148 : 2004 **:** Flame proof enclosures of electrical apparatus IS

418 : 2004 **:** Tungsten filamentgeneralserviceelectric lamps IS

1258 : 2005 **:** Bayonet lamp holders

IS1534:1977**:**Ballastforfluorescentlamps

IS1569:1976**:**Capacitorsforuseintubularfluorescent,highpressuremercuryvapourandlow pressure sodium vapour

dischargelampcircuit

IS1777:1978**:**Industrialluminarieswithmetalreflectors IS

2215 : 1983 **:** Starters for fluorescent lamps

IS2418:1977**:**Tubularfluorescentlampsforgenerallightingservices IS

3323 : 1980 **:** Bi-pin lamp holders for tubular fluorescent lamps

IS3324:1982**:**Holdersforstartersfortubularfluorescentlamps IS

4013 : 1967 **:** Dust-tight electric lighting fittings

IS6616:1982**:**Ballastsforhighpressuremercuryvapourlamps IS

8224 : 1976 **:** Electric Lighting fittings for Division 2 areas

IS9900:1981**:**High-pressuremercuryvapourlamps IS

9974 : 1981 **:** High pressure Sodium vapour lamps IS

10276 : 1982 **:** Edison screw lamp holders

IS10322**:**Luminaries

IS13021:1991**:**ACSuppliedElectronicBallastsfortubularfluorescentlamps

LightingPanels,Switch-boxes

IS 1293 : 2005 **:** Plugs & socket outlets of rated voltage upto and including 250volts & rated current upto and including 16 Amps

IS2551:1982**:**Dangernoticeplates

IS13947**:**Lowvoltageswitchgearandcontrolgear

IS3854:1997**:**Switchesfordomesticandsimilarpurposes

IS6875**:**Controlswitches(switchingdevicesforcontrolandauxiliarycircuitsincludingcontactor relays) for voltages upto and including I000VAC and 200V DC

IS13703:1993 **:**LowvoltagefusesforvoltagesnotexceedingI000VACor150V DC

Conduits,PipesandAccessories
IS2667:1988**:**Fittingsforrigidsteelconduitforelectrical wiring

IS3837:1976**:**Accessoriesforrigidsteelconduitsforelectricalwiring IS

9537 **:**Conduits for electrical installations

LightingWires/Cables
IS694:1990**:**PVCinsulatedcablesforworkingvoltagesuptoandIncluding1100V

IS 3961:1967**:** Recommended currentratingsforcables.(PVCInsulated and PVCsheathed heavy duty cables and light duty cables).

IS8130:1984**:**Conductorsforinsulatedelectriccablesandflexiblecords IS

10810 **:** Methods of tests for cables

ElectricalInstallationPractices&Miscellaneous
IS1944**:**Codeofpracticeforlightingofpublicthoroughfare IS

3646 **:**Code of practice for interior illumination.

IS5572:1994**:**ClassificationofHazardousareas(otherthanMines)havingflammablegasesand Vapours for electrical installation

IS6665:1972**:**Codeofpracticeforindustriallighting.NationalElectricalCodeIndianElectricity Rules.Indian Electricity Act

IS5:2004**:**Colourforreadymixedpaints&enamels.

IS280:2006**:**Mildsteelwiresforgeneralengineeringpurposes IS 374

: 1979 **:** Electric ceiling type fans & regulators

IS732:1989**:**Codeofpracticeforelectricalwiringinstallations

IS1255:1983**:**Codeofpracticeforinstallationandmaintenanceofpower Cablesuptoand including 33KV rating

IS2062:1999**:**Steelforgeneralstructuralpurposes

IS2629:1985**:**Recommendedpracticeforhot-dipgalvanizingofironandsteel

IS2633:1986**:**Methodsfortestinguniformityofcoatingofzinccoatedarticles IS

2173 : 1991 **:** Tubular steel poles for overhead power lines

IS3043:1987**:**Codeofpracticeforearthing

IS5216:1982**:**Guideforsafetyproceduresandpracticesinelectricalwork

IS5571:2000**:**Guideforselectionofelectricalequipmentsforhazardous areas

9.12.1 LightingSystemDescription

9.12.2.1 NormalACLightingSystem

NormalAClightingsystemwillbefedfromLT MCC.

EmergencylightingwillbefromDCbatterysystem,whichshall beprovidedatimportant

locations.

9.12.2.2 DesignPhilosophy

a) AcomprehensiveilluminationsystemshallbeprovidedL

b) Street Lighting shall be automatically controlled by synchronous timer. Provision to bypass the timer shall be provided in the panel for manual control.

c) The system shall include distribution boards, lighting panels, lighting fixtures, junction boxes, receptacles switch boards, lighting pole/masts, conduits, cables and wires, etc. The system shall cover all interior and exterior lighting such as area lighting, including Transformer yard etc. The constructional features of lighting distribution boards are given in item LT Switchgear.

d) The illumination system shall be designed on the basis of best engineering practice and shall ensure uniform reusable, aesthetically and glare free illumination. The lighting fixtures shall be designed for minimum glare. The Illumination levels to be adopted for various areas are indicated in Table Below.

Ballasts

All HPSV lamp fixtures shall be provided with wire-wound ballasts. All fluorescent fixtures except for Class-I, Div-II fittings/ increased safety fittings (Div-II/Hazardous Area) shall be provided with electronic ballasts. All luminaries and their accessories and components shall be of type readily replaceable by available Indian makes.

9.12.2.3 Fans&Regulators

Ceiling Fans shall be suitable for operation on 240 V,50 Hz, AC supply comprising of class F insulated copper wound single phase motor, 1200mm sweep, aerodynamically designed well balanced MS blades (3 Nos.), down rod, die cast aluminium housing, capacitor, suspension hook, canopies etc. finishedinstove enameledwhite. Power factorof fans shall not be less than0.9. Eachfanshall cover approximately l0 m2 area

9.12.2.4 SwitchBox

Switchboxesshallbemadeof1.6mmthick,MSsheetwith3mm.thickdecorative,cover.Switchbox shall be hot dip galvanized

9.12.2.5 JunctionBoxes

Junction box for lighting fixtures shall be deep drawn or fabricated type made of mm. 1.6mm thick CRCA Sheet. The box shall be hot dip galvanized.

9.12.2.6 Conduits,Fittings& Accessories

Conduits,PipesandAccessoriesGalvanizedheavydutysteelconduitsfornormalareaandgalvanized heavy-duty steel conduits with an additional epoxy coating for corrosive area shall be offered. Alternatively glass reinforced epoxy conduits with comparable compressive and impact strengthwith that of heavy-duty steel conduits may be offered.

a) RigidSteelConduits

Rigid steel conduits shall be heavy duty type, hot dip galvanized conforming to IS: 4 9537 Part-I & II shall be suitable for heavy mechanical stresses, threaded on both sides and threaded length shall be protected by zinc rich paint. Conduits shall be 4 smooth from inside and outside.

b) FlexibleSteelConduits

Flexibleconduitshallbewaterproofandrustproofmadeofheatresistantleadcoatedsteel.

9.12.2.7 Pull-OutBoxes

Pull out boxes shall be provided at approximately 4-metre interval in a conduit run. Boxes shall be suitable for mounting on Walls, Columns, Structures, etc. Pull out boxes shall have cover with screw and shall be provided with good quality gasket lining. Pull out boxes shall be weather proof type suitable for IP: 55 degree of protection. Pull out box & its cover shall be hot dip galvanized.

9.12.2.8 LightingWires

Lighting wires shall be 1100 V grade, light duty PVC insulated unsheathed, stranded copper/aluminum wire for fixed wiring installation, colour of the PVC insulation of wires shall beRed, Yellow, Blue and Black for R, Y, B phases & neutral, respectively and white & grey for DCpositive & DC negative circuits, respectively. Minimum size of wire shall not be less than 1.5mm^2 for copper and 4 mm2 for aluminium. The size of the lighting wires/ cables shall be selected such that the total voltage drop from the LDB to the lighting fixture I receptacle does not exceed 3%.

Lighting fixtures shall generally be group controlled directly from lighting panel. However, in office areas, control shall be provided through switch boxes. Each switch shall control a maximum of three fluorescent fixtures.

Wiring shall run throughout in separate conduits. Wires of different phases shall run in different conduits. Wiring for lighting circuits and receptacle circuits shall be carried out in separate conduits and from separate feeders.

Lighting panels etc. shall be earthed by two separate and distinct connections with earthing system. Switch boxes, junction boxes, lighting fixtures, fans, single-phase receptacles etc.shall be earthed by means of separate earth continuity conductor. The earth continuity conductor 14 SWG GI wire shall be run along with each conduit run. Cable armours shall be connected to earthing system at boththe ends.

9.12.3 LightingLevels

PumpHouseIndoor Area	AverageIllumination Level in Horizontal plane (in Lux)	Typeof fitting	Lamps
MainPumphousearea	200	HighBayanodized Aluminumreflector assemblycompletewith controlgearBox Tobesupplementedwith fluorescenttubelightsif	250/400W HPSVLamp 2 X40W

PumpHouseIndoor Area	AverageIllumination Level in Horizontal plane (in Lux)	Typeof fitting	Lamps
		required.	
ServiceBay	200	-do-	-do-
ControlRoom	300	Mirroroptic	2x40 Watt fluorescent tube lights
SwitchgearRoom	250	Mirroroptic	2x40 Watt fluorescent tube lights
Cablefloors&other areas (each)	100	Industrialtypevitreous enameled reflector	2x40 Watt fluorescent tube lights
W.C;galleries&Staircase	100	Industrialtypefitting without reflector	1x40 Watt fluorescent tube lights
Galleries	70	Water proof Bulk head Luminaries of cast Aluminiumstoveenameled	60W Incandescent lamps
BatteryRoom	150	Corrosion proof luminaries castAluminiumhousingwith specially designed vapour proof lamp holder	2x40 Watt fluorescent tube lights

9.12.4 GeneralRequirements

Location of lighting fixtures, switches and receptacles shall be shown on the drawing and shall be relocated if required to suit the site conditions.5A, 3 pin, 15A, 6 pin receptacles with switches shall be provided on the light control switch boards.

LP'sshallbeprovidedwithlabelsindicatingLPnumberandoutgoingcircuitfeedernumbers.

LPs shall be provided with cable gland for incoming cable and knockouts for outgoing conduit termination.

Cable and Conduit supports shall be provided at an interval of 300-400 mm for horizontal runs and 400-500 mm for vertical runs.

Cables and Conduits shall be kept, wherever possible at least 300 mm away from pipes, heating devices and other equipment.

For the purpose of calculating connected loads of various circuits, a multiplying factor of 1.25 will be made to the rated lamp voltage for lamp fixtures to take into account the losses in the control gear.

Junction boxes, pull boxes, terminal blocks, glands, conduits and accessories (elbows, tees, bends etc.) and supporting/anchoring materials shall be supplied, to make the installation complete.

Inalltypesofcabling,dueconsiderationshallbegiventoneatnessandgoodappearance.

Theworkforinstallation,testingandcommissioningoftheindoorlightingshallincludethemounting of fixtures with necessary materials, laying of cable/conduit, pulling of wires through conduit and external earth wire, providing all accessories for cable/conduit installation, including conduit fittings. Providingoflightcontrolswitchboardwithswitches,switchboardmounted5A,3pinreceptacleswith switches etc.

9.12.5 Testing

Lightinginstallationtestingshallincludebutnotbelimitedtothefollowing:

- Measuretheinsulationresistanceofeachcircuitwithoutthelampsbeinginplace.Itshouldbenot less than 1 M ohms to earth.
- Current and voltage of all the phases shall be measured at the lighting panel busbars with all the circuitsswitchedonwithlamps.Ifrequired,loadshallbere-balancedonthethreephases.
- Checktheearthcontinuityforallsocketoutlets.Afixedrelativepositionofthephaseandneutral connections inside the socket shallbe establishedforallsockets.

Afterinsertingallthelampsandswitchingonallcircuits,minimumandmaximumilluminationlevel shallbe measuredinthe areawithanapprovedindustriallightmeter.

9.13 D.C.BATTERYANDBATTERYCHARGER

9.13.1 BATTERY

9.13.1.1 INTENTOF SPECIFICATION

This specificationis intendedto covertheD.C.Battery withallmaterials andaccessories requiredfor the efficient & trouble free operation of control room. DC power supply from maintenance free rechargeable seal lead acid batteries i.e. VRLA battery would be preferred.

9.13.1.2 CODESANDSTANDARDS

Allstandards,specificationsandcodesofpractice,referredtoherein,shallbethelatest edition including all applicable officialamendments and revisions as on date of opening of bid.

In case of conflict between this specification and those (IS Codes, Standards etc.) referred toherein, the former shall prevail.

Allworksshallbecarriedoutasperthefollowingstandardsandcodes:

IS:10918	-	SpecificationforventedtypeNi-Cdbatteries.
BS:1146	-	Specificationforpotassiumhydroxide.
IS:1069	-	Specificationforwaterforstoragebatteries. Indian Electricity Rules. IndianElectricityActs

Equipmentcomplyingwithotherinternationallyacceptedstandardssuchas IEC,BS,VDEetc.willalso be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the contractor shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments of revisions in force as on date of opening of bid and shall clearly bringout the salient features for comparison.

9.13.1.3 GENERALTECHNICALREQUIREMENTS

9.13.1.3.1 Equipments

9.13.1.4.1 Containers

Containers shall be made of poly propylene plastic material. Containers shall be robust, heat resistance, leak proof, non absorbent, alkali resistant, nonbulging type and free from flaws such as wrinkles, craks, bisters, pin holes etc. Electrolyte level lines shall be marked on container in case of transparent containers. In case of opaque containerslevel gauge shall be provided.

9.13.1.4.2 VentPlugs

Safety Valve/Vent plugs shall be provided in each cells. They shall be anti splash type, having more than one exit hole and shall allow the gases to escape freely but shall prevent acid from coming out. The design shall be such that the water loss due to evaporation is kept to minimum. In addition the ventilator shall be easily removed for topping up the cells and ofsuchdimensionsthatsyringetypehydrometercanbeinsertedintotheventto takeelectrolyte samples.

9.13.1.4.3 Plates

The plate shall be designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuations of load. The construction of plate shall conform to latest revisions of IS: 10918. The separators shall maintain the electrical insulation betweenthe plates and shall allow the electrolyte to flow freely. Separators should be suitable for continuous immersion in the electrolyte without distortion.

Thepositiveandnegativeterminalpostsshallbeclearlymarked.

9.13.1.4.4 SedimentSpace

Sufficient sediment space shall be provided so that cells will not have to be cleaned during normal life and prevent shorts within the cell. Contractor shall furnish the supporting facts to prove the same.

9.13.1.4.5 CellInsulator

Each cell shall be separately supported on PVC/porcelain/hard rubber insulators fixed on tothe racks with adequate clearance between adjacent cells. Minimum distance between the adjacent cell shall be more than the budge allowed for two cells in accordance with IS:1146.

9.13.1.4.6 Electrolyte

TheelectrolyteshallbepreparedfrombatterygradePotassiumhydroxideconformingBS:5633 and distilled water conforming to IS:1069. The cells shall be shipped dry uncharged. The electrolyte shall be supplied separately.

9.13.1.4.7 Connectors& Fasteners

Nickel coated copper connectors shall be used for connecting up adjacent cells and rows.Bolts, nuts and washers shall be effectively Nickel coated to prevent corrosion. The thicknessof Nickel-coating of connectors should be not less than 0.02mm. all the terminals and cells interconnectorsshall be fully insulated or have insulation shrouds. End take off connections from positive and negative poles of batteries shall be made by single core cables having stranded aluminum conductors and PVC/XLPE insulation. Necessary supports and lugs for termination of these cables on Batteries shall also be supplied by the contractor. Allconnectors and lugs shall be capable of continuously carrying the 30 minute discharge current of the respective. Battery and through fault short circuit current which the battery canproduce and withstand for the period declared. Contractor shall furnish necessary sizing calculations to prove compliance to the same.

9.13.1.4.8 BatteryRacks

Wooden racks for all the batteries shall be provided. They shall b e free standing typemounted on porcelain/hard rubber/PVC pads insulators. Batteries shall preferably be locatedin the single tier arrangement. However, batteries shall having a complete cell weight of lower than 50kg could be located in the double tier arrangement. The batteries racks and wooden supports for cable termination shall be coated with three (3) coats of antiacid paint of approved shade. Numbering shade, Numbering tags, resistant to acid for each cell shall be attached on to the necessary rack. The bottom tier of the stand shall not be less than 150mm above the floor.

Wherever racks are transported in dismantled conditions, suitable match markings shall be provided to facilitate easy assembly.

9.13.1.5 Manufacturer'sIdentificationSystem

Thefollowinginformationshallbeindeliblymarkedonoutsideofeachcell

i) Manufacturer'snameandtrademark

ii) Country&yearof manufacture

iii) manufacturer'stypedesignation

iv) AHcapacityat5hourdischargerate

v) SerialNumber

9.13.1.6 Accessories

One complete set of all accessories and devices required for maintenance and testing of batteries shall be supplied corresponding of each battery bank. Each set shall include at least the following:

i) Hydrometer - 2Nos.

ii) Setofhydrometerspringsuitablefortheventholesindifferentcells. - 2Nos

iii) Thermometerformeasuringelectrolytetemp. - 5Nos

iv) SpecificGravitycorrectionchart. - 2Nos

v) Wallmountingtypeholdermadeofteakwoodforhydrometerand thermometer. - 2Nos

vi) Celltestingvoltmeter(3-0-3v)conformingtoIS:1248. - 2Nos

vii) Alkalimixingjar. - 2Nos

viii) Rubberapron. - 2Nos

ix) Pairofrubberglovers - 2Nos

x) Setofspanners - 2Nos

xi) "Nosmoking"notice. - 2Nos

xii) Goggles(Industrial) - 2Nos

xiii) Instructioncard. - 10Nos

xiv) MinimumandmaximumandMaximumtemperatureIndicator -

One setofvariablemetallicresistor and shunt suitablefor carrying out the discharge tests (5 Hr discharge rate) on all the batteries shall also be supplied.

ii.Thefollowinginformationshallbegivenontheinstructioncardssuppliedwiththe Battery :

a) Manufacturer'sinstructionsforfillingandinitialchargingofthebatterytogetherwith starting and finishing charging rate

b) Maintenanceinstructions.

c) DesignationofcellinaccordancewithIS: 10918

d) Storingconditionsofelectrolyte.

9.13.1.7 TESTS

1. AllroutineandacceptancetestsshallbecarriedoutasperrelavantIndianStandards.

2. Type test report of the tests conducted on identical battery within last five years shall be furnished. However for Battery not type tested in last five years, type test need to be performed without any extra cost to Owner.

9.13.1.7.1 RoutineTests

All the routine tests listed below shall cover cells containers, hard wares beingsupplied as per the latest issue of IS:1146 and IS:1651 or 1652 (whichever isapplicable)

a) Container

i) Verificationofconstructionalrequirements**.**

ii) Verificationofworkingandpacking.

iii) Highvoltagetests(Cl.7.6ofIS:1146)

b) CellandBatteries

i) Verificationofconstructionrequirements

ii) Verificationofmarking

iii) Verificationofdimensions

9.13.1.7.2 Typetests

All type listed below shall cover cells containers, hard wares of each type being supplied, as per the latest issue of IS:1146 and IS:1651 or IS:1652 (whichever is applicable depending on type of Battery beingoffered.)

a) **Container(RubberandPlasticcontainers)**

i) Highvoltagetest

ii) Dropball test

iii) Plasticyieldtest

iv) Acidresistancetest

v) Hydraulicthrustendurancetest

b) CellandBatteries

Thefollowingshallbecarriedoutinthesequencegivenbelow:-

i) Testsforcapacitiesfor5hrand30minutesdischargeratesandtestforvoltage during discharge.

ii) Amperehoursandwatt-hourefficiencytest.

iii) Testsforretentionofcharge.

iv) Endurancetests.

Type tests shall be carried out on three cells selected randomly. Two cells shall undergo all tests except capacity and endurance tests while the other would undergo only capacity and endurance test.

9.13.1.7.3 AcceptanceTests

Allacceptancetestsaslistedbelowshallbecarriedoutatsiteaftercompletionofinstallation.

i) Verificationofmarkings.

ii) Verificationofdimensions.

iii) Testsforcapacitiesfor5hrsdischargeratealongwiththetestforvoltageduring discharge.

The contractor shall arrange for all necessary equipment, including the variable resistor, tools, tackles and instruments. If a Battery fails to meet the guaranteed requirements the Owner shall have the option of asking the contractor to replace the same.

9.13.1.8 TechnicalParameters

9.13.1.8.1 Battery

a)	Batteryvoltage	Tobedecidedbythebidder
b)	No.ofcells	Asperthe rating
c)	BatteryType	StationaryNickleCadmium. HighDischargetype/VRLA Type
d)	Capacity	200AHor120 AHas specified
	Hourrateto1.0V/Cellat27^{0}Cinscopeofwork	
e)	Floatvoltage	1.4 V/Cell
f)	Boostvoltage	1.54V/Cellto1.7V/Cell

9.13.2 BATTERYCHARGER

9.13.2.1 INTENTOF SPECIFICATION

This specification shall be applicable for all chargers. These chargers shall supply power to control circuits of various equipment. Any item which is not specifically mentioned but required for successful & trouble free operation of the charger shall be in scope of bidder.

9.13.2.2 CODESANDSTANDARDS

All Standards, specifications and codes of practice referred to herein shall be the latesteditions including all applicable official amendments and revisions as on date of opening ofbid. In case of any conflict between this specification and those (IS Codes, standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards and codes.

ANSI-C		Guideofsurgewithstandcapabilitytests.
IS:5		Coloursforreadymix.Pains.
IS:694		PVCinsulatedcableforworkingvoltagesuptoandincluding1100V.
IS:1248		SpecificationforDirectactingindicatinganalogueelectricalmeasuring instruments.
IS:2147		Degreeofprotectionprovidedbyenclosuresforlowvoltageswitchgearand control gear.
IS:2959		Contactorsforvoltagesnotexceeding1000VACor1200V DC.
IS:3231		Electricalrelaysforpowersystemprotection.
IS:3842		ElectricalrelaysforACSystem.
IS:3895		Mono-crystallinesemi-conductorRectifierCellsandStacks.
IS:4064		Airbreakswitches,airbreakdisconnector,fusecombinationunitsforvoltage not exceeding 1000 V AC or 1200 V DC.
IS:4540		Mono-crystallinesemi-conductorRectifierAssembliesandEquipment.
IS:6005		Codesofpracticeforphospartingofironandsteel.
IS:6619		SafetyCodeforSemi-conductorRectifierEquipment.
IS:6875		ControlSwitches/switchingdevicesforcontrolandauxiliarycircuitsincluding contractor relays for voltages 1000 V AC or 1200 V DC.
IS:9000		Basicenvironmentaltestingproceduresforelectronicandelectricalitems.
IS:9224		Space.forlowvoltagefuses. Indian Electricity Rules. IndianElectricity Acts.

3.0 Equipment complying with other accepted standards such as I.E.C., B.S., V.D.E. etc., will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the contractor shall clearly indicate the standards(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.

9.13.2.3.3.1GENERALTECHINICALREQUIREMENTS

9.13.2.3.1 EquipmentDescription

1. The Battery Chargers as well as their automatic regulators shall be of static type. Battery chargers shall be capable of continuous operation at the respective rated load in Trickle mode i.e. Trickle charging the associatedmaintenance free rechargeable seal lead acid batteries i.e. VRLA battery while supplying the D.C. loads. The Batteries shall be trickle charged at 1.4 V to 1.42 V per cell. All chargers shall also be capable of Boost charging the associated D.C Battery at 1.54 to 1.7 volts per cell at the desired rate. The Chargers shall be designed to operate, as mentioned above, at ambient air temperature of 50 deg C.

2. Battery charges shall have a selector switch for selecting the battery charging mode i.e. whether Trickle or Boost Charging.

3. All Battery Chargers shall be provided with facility for both automatic and manual control of output voltage and current. A selector switch shall be provided for selecting the mode of output voltage/current control. Whether automatic or manual. Means shall be provided to avoid current/voltage surges of harmful magnitude/nature which may arise changeoverform Auto to Manual mode or vice-versa under normal operating condition.

4. Soft start features shall be provided to build up the voltage to the set value slowly within fifteen second. The chargers shall have load limiters which shall cause when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the load limiter setting of the Charger. The load limiter characteristic shallbe such that any sustained overload or short circuit in DC system shall not damage the Charger shall trip on overload or external short circuit. After clearance of fault, the Charger voltage shall build automatically when working in automatic mode.

5. When on automatic control mode during Trickle charging, the Charger output shallremain within +/-1%of the set value of AC input voltage variation of +/- 10% , frequency variation of +3/-5% combined voltage and frequency (absolute sum)variation of 10% and continuous DC load variation from zero to full load Uniform and stepless adjustment of the voltage setting (in both manual & automaticmode) shall be providedon frontofthe charger panel covering the entire trickle charging output range specified. Stepless adjustment of the load limiter setting shall possible from 80% to 100% of the rated output current for Trickle charging mode.

6. During Boost charging, the Battery Chargers shall operate on constant current mode (When automatic regulator is in service. It shall be possible to adjust the Boost charging current continuously over range of 50 to 100% of the output current for Boost charging mode.TheChargeroutputvoltageshallautomaticallytoonrising,whenitisoperatingon

Boost mode, as the Battery chargers up. For limiting the output voltage of the Charger, a potentiometershallbeprovidedshallbeprovidedonthefrontofthepanel.Whereby itshall be possible to set the upper limit of this voltage anywhere in the output range specified for Boost charging mode. All voltage and current setting potentiometers shall be vemier type.

7. Engineering the Charger with fully charged battery connected plus 10% load shall not result in output voltage greater than 110% of the voltage setting. Time taken to stabilise, to within the specified limts in clause 3.1(e) shall be less than fifteen seconds.

8. Momentary output voltage of the Charger, with Battery, connected shall be within 94 to 106% of the voltage setting during sudden load change from 100% to 20% of full load orvice-versa.Outputvoltageshallreturnto,andremain,withinthelimitsspecifiedinclause 3.1 (e)inlessthan2secondsafterthe abovementionedchange.

9. The Charger manufacturer may offer an arrangement in which the voltage setting device for Trickle charging mode is also used as output voltage limit setting device for Boost charging mode, and the load limiter of Trickle charging mode is also used as Boost charging current setting device.

10. SuitablefiltercircuitsshallbeprovidedinalltheChargerstolimittheripplecontent(peak to peak) in the output voltage to 1% irrespective of the DC load, even when they are not connected to a battery.

11. The D.C system would be ungrounded and would float with respect to the ground potential when healthy. An earthfault relay would be provided in the D.CDistribution Board for remote annuniciation.

9.13.2.4 PrintedCircuitBoards(PCB)

PCB shall be made of glass epoxy of 1.6mm thick, fire resistant, bonded with 99.8% pure copper foil, free ofwrinkles, blisters, scratches and pinholes. Thecontract surface of the edge connector of the PCBs shall be plated with hard gold to a minimum thickness of 5 microns. Component identification shall be printed on PCB by silk screen method. All PCBs shall be tropicalised and masked.

9.13.2.5 Contactors

All Battery chargers shall have an AC contactor on the input side. It shall be of air break typeand suitable for continuous duty. The operating coil be rated for 415 Volts AC.

9.13.2.6 ThermalOverloadRelay

A thermal overload relay incorporating a distinct single phasing protection (using differential movement of bimetal strips) shall also be provided for the AC input. The relay shall trip the above contactor.

9.13.2.7 Rectifier-TransformersandChokes

The rectifier-transformers and chokes shall be dry and air cooled (AN) type. The rating of the rectifier-transformers and chokes shall correspond to the rating of the associated rectified assembly. The rectifier-transformers and chokes shall Class-B insulation with temperature rise limited to Class-A insulation value.

9.13.2.8 RectifierAssembly

The rectifier assembly shall be full wave bridge type and designed to meet the duty as required by the respective Charger. The rectifier cells shall be provided with their own heat dissipation arrangement with natural air cooling. The rectifier shall utilize diodes/thyristors and heat sinksof extruded and anodized type for power diodes and thyristors rated to carry 200% of the load current continuously and temperature of the heat sink shall not be permitted to exceed 85^0C absolute duly considering the maximum charger panel inside temperature. The contractor shall submit calculationsto show whatmaximum junctiontemperaturewill beand what the heat sink temperature will be when operating at 200% and 100% load current continuously duly considering the maximum surrounding air temperature of 50^0C outside the panel. Necessary surge protection devices and rectifier type fast acting fuses shall be provided in each arm of the rectifier connections.

9.13.2.9 Instruments

D.C. voltmeter, D.C. ammeter and A.C voltmeter in 96mm square shall be provided for all chargers. The instruments shall be flush mounted type, dust proof and moisture resistant. The instrumentsshallhaveeasilyaccessiblemeansforzeroadjustments.Theinstrumentsshallbeof 1.5accuracyless.

9.13.2.10 AirBreakSwitches

All chargers shall have AC input and DC output switches of air break, single throw, load breakand fault make type. The contacts of the switches shall open and close with a snap action. Switches shall be rated for 120% of the maximum continuous load, 'ON' & 'OFF' position of the switch shall be clearly indicated.

9.13.2.11 ControlandSelectorSwitches

Control and selector switches shall be of rotary stayput type with escutcheon plates showingthe functions and positions. The switches shall be of sturdy construction and suitable for mounting on panel front. Switches with shrouding for live parts and sealing of contacts against dust ingress shall be preferred. The contact ratings shall be at least the following :

i)	Makeandcarrycontinuously	-	10Amps
ii)	Breakingcurrentat110VDC	-	0.5 Amps(inductive)
iii)	Breakingcurrentat240V AC	-	5Amp.At0.3p.f

9.13.2.12 Fuses

FusesshallbeofHRCcartridgefuselinktype.Fusesshallbemountedonfusecarrierswhichare mounted on fuse. Wherever, it is not possible to mount fuses on fuse carriers, fuses shall be directly mounted on plug in type bases. In such cases one insulated fuse puling handle shall be supplied foreach charger.Kick-off fuses(tripfuses)with alarmcontacts shall beprovidedforall D.Cfuses.

9.13.2.13 IndicatingLamps

Three (3) indicating lamps shall be provided to indicate A.C supply availability. The indicating lampsshallbeofpanelmounting,filamenttypelowwattageandcapableofclearstatus

indication under the normal room illumination. The lamps shall be provided with seriesresistors (non-hygroscopic) preferably built, in the lamp assembly and replaceable from front. The lamp covers shall be preferably screwed type, unbreakable and moulded from heat resistant material.

9.13.2.14 BlockingDiode

Blocking diode shall be provided in the output circuit of each Charger to prevent current flow from the D.C Battery into the Charger.

9.13.2.15 AnnunciationSystem

Visualindicationsthroughannunciationfaciashallbeprovidedinallchargersforthefollowings:

i) A.CSupply failure.

ii) Rectifierfusefailure

iii) Surgecircuitfusefailure

iv) Filterfusefailure

V) Loadlimiteroperated

vi) Chargertrip

vii) Batteryinboost

9.13.2.16 NamePlatesandMarking

The name plates shall be made of non-rusting metal/3 ply Lamicoid and shall have black back-ground with white engraved letters and secured by screws. These shall be provided near top edge on the front as well as rear sides of Charger. Name plates with full and clear inscriptions shall also be provided on and inside of the panels for identification of the various equipments.

9.13.2.17 Construction

The Chargers shall be indoor, floor mounted, self supporting sheet metal enclosed cubicle type. The contractor shall supply all necessary bade frames, anchor bolts and hardware. The Charger shall be fabricated using cold rooled sheet steel not less than 2.0mm. and shall have folded type of construction. Thepanelframeshall be fabricated using cold rolled sheet steelof thickness not less then 2.0mm. Removable undrilled gland plates of at least 3.0mm sheet steel and lugs for all cables shall be supplied by the Contractor. The lugs for cables shall be made of electrolytic copper with tin coat. The Charger shall be tropicalised and vermin proof. Ventilation luvers shall be backed with fine brass wire mesh. All doors and covers shall be fitted with synthetic rubber gaskets. The Charges shall bave hinged double leaf doors provided on front and/ or backside of adequate access to the Charger internals. All the Charger cubicle doors shall be properlyearthed. The degree of protection of Charger enclosure shall be atleastIP-52 per IS: 2147.

1. All indicating instruments, control & Selector switches and indicating lamps shall be mounted on the front side of the Charger. Design of panels shall be based on the followingdimensions.

a)	Overallheight	**-**	Maximum2350 mm
b)	Operating handles (highest and lowest positions reached by operator's hand),protectiverelaysinstrumentsand mechanical indicators	**-**	Maximum1800mm minimum 350 mm
c)	Doorsandpanelhandlesandlocks	**-**	Maximum1800mm Minimum 300 mm

2. Electronic equipments shall be of modular design consisting of plug in modules in standard 19 inches metallic racks with metallic card guides. The cards should be provided with proper handles. Card to card wiring should be preferably through a mother board Unplanned Jumpering and track. Modifications are not permitted. Mechanical interlocks to prevent wronginsertionof cardsshouldbe provided.Eachcardshallhave its junctionandtestpoints identified. Maintenance aids such as extension printed wring boards and jumper leads shall be provided.

3. For locking Trickle/Boost selector switches in the trickle position only. This would be used for having key mechanical interlock between Trickles/Boost selector switch and isolator in D.C distribution board.

4. The Charger enclosure door locking requirements shall be met by the application of padlocks. Padlocking arrangement shall allow ready insertion of the padlock shackle but shall not permit excessive movement of the locked parts with the padlock in position.

9.13.2.18 Wiring

Each charger shall be furnished completely wired up to power cables lugs and terminals blocks ready for external connection. The power wiring shall be carried out with 1.1 KV grade PVC insulated cables conforming to IS: 1554 (Part-II). The control wiring shall be 1.1 KV grade PVC insulated stranded copper conductor, of 2.5 sq.mm conforming to IS: 694 Control wiring terminating at electronic cards shall not be less than 1.0 sq.mm Control terminals shall be suitable for two wires with 2.5 sq.mm stranded copper conductors. All terminals shall be numbered for ease of connections and identification. At least 20% spare terminals shall be provided for circuits.

1. Power and Control wiring panels shall be kept separate. Any terminals or metal work which remains alive at greater than 115V when paneldoor isopened shall be fully protected by shrouding.

2. An air clearance of at least ten (10) mm shall be maintained throughout all circuit, except low voltage electronic circuits, right up to the terminal lugs. Whenever this clearance is not available, the live parts shall be insulated or shrouded.

9.13.2.19 Painting

Allsheetsteelworkshallbepretreatedintanks,inaccordancewithIS:6005.Degreasingshall be done by alkaline cleaning. Rust and scale shall be removed by pickling with acid. After pickling the parts shall b e washed in running water. Then these shall be rinsed in slightly alkaline hot water and dired. The phosphate coating shall be 'Class-C' as specified in IS:6005. Welding shall not be done after phosphating. The phosphate surfaces shall be rinsed and passivated prior to application of staved lead oxide primer coating after primer application, two coats of finishing synthetic enamel paint of shade-622(smoke grey) of IS: 5 shall be applied, unless required otherwise by the Owner. The inside of the Charges shall be glossy white. Each coat of finishing synthetic enamel paint shall be properly stoved.The paint thickness shall not be less than fifty (50) microns. Finished parts shall be coated by the peelable compound by spraying method to protect the finished surfaces from scratches, grease and dirt during testing, transportation handling and erection. All hardwares shall be nickel chromium plated.

9.13.2.20 TESTS

The routine tests shall be carried out on Battery Chargers as per relevant latest Indian Standards. The type test report of the tests conducted on identical Battery charger within last five years from the date of Letter of Award shall be furnished. However, if the type test are not conducted in last five years, the type tests need to be performed without any extra cost it Owner.

9.13.2.20.1 TypeTests

FollowingtypetestshallbecarriedoutoneachratingandtypeofBatteryCharger.

a) Completephysicalexamination

b) i) Temperatureriseatfullload.

ii) Temperatureriseofrectifierassemblyat200%offullload.

c) Insulationresistancetest.

d) HighVoltage(powerfrequency)testonpowerandcontrolcircuitsexcept low voltage electronic circuits.

e) Ripplecontenttest at

i) No load

ii) Halfload

iii) Fullload

a) AutomaticvoltageregulatoroperationtestatspecifiedA.C.supplyvariationsat.

i) No load

ii) Halfload

iii) Fullload

a) Loadlimiteroperation test

b) Efficiencyandpowerfactormeasurement

c) Input and output surge withstand capability test Surge Voltage as per ANSIC37.90 a shall be applied not less than 2 sec. at the following points of the Charger operating at 50^0 at full load.

i) AcrosseachA.Cinputphase

ii) AcrossA.Cinputlinetoground

iii) AcrossD.Coutputterminals.

iv) AcrosseachD.Coutputterminaltoground

Thechargershallnotexhibitanycomponentdamageandthereshallbeno change in performance as per cluse 4.02.00 (f) and (g).

9.13.2.20.2 3.7.01EnvironmentalTest

Steadystateperformancetests{Clause4.02.00(f)and(g)}shallbecarriedoutbefore and after each of the following tests.

i) SockTest

The electronic modules shall be subjected to continuous operation for minimum period of 72 hours. During last 48 hours, the ambient temperature shall be maintained at 50^0 C. The 48 hours test period shall be divided into four equal 12 hoursegments.The inputvoltage duringeach12 hours shallbe nominalvoltage for 11 hours followed by 110% of nominal voltage for 30 minutes followed by 90% of nominal voltage of 30 minutes.

ii) Degreeofprotectiontest

9.13.2.20.3 RoutineTests

3.8.01 Followingroutinetestshallbecarriedoutinall Rectifier-transformers.

a) Temperaturerisetest

b) Insulationresistancetest.

c) Highvoltage(powerfrequency)test.

3.8.02 Followingroutinetestsshallbecarriedoutonall Battery Chargers.

a) Compietephysicalexamination.

b) Temperaturerisetestatfullload.

c) Insulationresistancetest

d) High,voltage(powerfrequency)test.

e) Ripplecontenttest at

i) No load

ii) Halfload

iii) Fullload

f) AutomaticvoltageregulatoroperationtestatspecifiedA.Csupplyariationsat

i) No load

ii) Halfload

iii) Fullload

g) Loadlimiteroperation test

h) Checkingofproperoperationofannunciationsystem

i) Dynamicresponsetest'

Overshoot/UndershootinoutputvoltageoftheChargersasaresultofsudden change in load from 100% to 20% to 100% shall be measured.

j) BurninTest-shallbecarriedoutonatelectricalmodulesaspanelswithmodule as routine test. During the test panel/module shall be subjected to ambient temperature to 500C for 48 hours in energized condition, the temperature rise inside the cubicle shall not exceed 10^0 C during the test.

k) Degreeofprotectiontest-thechargershallbecheckedforgasketing arrangement as per drawing.

9.13.2.20.4 Followingroutinetestsshallbecarriedouton Annunciationsystem:

a) Annunciation Assembly & modules shall be functionally test as per EEUA-45D.

b) Burnintestshallbecarriedoutasper Cl.4.03.00

c) The Contractor shall furnish for inspection, the type and routine tests certificates for the following components whenever required by the Owner's approval.

a)	Relays
b)	Instrument
c)	SCR
d)	Diodes
e)	Chokesand transformer
f)	Annunicator

9.13.2.21 COMMISSIONING

The Contractor shall carryout the following commissioning tests and checks after erection of the equipment at site.

a)	Completephysicalexamination
b)	Checkingofproperoperationofannunciationsystem
c)	Temperaturerisetestatfullload.
d)	Insulationresistancetest
e)	Automaticvoltageregulatoroperation
f)	Loadlimiteroperation
g)	Dynamicresponsetest Overshoot/ undershoot in output voltage of the Chargers as a result of suddent change in load from 100% to 20% and 100% shallbemeasuredwiththeBatteriesconnected/disconnected. Output voltageoftheCharger connectedwith Batteryshall be within 94% to 106% of the voltage setting in above conditions and shall return to and remain, within the limits specified in clause 3.01.00(e) in less than2 seconds.

1. If Charger fails to meet the specified requirements, the Contractor shall replace the same with appropriate charger without affecting the commissioning schedule, and without any extra cost the Owner.
2. **A**bovetestand checksshall be carriedout inthe presenceoftheEngineer, it desired by the Engineer, for which the Contractor shall give atleast 20 days advance notice.

3. GuaranteedTechnicalspecification/Data

The contractor may furnish all data related toguaranteed technical specifications andrelevant data as per details mentioned in Appendix EM1 data sheet E-5.

9.13.2.22 TECHNICALPARAMENTS

a)	D.Coutputratings		
	i)	System	110V
	ii)	TrickleChargingMode	
		-Voltage range	90V-130V
		-Ratedcurrent	15A
	iii)	BoostChargingMode	

		-Voltagerange	115-150V
		-Ratedcurrent	15A
b)	A.Cinput		
	i)	Voltage	415,±10%(3phase4)
	ii)	Frequency	50Hz+3%to (-)5%

9.14 TECHNICALSPECIFICATIONSFORINSTALLATION,TESTINGANDCOMMISSIONINGOF ELECTRO-MECHANICAL EQUIPMENTS AND SYSTEMS

9.14.1 SCOPE

This specification covers complete mechanical, hydraulic and electrical installation including labour, materials, tools, instruments, services, storage during erection, unpacking, grouting, cabling etc. and also testing, commissioning and putting into commercial operation of all pumping units driven by electric motors along with all the electrical and mechanical equipment and systems.

9.14.2 EXTENTANDITEMSOFWORKS

1. Placesof Erection

The installation works, covered by the present specification is distributed principally in the pumping station and shall include the all the equipment and Cubicles covered in this specification.

2. Theinstallationworkalsoincludeslayingofpowerandcontrolcablesforinter-connecting power and control circuits.

3. Itemsof works

The contractor shall provide skilled, semi-skilled and unskilled labour, all necessary services, construction tools, derricks, cables and slings, rigging skids, blocking, scaffoldings, welding machines, equipments for heating, stress relieving equipment, instruments, appliances, materials and supplies required for handling, storage during erection, erection and testing etc., that may be required to accomplish the work under this contract, unless otherwise provided for. Adequacy of such equipments willbe subject to final approval by the Engineer.

2.4 Thematerialstobefurnishedbythecontractorshallincludebutnotbelimitedtothe following:

a) Allconsumablematerialanddevices

b) Alljoiningmaterialslikegaskets,roundrubber,gland-packingetc.

c) Cable identification tags, wire identification ferrules, HT & L T insulating tapes, Bitumen tapes, solder etc.

4. Theworktobeperformedbythecontractorshallincludebutnotbelimitedtothefollowing services as required for the complete installation and placing the equipment in commercial operation:

a) Indenting of equipment and materials (the equipment shall be received by the contractorfrom his stores and transported into the eretion bay).

b) Providingadequate,mechanicalandweatherproofprotectionfortheequipmentandmaterials (see also clause 7).

c) Providing temporary power and lighting facilities inclusive of all materials, required for the installation work (see also clause 6)

d) Handling and assembling equipment and materials (as given in clause 3) including erection, leveling aligning, grouting, fixing, cabling, wiring, piping, welding, purifying and filling oil and lubricants, connecting, start up and initial

e) Checking of all systems and components of equipments, pre-commissioning and commissioningtest, bringing into initial operation and commissioning.

f) AccordingforallmaterialequipmentandreturningalltheunuseditemstotheEngineer.

g) Paining of all non-galvanized steel parts and paining for phase, circuit, voltage and equipment identification of different circuits, switches, piping etc.

h) All incidental and auxiliary works as may be necessary for the satisfactory and successful completion of the work in accordance with the specification, standards and manufacture's / consultants instructions.

5. Allthe works shall be carried out to the satisfaction of the Engineer. The contractor shall be responsible for the correctness, alignment and positioning of the work according to the drawings and manufacture's /supplier's instruction, base lines and bench marks.

6. Thecontractor shall be completely responsible for all the works covered under the scope of this specification not withstanding that the may have assisted by the Engineer in doing so.

9.14.3 LISTOFMAJOREQUIPMENTSTOBE ERECTED.

The list of major equipment which are required to be installed within the scope of this speciation is given below. The list does not cover all the equipments and materials required to be installed and required for the proper functioning of the generating station. The list should not be considered as defining the equipment of limiting the extent work.

i) VerticalTurbine pumps

ii) Firefightingequipmentforeachpumphouse.

iii) Coolingwaterequipmentforeachpumphouse.

iv) OnenumberE.O.Tcrane,asspecifiedforeachpumphouse.

v) Controlandprotectingequipmentforeachpumphouse.

vi) Two numbers, 3 phase transformers (with appropriate voltage grade 33/6.6 KV, 6.6/.415 KV, 33/.415 KV and proper capacity) in each new pump house to meet the prime drive load and other auxiliary LT load.

vii) 6.6KVswitchgearetc,includingassociatedcivil works.

viii) 415Volts,LTACSwitchgearforeachpumphouse.

ix) A Set of battery, set of charging equipment and one D.C distribution board for each new pump house.

x) Automationsystem(PLCnetworking)forindividualMega-Liftscheme.

xi) Illumination board and fitting and wiring of various luminaries and fixtures for each pump house.

xii) Layingofgroundmatintheeachpumphouse.

xiii) Installationofinternalcommunicationsystem.

xiv) Air cabling and wiring connecting different equipment installed in the each pump house. Erection of all embedment required for laying of cable racks, ventilation and air conditioning ducts, various piping etc

xv) Allpipesandfitting.

9.14.4 STANDARDS

The procedure followed and precautions taken and the equipments/ materials used in the installation work shall conform to the relevant Indian or Internal Standards and also to the following wherever applicable.

1. IndianElectricityRules,1956
2. IndianBoilerRegulationsandallotherapplicablestatutoryrulesandregulations.
3. IndianFactories Act
4. IndianExplosives Act
5. NationalElectricalCode-StandardsoftheNationalBoardofFineUnderwrites(USA)

9.14.5 DRAWING

1. A listof drawingsenclosedwith specifications aregiven in a separatevolume.These are only specificationdrawings and are not to be used for construction. These are enclosed to facilitate understanding of the project scheme, general pump house layout and the equipmentsinvolved,etc,andforestimatingthenatureandextentworkinvolved.Thelistof drawings and equipment/materials shown are liableto be revised for additions,corrections and to include additional drawings.

2. Constructiondrawingsshallpreparedbythecontractoronthebasisofmanufacture's /suppliers drawings The contactor shall carry out theinstallationwork according to suchdrawings and instruction books issued for construction by various manufactures.

3. The drawings, diagrams and manufacturer's instruction shall be read together. Disagreements and inconsistencies, if any, shall be brought to the notice of the Engineer whose decision shall be final.

4. Duringtheprogressofthework,thecontractorshallmaintainandmarka completesetof the latest design, drawings issuedfor construction, in which all deviations from thedrawings in the actual execution shall be clearly marked as " as built" conditions,. Upon completion of all works, the contractor shall furnish the Engineer with a set of "as built " drawings.

9.14.6 TEMPORARYPOWER&LIGHTING

1. Al temporary lighting and power facilities required for the installation work shall be furnished and installed by the contractor. These temporary installations shall include cables, outlets and conduits supports, insulators fuses, switches and other required materials.

2. Thecontractorwillhavetotakeconstructionpowerfromarea DISCOM

3. Engineer cannot guarantee uninterrupted supply of electric power and no claim for compensation for any failure or short supply shall be entertained by the Engineer nor shall any extension of time be entertained on this account.

4. The materials used for temporary facilities shall not be reused in any permanent installation. The contractor shall remove all temporary facilities from the plant premises, after the same have served the purpose.

9.14.7 STORAGEANDPROTECTIONOFTHE WORKS

1. The contractor shall used care and diligence to ensure that all works, equipments, material furnished, handled, stored and/or installed by him are at all times thoroughly protected from the weather and from any damage. Necessary labour, tarpaulins, boards, boxes, frames, canvas, polythene sheets and other materials and any temporary light, heat or cooling facilities, fire protection or protection from insects required to keep the materials/equipment in first class condition shall be furnished and installed by the contractor.

2. The contractor will be responsible for the receipt, storage and protection of material and/or equipment as received at site on behalf of the employer for installation by the contractor. The equipment shall be suitably insured during transit, storage, erection, testing and commissioning so that all risks of the employer are fully covered.

3. The contractor shall provide watch and ward storekeepers, etc. to safeguard the materials, tools, construction aids and equipment while in the contractor's care, custody or control during the performance of work and till its taking over by the employer.

9.14.8 EQUIPMENTINSTALLATIONANDCOMMISSIONING

1. The contractor shall check, clean all dirt and rust, install, connect, test and place in commercial operation all plan/ machinery, equipments included in this specification, in accordance with the detailed Instructions/drawings of the manufactures/suppliers or as directedby the Engineer.Allworksshallbeperformedby qualified,trainedandexperienced personnel, licensed where required *in* the various trades.

2. Extreme care shall be taken in handling equipment in position and moving it into place. Any damage to the equipment or T&P belonging to the contractor or employer shall be reported to the Engineer. Installation of the damaged equipment shall not proceed until the Engineer has had an opportunity to assess the extent of damage and decide on the procedure to be adopted. The contractor shall repair or replace at his expense, any equipment damaged by him during the progress of work. Such repairs or replacements shall be subject to the Engineer's approval.

3. Allequipmentsshallbeinstalledandsecuredinplaceinaworkmanlikemannersothatit

is level and true, properly aligned and oriented. Tolerances shall be as per manufacturer's drawings/instructions or. as specified by the. Engineer No equipment shall be permanently bolted down to foundation or structure until the alignment has been checked and found acceptable by Engineer.

4. Contractor shall make his own arrangement for hoisting and handling the equipment.The contractormay suitably plan thesequenceof erectionofequipmentso thatthe craneis Installed and commissioned by him prior to erection of the pumping unit.

5. The erection and installation of the equipment shall be subject to the supervision of the Engineer or his representative. The contractor shall also arrange for the service of the erection supervisor of the manufacture at his own expense wherever it is felt essential. The contractor shall comply with the instructions of the Engineer/erection supervisor regarding the procedure, method and quality of work and shall execute the work to their satisfaction. The detailed action schedule, including the number, specialization and duration of stage of all supervisory erection and commissioning personnel of various supplier shall be finalizedby the contractor and shall be subject to the approval of the employer.

6. It shall be the responsibility of the contractor to provide and depute the requirednumberoffirstclasswelders,weldingrods,weldingsetsforalltypesofweldingwork.athis cost. All welders shall be certified welders who shall be got tested and approval by the Engineer at site. All arrangements in regard to the tests for approval of the welders, at site, will have to be made by the contractors, at his cost. Details of welding tests and acceptance standards shall be laid out by the Engineer in consultation with the erection supervisors of the manufacturer and will be binding on the contractor.

7. The contractor shall provide concrete foundations, furnishing and placing of reinforcementand concreting as and when necessary. The contractor shall also be responsible for setting the anchor bolts and foundation bolts correctly and in position. The contractor shall also carry out grouting to the satisfaction of the employer.

8. A service bay is provided in the each pump house for facilitating unloading and assembly of equipment.

9.14.9 EQUIPMENTSPECIFICATIONSANDINFORMATION

1. The technical specifications of various equipment and systems to be erected are given in various sections. The drawings as listed in a separate volume indicating the general arrangement and layout of different items at various levels in the each pump house are enclosed. The weights and dimensions of various items of heavy equipment may beindicated in the offer by the contractor.

    a. The contractor shall familiarize himself with the constructional features of all Electrical & Mechanical plant &equipments as applicable for scheme. The erection schedule shall need to be adhered to and the contractor shall quote accordingly.Any deviationfrom thisshallbeclearly broughtandin thetenderalongwithreasons forsuchdeviations.Theemployerreservestherightto reject,anybiddeviatingfrom the schedule as envisaged without assigning any reason.

2. The contractor' shall review the location of equipment/various panels and give his recommendations regarding their location which could be more suitable from the point of view of erection, operation and maintenance.

3. Cables,Racks,Trays& Accessories

    a. The power and control cables forthe aforementionedequipmentto be erectedshall be on cable racks, in build up trenches on cable trays and supports in conduits and ducts or bars on walls, ceiling etc. which shall be got approved from the engineer.

    b. The contractor's scope of work .include laying, fixing, joining, bending and terminatingofpower/controlcablespertainingtothepumpingunitsanditsauxiliary equipment such as unit control and automation boards, motor terminals etc. All the control and power equipment as well as auxiliary transformer and H.T. switch gearto be erected in the switchyard. Permanent cable trenches for laying cables underground, the excavation and back fitting of trenches and' permanent reinstatement are included in the scope of work of this contract.

    c. Standard cable grips and reels shall be used for cable pulling and care shall be taken to avoid damage to cable end seal and cable insulation or stressing cable beyond manufacturer's recommendations in pulling.

    d. All the cable termination shall be made according to the relevant drawings in a neat workman like and approved manner. Cables shall be provided with non-corrosive type identification tags at the ends and at suitable intervals in long· runs. At the control cable terminations, each core shall also be provided with ferrulesdesignating the wire number or any other identifications mark as given in the schedule. The cable cores or any. Other identification mark as given in the schedule. The cable cores or wires which are not used for making connections shall be sharply cut without exposing any conductor. All identification tags, wire ferrules etc. required shall be provided by the contractor. Metal sheath of the cable shall be bounded to the earth system of station.

    e. All power cables shall be megger tested before connecting or jointing. After jointing all LV cables shall be mugger tested and HV cables appropriately pressure tested before commissioning. All the cable cores shall be tested for continuity, insulation resistance to earth and between conductor. The contractor shall furnish all testingkit and instruments required for field testing including high voltage testing kit.

9.14.10 GROUNDINGOFEQUIPMENT

Allelectricalequipmentsrequiredtobegroundedshallbeconnectedtothe grounding bus as per relevant drawings/instructions of Engineer.

9.14.11 INSPECTIONANDTESTS

1. Upon completion of the various phases of the work, or at convenient times during the progress of the work, equipment and wiring installed by the contractor shall be checked, tested and got inspected. Any defects pointed out by the Engineer/GovernmentInspectorshallbecorrectedbythecontractoratnoadditional

cost.

2. All checking and testing procedures shall be performed by competent and experienced personnel employed by the contractor In the presence of all as directed by the Engineer.

3. All equipments and instruments required to conduct the tests shall be provided by the contractor.

4. The contractor shall provide all labour, materials, tools and instruments and supervision and shall be responsible for conducting pre-commissioning tests on all equipments as per relevant standards. In cases, where the services of the commissioning engineer of the manufacturer/supplier of the equipment is availed, the tests shall be performed under the overall supervision of the said commissioning engineer.

5. Thechecksandteststobemadeshallincludebutnotbelimitedtothefollowing:-

i) All routine and pre-commissioning tests and any other special test required to be conducted at site on other motors, pumps, associated equipment as specified and as agreed to between the contractor and the engineer as per recommendations ofsupplier of various equipments.

ii) All routine and. pre-commissioning tests and any other special tests required to be conducted at site on each and every equipment as per the relevant standards and manufacturer's instructions and recommendations.

iii) Visual checks for correctness of all wire and cable connections, including internal wiringof control panels, switch gear, transformers and all other equipment.

iv) Visualchecksforcorrectnessofallpipingsandchecksforanyleakagesofairwateroiletc.ast hecasemaybe.Continuitychecksforallcontrolandpowercables includingeachconductorofmulticonductorcables.

vi) Insulationresistancetestsof,*all*powerandcontrolcables,motors,panels, switchgear gear, instrument transformers etc.

vii) Polaritychecksofallinstrumenttransformers.

viii) Leadresistancemeasurementsofcurrenttransformercircuits.

xi)TheprimaryandsecondaryinjectiontestsforCTsandrelays.

xi) Checksforadjustmentandcharacteristicofallcontroland protectiverelaysinaccordance withmanufacturer's instructions.

Settingandcalibrationofrelays

xii) Checkallequipmentforpropermechanicaladjustmentandfreedomofoperation.

xiii) Checkelectricaloperationofallremotelyoperatedequipment.

xiv) Energizeallcontrol,protection,alarm andsupervisioncircuitsandcheckeachcircuit

forcorrectfunctionaloperationincludingallinterlockdevices.

xv)Check all meters for proper rotation and correct measurement under load conditions. Checks to detect excessive vibration of equipment and foundations, misalignment etc.

xvii) All other tests as specified under various sections. Different relevant standards and codes of practice but not mentioned here.

During the course of all tests, contractor shall keep a complete record of all tests done and measurements taken and also record all adjustments, alternations and repairs made to the equipment. After completion of the tests, contractor shall furnish three copies of all such records complete to the engineer duly signed.

9.14.12 INITIALOPERATION,COMMISSIONINGANDCOMMERCIALOPERATION

1. Before putting the units in operation, all equipment shall be thoroughly cleaned and then inspected in the presence of the Engineer-in-charge for correctness and completeness of installation . and acceptability for operation

2. The procedure to be followed for completion tests, trial run and period of initial operation shall be as per standard and as agreed to between the contractor and engineer prior to the tests being carried out. Sufficient notice 'should be given by the contractor about readiness for performing the trial run and initial operation.

3. When the contractor and engineer as satisfied that the equipment is operating properly, testsreportsheets,intheformasapprovedbytheengineershallbecompiledforeachpiece of equipment. Five copies of each report shall be submitted to the Engineer.

4. Immediately.after the trial run, an overall inspection of the station shall be made to detect any signs of mal-functioning of any part of the equipment or of any auxiliary system.

5. Approval in writing will be given by the employer/engineer after he is entirely satisfied regarding the correct and proper functioning of all equipments auxiliaries, services etc. for putting the pumping units into initial operation.

9.14.13 TRAININGOFENGINEER'SSTAFF

The contractor shall provide the necessary facilities for training the project staff for the erection, testing and commissioning of the equipment including in these specifications.The training shall commence immediately after the award of the contract and shallcontinue till all the plant and equipment is erected, tested and commissioned. These trainees will be deputed to operate and maintain the machinery subsequently.

9.14.14 ERECTIONANDCOMMISSIONINGSCHEDULE

The contractor shall furnish along with the tender a detailed erection and commissioning target given in these specification.

9.14.15 SCHEDULEOFCONSTRUCTIONEQUIPMENTANDEXPERIENCE

The tender shall indicate the list of construction equipment which will be brought by him to the site for carrying out various constructions and testing activities

9.15 Miscellaneous

9.15.1 Cableglandsandlugs

Allcableglandsshallbemadeoutofbrassandshallbeofdoublecompressiontype. All cable

lugs shall be of tinned copper, crimping type.

9.15.2 Cabletrays

Cable carrier system shall comprise of site fabricated ladder type cable trays made out of structural steel and painted with two coats of red oxide primer and a final coat of enamel paint. The constructionofthecabletraysshallbeasperthesite requirement.Analternatecablecarriersystem may be considered made of Hot Dip Galvanised Iron.

9.15.3 LocalPush-button(PB)Stations

Construction	Outdoortypeweatherproof
Mainpump motor	On-offwithde-interlockswitchandammeter
Othermotors	On-off
Valvemotors	Forward-reverse-stop

9.15.4 LightingPanel

The panels shall be of 14 gauge sheet metal construction. Panels shall be equipped with phase and neutral busbars of adequate capacity and miniature circuit breakers. The incomer shall be of ELMCB and outgoing circuits shall have only MCBs.Miniature circuit breakers shall be mounted in such a way that operating levers project outside the front bakelite cover plates. A hinged door to cover the operating knobs shall be provided. Synthetic rubber gasketing shall be provided between box and cover. The board shall be provided with detachable top and bottom plates with 25 mm knockouts.All metal surfaces shall be cleaned free of rust, given a coat of red oxide primer and finished withtwo coats of synthetic enamel paint of shade 631 as per IS 5. A 415V danger board and engraved nameplate shall be fixed on the panel. The lighting panels shall be marked with the voltage and No. of phases of the supply.

9.15.5 StreetLight Pole

Coat of bituminous preservatives to be applied before concreting to the embedded portion of the pole.Two coats of red oxide primer shall be applied followed by two coats of aluminium paints to the portion above ground of pole and mounting bracket, sleeves etc.

10 m long swage steel tubular pole conforming to IS 2713 with 1.8 m buried in ground with weather proof junction box fixed at 1500 mm above the ground containing one 6A, DP 10kA 'B' series MCB and a connector strip to loop in loop out cable, with wiring by 3 runs of 6mm^2 PVC insulated cables from the weather proof box to the top of the pole up to the luminaires.

9.15.6 Rubbermat

1 M wide11 kV grade and1.1 kV grade rubbermat shall be providedin frontof the 6.6 kVand 415 V panels.This mat shall cover the full length of the panel.

9.15.7 Fire Extinguisher

Min.7.5 kg carbondioxideextinguishersshallbeprovidedinelectricalpanelrooms.Thesecylinders shall be located on wall at easily accessible locations.

Firebucketstandwith4numbersroundbottomfirebucketshallbeprovidedoutsidethe transformer room.

9.16 DataSheetstobefilledbyContractor–Electrical

9.16.1 TechnicalParticulars

Thecontractorshallcompletethevarioustablesgivenunderthisscheduletogivethetechnical particulars of the equipment proposed by him.

Ifanyadditionalparticularsarenecessaryortheparticularsaregiveninsomeotherformthesame may be enclosed separately.

Thecontractorshallgiveallthe particulars.Thetender,maybeconsideredasnon-responsive,if important particulars are not submitted.

9.16.2 HT Switchgear

1	GeneralParticulars a)NameofPanelmanufacturer b)Constructioncompartmentalisedor non-compartmentalised c)Sheetmetalthickness d)Degreeofprotection	
2	DimensionsoftheBoardLength(mm)xWidth (mm) x Depth (mm)	
3	I)Materialofbusbars ii)Busbarsize Phase Neutral iii)GroundBus(Material&size)	
4	VacuumCircuitBreaker a)Make b)Type	
5	Protectionrelays a)Make b)Type	
6	ControlWiring a)Size b)Type c)Insulation d)Voltagegrade	
7	ControlTerminals a)Make b)Type c)VoltageGrade	

	d)Currentrating e)Minimum10%spareterminalfurnished	
8	PushButtons a)Make b)Type c)No.&RatingofContacts	
9	IndicatingLamps a)Make b)Type c)Rating	
10	IntegratingMeters a)Make b)Type c)AccuracyClass d)VABurden	
11	CurrentTransformers a)Make b)Type c)CoreDetails(Currentratio,VABurden, Accuracy,RCTandVK) Core1: Core2: Core3:	
12	PotentialTransformers a)Make b)Type c)CoreDetails(Voltageratio,VABurden, and Accuracy) Core1: Core2:	
13	TerminalBlocks a)Make b)Type c)Currentrating d)VoltageGrade e)Suitablefor2Nos.Cu2.5.mm2wire	
14	H.T.Capacitors a)Make b)Type	

	c)kVARRating/UnitxNo.ofUnits	

9.16.3 SoftStarter

1	GeneralParticulars a)NameofPanelmanufacturer b)Sheetmetalthickness c)Degreeofprotection	
2	DimensionsoftheBoardLength(mm)xWidth (mm) x Depth (mm)	
3	I)Materialofbusbars ii)Busbarsize Phase Neutral iii)GroundBus(Material&size)	
4	Bypasscontactor/breaker a)Make b)Type c)rating	
5	Protectionrelays a)Make b)Type	
6	ControlWiring a)Size b)Type c)Insulation d)Voltagegrade	
7	ControlTerminals a)Make b)Type c)VoltageGrade d)Currentrating e)Minimum10%spareterminalfurnished	
8	PushButtons a)Make b)Type c)No.&RatingofContacts	
9	IndicatingLamps a)Make	

	b)Type c)Rating	
10	IntegratingMeters a)Make b)Type c)AccuracyClass d)VABurden	
11	CurrentTransformers a)Make b)Type c)CoreDetails(Currentratio,VABurden, Accuracy,RCTandVK) Core1: Core2: Core3:	
12	PotentialTransformers a)Make b)Type c)CoreDetails(Voltageratio,VABurden, and Accuracy) Core1: Core2:	
13	TerminalBlocks a)Make b)Type c)Currentrating d)VoltageGrade e)Suitablefor2Nos.Cu2.5.mm2wire	

9.16.4 L.T. Switchgear

1	GeneralParticulars NameofManufacturer Sheetmetalthickness	
2	AirCircuitBreaker a)Make b)Type	
3	MouldedcaseCircuitBreaker	

	a)Make b)Type	
4	SelectorSwitch a)Make b)Type	
5	PushButtons a)Make b)Type	
6	IndicatingLamps a)Make b)Type	
7	IntegratingMeters a)Make b)Type	
8	CurrentTransformers a)Make b)Type	
9	L.T.Capacitors a)Make b)Type	

9.16.5 Battery

1	BatteryCapacityat27°Cat10hourrate Initial Rated Endoflife	
2	Typeofpositiveplates	

3	No.ofpositiveplates/cell	
4	No.ofcellsrequiredtogiveratedD.C.voltage No.ofsparecells	
5	Expectedlifeofbattery	

9.16.6 BatteryChargercumDCDB

1	Manufacturer'sName	
2	Type-FloatCharger/BoostCharger/Floatcum boostcharger	
3	Rating i)Inputvoltage ii)Outputvoltage iii)Ratedoutput	

9.16.7 L.T.Cables

NameofManufacturer 1. LTPowercable 2. Control/Lightingcable	

9.16.8 H.T.Cables

1.	NameofManufacturer	
2.	Type	
3.	No.ofcores	
4.	Size	

9.16.9 Miscellaneous

1	Cableglandsmakeandtype	
2	CableLugsmakeandtype	
3	Typeofwireslighting MakeVoltage grade	
4	OutdoorCabling:- CableroutemarkerRCCblocktypeprov. CableprotectioncoversRCCtilesprov.	 Yes/No Yes/No

5	LightingFixture–Makes ACSR	
6	conductor size	
7	ClampforACSRconductor– a) make b) type	

9.17 LISTOFELECTRIACALDRAWINGS

9.17.1 HT Capacitors

Drawinganddocumentsrequired

- GAdrawingofthecapacitorunit,bank
- Instructionmanualforinstallation,operationandmaintenanceforcapacitor

9.17.2 6.6kVIndoorSwitchgear

Drawinganddocumentsrequired

- GAdrawingof33kVpanelwithfoundationdetails
- SinglelinediagramforHVpanels
- Schematicdiagramsforvariousmodules
- Instructionmanualforinstallation,operationandmaintenanceofvariouscomponentsof switchgear

9.17.3 MetalEnclosedLTSwitchgear

Drawinganddocumentsrequired

- GAdrawingofeachpanelwithfoundationdetails
- Singlelinediagramforeachpanels
- Schematicdiagramsforvariousmodules
- GAdrawingofthebusductincludingsupportingstructure Ifrequired
- Instructionmanuals-installation,operationandmaintenanceofswitchgear

9.17.4 BatteryandChargercumDCDB

Drawinganddocumentsrequired

- GAdrawingofthebatteryandthechargercubicle
- SchematicdiagramforbatteryandchargercumDCDB
- Instructionmanualforinstallation,operationandmaintenanceforbatteryandcharger

9.17.5 Motors

Drawinganddocumentsrequired

- GAdrawingoftheeachmotorshowingdimensionaldetailsandterminalboxdetails
- Motorselectiondetails

- MotorCharacteristics
- Instructionmanualforinstallation,operationandmaintenanceformotors

9.17.6 LTCapacitors

Drawinganddocumentsrequired

- GAdrawingofthecapacitorunit,bank
- Instructionmanualforinstallation,operationandmaintenanceforcapacitor

SECTIONV –
CMECHANICALWORKS

SECTION – V
MECHANICALWORKS

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TECHNICALSPECIFICATIONFORMECHANICALWORKS
INTRODUCTION

13.0 CRANESANDHOISTS

EachpumphousewillbeprovidedEOTcranesasperspecification.Thecapacityandotherdesigns will be carried out by EPC contractor.

14.0 VENTILATIONANDAIRCONDITIONINGSYSTEM

Generalguidelinesarespecifiedinthissection.Theairconditioningmayberequiredforcontrol rooms. The ventilation is required for pump house and electrical room, if AC is not provided

13.0 CRANESAND HOISTS

13.1 SCOPE

Specification covers the design, manufacture, shop assembly, shop testing, dispatch, erection,testing at site and commissioning of 1 no. Electrically operated overhead Traveling crane (EOT) for the pumping stations.

13.2 EOTCRANEFORPUMPHOUSE

The crane shall be provided with a main hoist of capacity capable of safely handling the motor rotor with shaft or any other heaviest assembly of the pump house. The capacity shall not be less than25% above the weight of the heaviest item envisaged to be lifted during erection and maintenance. The crane shall be with an auxiliary hoist of suitable capacity and shall be complete with motors for all motions of the crane and the hoists, control gears, power and control cables, runway rails,runway conductors with mounting brackets, collectors, insulators etc. The wire rope should be galvanized and construction to be IWRC type.

The pump house crane shall be pendent operated. The power shall be supplied from a single electrical power supply point at a suitable location on the operation floor of pump house.

13.3 STANDARDS

All equipments under this specification shall comply fully except as otherwise specified in this specificationwiththe requirementsof latest editionofrelevant IndianStandardspecifications andin their absence with British Standard Specification or with any other internationally acceptedstandards

TherelevantIndianStandardsareasfollows\

IS: 807 - Code of Practice for design, manufacture, erection and testing(Structural portion)of crane and hoists.

IS: 3177 - CodeofPracticeforelectricoverheadtravelingcranesandgantrycranesotherthan steel works cranes.

IS: 800 - CodeofPracticeforGeneralConstructioninsteel. IS:

2266 - Steel wire rope for general engineering purposes.

IS: 5749 - Forged Ram shorn hooks.

IS: 3815 - Pointsh00kswithshankforgeneralengineeringpurpose. IS:

2062 - Weld able structural steel.

IS:325- Threephaseinductionmotors.

13.4 TECHNICALREQUIREMENTS

Thecraneshallbeelectricallydrivensingletrolley,doublegirder/overheadtravelingtype.

Power will be supplied from the conductors (bus bars) mounted at. convenient height along the length of the pump house.

Thecranespan,liftofmainandauxiliaryhooksshallbeprovidedtosuittherequirements.Other requirements are indicated below:

i) Crane rail -CR-60alongwithembedment

ii) SafetyFactorsof -AsperClause7.4IS3177Mechanicalcomponents

iii) Factorofsafetyofsling-6

iv) Brakesfor hoisting -Elector-magneticandThruster
v) Brakeforothermotion-Elector-magnetic
vi) Classofmechanism -M5
vii) Nearestpositionofmainhook-≤800mm to centre line of gantry rail upstream side
viii) Nearest position of main hook- ≤ 1600 mm tocentrelineofgantryraildownstreamside

The manufacturer may improve upon the hook limits specified to suit requirements. Minimum clearance to (400 mm) shall be made available between the extreme points of crane and side wall and 500 mm between the top of the crane and the overheadobservation.

13.5 INCHINGOPERATION

Inching operation for all motions shall be provided for achieving slow operation of the crane for the purpose of erection, lowering, centering, alignment etc. This shall be 10% of normal speed.

13.5.1 The crane shall be complete will trolley and truck, wheel& and axles. Drive mechanisms, Hoisting Drums, Brakes, Creep Speed Arrangement, Lifting tackles, Buffers' Electric Motors, Controls, Switch Board and cabling, hams, warning lights, limit switches etc. Any item not mentioned herein but required to make the system complete for the satisfactory performance of the crane shall also be included.

13.5.2 Mechanical and Electrical equipment of each crane shall be of simple robust design, easy for correction adjustment, readily accessible for maintenance and elegant in appearance. All steel used in the crane shall be tested to requirements.

13.5.3 Theliftingtackleshallconsistofasafety typelowerpulley block,hook,necessarysheaveandflexible steel wire ropes. The lower sheaves and ropes shall be of adequate design and size to handle the specified loads. The hooks shall be of forged steel. The main hook shall be of Ram shorn type conformingtoIS: 5749(latestedition)and the auxiliary hookshall beof shanktype conforming to IS: 3815 (lastededition). The factorofsafety for the rope shall not be less than six (6). The sheavesshall be of heavy duty with deep flanges made of cast steel and shall be properly grooved to fit the rope and adequately guarded.

13.5.4 Each crane shall be equipped with motors of ample capacity for the duties and speeds specified conforming to IS: 325-1970. The motor shall also meet the requirements as specified in IS: 3177 (latest edition) rated capacity of each motor shall be such that its full load torque shall rate be exceeded in giving the specified performance of the crane. The rating of the main hoist motor (slip ringinduction)shallbeonehourandratingsofallothermotorsshallbehalfanhour.Allmotorsshall be suitable for operations at 415V, 50 cycles, 3 phase, 3 wire system.

EachcraneshallhaveapermanentinscriptioninEnglishoneachside,readily visiblefrom theground level, stating the safe working loads in tones for both the hooks, year of manufacture, crane serial number and manufacturer's name.

Power conductor system (Down Shop Lead); Contractor shall provide a proven insulated (PVC Covered) mobile conduction and current collector system complete with all installation, accessories and special tool and tackles.

13.6 TESTS

ShopTests

13.6.1 Shop testsshall includeallteststo be carriedout at supplier's work,worksofhis sub-supplier and at works where raw materials supplied for manufacture of equipment is produced. The supplier shall carry out a comprehensive inspection and testing programme during manufacturer at the works. All the test certificates and reports shall be submitted to Owner for approval Owner's representative shall be given full accesses to all tests. The manufacturer shallinform the Owner of the testing wellin advance so that it so desired Owner's representative can witness the test.

13.6.2 All electrical and mechanical equipment shall be tested in accordance with the appropriate Indian Standards or British Standards and such other tests asmay be required by statutory regulations shall be carried out at either the crane manufacturer's or equipment manufacturer's Works. Test certificates giving the necessary test figures shall be furnished to the Purchaser. All test certificates must be endorsed with sufficient information to identify 'the material or equipment which the certificate refer, and must carry on top right hand corner the identification of the owner and the Contract. Material used for the manufacture of crane hoists shall be of tested quality and suitably identified.

13.6.3 The EOT crane shall be completely assembled at shop including wirings and fittings shall be tested at “No Load” on hoisting and cross travel motions

13.6.4 Electrical hoist,shall be assembled at shop and tested for capacity, proof load, lift, functional check as per requirement of respective code & approved specs.

13.6.5 All electrical equipments offered shall be of type-tested quality. Necessary type test reports shall be furnished before fabrication is started. In case the type test has not been carried out earlier on equipments, the same shall be carried out without any commercial implication toOwner/Consultant.

13.6.6 Controlcabinetshallbesubjectedtothefollowingtest.

(a) Mechanicaloperationtest
(b) Highvoltagetest(2KVfor1 minute)
(c) Electricalcontrolinterlock.andsequential test
(d) Verificationofwiringasperapprovedschematic

13.6.7 Followingtestsshallbecarriedoutonallsolid-stateequipment

(a) Surgewithstandcapabilitytest(ReferANSIpublicationC39.9a-1994orlatest)
(b) Buminandelevatedtemperaturetest.
(c) Insulationtestasapplicable

13.6.8 Routine test and Acceptance test shall be carried out on all associated equipment as per relevant standards. Certified copies of all type and routine test certificates shall be submitted for the purchaser's approval before the dispatch of the control cabinet.

13.6.9 Girders(web,topandbottom,carriage,Crab,Gearboxandropedrum:

a) Theplatematerialsshallbetestedforchemical&mechanicalproperties.
b) Theplatesabove25mmthickshallbeultrasonicallytested.

c) Heattreatmentasapplicable

13.6.10 Forgings(Wheels,gears,pinions,shafts,axles,couplinghooksandhooktrunion).

a) Chemical and mechanical testing. For mechanical testing one sample, per sample, per heat treatment cycle shall be taken. Integral test pieces shall be identified for testing.

b) Ultrasonictesting(Forgearsandpinionblanksbeforeteethcutting).

c) D.P.testing

d) Heat treatment

e) Hardnesstest

13.6.11 Welding

a) Alltheweldingprocessesandweldersshallbequalifiedasper ASMESec.IXandonlyqualifiedweldersshallbeemployedforalltheweldingworks.Allthe welding procedure specification as per ASME Sec-IX shall be furnished to Owner to review.

b) Forweldedsteeldrums,allcircumferentialweldsshallbe100%radio graphed and all butt weld joints on structural members subject to " tensile stress shall also· be 100% radio graphed, 25% of other butt weld joints shall be radio graphed at random.

13.6.12 Hook

a) Chemical,mechanical(Tensile,proofloadetc.)

b) U.T

c) D.PT.beforeandafterproofloadtesting

13.6.13 Steelcastings(pulleysheaves,brakedrumsetc.)

a) ChemicalandHardnessandmechanicalspecification.

b) Ultrasonicexamination.

13.6.14 Wire ropes

Wireropesshallbetestedasperrelevant standard.

13.7 TESTSAT SITE

(i) InsulationTests

After erection but before the crane is connected to supply, the insulation ofelectrical equipment shall be tested by a suitable instrument and any defects revealed shall be rectified, as specified in relevant Indian or British Standards.

(ii) The basic parameters like crane clearances shall be verified. The height of the liftalso shall be measured.

(iii) Testsof operation

After the supply has been connected, and before the complete crane installation is put into commercial service, tests shall be carried out as specified in IS: 3177 (latest edition).

(iv) Deflectiontests

The deflection test shall be carried with the safe working load at rest and with the trolley in a central position as specified in IS: 3177 (latest edition).

(i)No deviation in the specification should be anticipated by the Supplier without, the prior consent of Owner/Consultant.

13.7.1 Contractorshouldsubmittestcertificatesasrequiredbystatutoryauthorities.

13.8 GuaranteedTechnicalspecifications!Data

The Contractor may furnish all the data related to guaranteed technical specifications and relevant data

13.9 LISTOFMANDATORYSPARESFORCRANESATEACHPUMPINGSTATIONEOT CraneforPumpHouse

i)	Setofallbearings	2sets
iii)	Oil seals	2setsforeachtype
iv)	Brakesprings	2setsforeachtype
v)	Alllimitswitches	2setsforeachtype
vi)	Timersandrelays	2setsforeachtype

14.0 VENTILATION&AIRCONDITIONINGSYSTEM

14.1 VENTILATIONSYSTEM

Ventilation System is to be incorporated for ventilation of Pump House, Auxiliary Building and for all other Mechanical areas (where Air Conditioning is not provided) excluding Control Room and Office
15.2AxialFlow Fans

These fans shall have cast aluminum impeller with blades of aerofoil design. The fan casing shall beof heavy gauge sheet steel construction. Necessary rain protection cowl, inlet and outlet cones; bird protection screen, dampers etc. shall be provided.

For supply fans, coarse filters and fine filters shall be provided. The fans coming in gaseous areasshall be suitably painted. All other accessories like supporting structure etc. as required shall be provided.

14.2 CentrifugalFans

These fans shall have scroll fabricated out of heavy gauge steel sheet. The impeller shall have die formed backward curved blades and shall have non-overloading characteristics. The fan bearings shallbeballorrolleroftheself-aligningtype.Thefansshallbebeltdriven.Necessaryaccessorieslike fan belt protection screen, vibration isolation damper, base plate etc., shall be provided.

14.3 RoofVentilators

RoofVentilatorsshallbelocatedinthepumphouse.

The impeller shall be of axial flow type, cast in one piece and casing shall be heavy gauge construction. The head shall be provided to protect from rain and other contingencies. All accessories, steel supports as required will be provided.

14.4 Motors

All the motors provided shall have output 10% higherthan the equipment power required (including that of drive in any) and shall be suitable foroperation 50^{o}C ambient.

14.5 AIRCONDITIONINGSYSTEM

The control room and office area in each pumping station shall be air-conditioned. Separate chiller units shall be provided for the control room & for office area.

14.6 AirConditioningSystemDesignconditions

a) Fordesignconditions,referencloseddatasheet

b) AllAirConditionsequipmentshallbeprovidedwith100%standbyequipment. All loadcalculations shall have to be got approved by OWNER.

c) Split/Packaged.AirConditioners

EithersplittypeorPackagetypeAirconditionershallbeuse.Thesplit/packageair conditioners shall consist of the following:

i) Casing
ii) Compressor
iii) Condenser
iv) AirHandling Fan
v) CoolingCoil
vi) Humidifier
vii) Filters
viii) Piping,valvesetc
ix) Controls,Instruments,MCCcumcontrolpanel.

d) Thediffusers,grillsetc.asrequiredshallbeprovided.

e) Thecabinetcasinghousingshallbemanufacturedfrom1.6mmthicksheetsteelandshallbe given two coats of rust preventive paint. The casing shall be lined with 25 mm thick insulation.

f) Thecondensershallbeeitheraircooledorwatercooledshall&tube type.

g) The air handling fan shall be axial/centrifugal type with forward curved blade and shall be complete with drive etc.
Pre-filters shall be of metallic Synthetic construction and after filters shall bemicro-vee type.

h) CoolingcoilshallbeDXtypeandshallbemadeofseamlesscopper tubes.

14.7 SpecificationofInsulation--'Material

	Code	ThermalConductivitymw/cm°C	DensityKg/m³
Resinbondedmineral wool/glass Wool/ equivalent	IS:8183	0.49at50°C	Atleast24
Mineral wool pipe section(min.Gr.2)	IS:9842	0.43at50°C	Atleast81
ExpandedPolystyrene	IS4671	0.37at50°C	Atleast1S

14.8 Type

Sl.No	Surface	InsulationMaterial	InsulationForm	Thickness (mm)
1.	Supplyair&ResinReturn airduct for airsystem	Resinbonded Mineralwool (15:8183)	Roll	25
2.	RefrigerantPiping	ExpandedPolystyrene OR Mineralwool	Pipe section	75
3.	AHUdrainpipe	Expanded Polystyrene OR Mineralwool	Pipe section	25
4.	AHU drain pan, coil section and tank section	ExpandedPolystyrene OR Mineralwool	Slab	25
5.	Expansiontankwith pipe	ExpandedPolystyrene OR Mineralwool	Slabs/Pipe section	50

14.9 ListofApplicableStandards

15:660	SafetyCodeforMechanicalRefrigeration
ANSI-B, 9.1 ARI:520	Safety Code for Mechanical refrigeration
IS:520	StandardforpositiveDisplacementRefrigerationCompressorandCondensingUnits
IS:5222	Codeofpracticeandmeasurementfortestingrefrigerantcompressors

IS:4501	ShellandTubetypeheatExchange
ASHAR 22-72	MethodofTestingforratingwatercooledrefrigerantcondensers IS :
4503	Shall and tube type heat exchanger
ANSI-B-31.5	RefrigerationPiping
IS:650	Safetycodeforair conditioning
ASHRAE -3	MethodsofTestingforRatingforcedcirculationaircoolingandairheating coils. IS:
659	Safety Code for Air-Conditioning
IS:1520	HorizontalCentrifugalpumpsforclear,cold,freshwater.
IS : 5120	TechnicalRequirementforRotodynamicspecialpurposepumps. IS:
655	Specification for Metal Air Duct
IS277	SpecificationforGalvanizedSteelsheet
IS: 7375	SpecificationforWroughtAluminumandaluminumsheetandstrip. IS :
3583	Specification for Electrical axial flow fans
IS:2312	PropellertypeA/CVentilation fans
IS : 2831	Methodsoftestforairfiltersusedinairconditioningandgeneral ventilation.
IS:277	Galvanizedsteelsheets
IS:1239	Mildsteeltubesandtubulars
IS : 3069	Glossaryofterms,Symbolsandunitsrelatingtothermalmaterials IS :
4671	Expanded Polystyrene for Thermal insulation.
IS:8183	Bondedmineralwool
IS:4849	Centrifugalfans

14.10 GuaranteedTechnicalspeciflcatidns1Data

The contractor may furnish all the data related to guaranteed technical specifications and relevant data.

i) Theambientdesignconditiontobeconsideredshallbe
Temperature = 24.4 deg. C ± 1.1 deg. C for all areas other than control equipment room etc. and 22 deg C: 1.1 deg C for the control room.
asmentionedinthesite data.

ii) The number of fresh air changes per hour shall be 21.5 (min) or 0.45 m^3 / min per person.Whichever is higher.

(B) VentilationSystem

i) Generalareas- 10

ii) Batteryroom - 15

iii) However,inareasproducinglotofheat,thetemperatureshouldbethecriteria

iii) Theinternaldesignconditionstobemaintainedareasfollows:
The number of air changes per hour in mechanically ventilated areas shall be as follows.
Temperatureriseabovedesignambientshouldbemaximum3^{0}C.Thecriteriawhichgive higher number of air changes shall be selected.

SECTION-VI

PART - A
PIPELINEWORKS

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SECTION – VI
PART – A
PIPELINEWORKS
GENERAL

TYPEOFPIPESTOBEPROVIDEDFORDIFFERENTCOMPONENTSOFUGPLIrrigation System.

Sl. No.	ComponentsoftheUGPLIrrigation System	Typeofpipestobeprovided
1	**Intakepipes**	RCCNP4Hume pipes
2	**RisingMain/PressureMain**	
	a. Diameterupto1000mm.	a. DuctileIron Pipe asperdetailedspecification.
	b. Diameter morethan1000mm)	b. M.S pipe as per detailedspecification.
3	**Distributionnetwork**	
	a. Below300mm dia.	a. HDPE pipe as per detailed specification.
	b. 300mmto800mmdia.	b. D.I pipe as per detailed specification.
	c. Above800mmto1000mm dia.	c. GRP/PSC/D.I.pipeasperdetailed specification.
	d. Morethan1000mm	d. MSpipeasperdetailed specifications.

A. R.C.CHumePipes

1.0 **GENERAL**

R.C.C Hume Pipes of non pressure type NP_4 shall be used as water conductors from intake to the sump well of Pump Houses.

1.1 **SCOPE**

Scope of the work includes procurement of NP_4R.C.C Hume pipes of adequate size from reputed manufacturers having accreditation from B.I.S transportation from factory to the site, unloading & laying of the pipes on the prepared bed fixing in position & filling up the trenches as per specification

2.0 **SPECIFICATION**

Schedule – 3: Reinforced Concrete, Medium duty, Non-pressure Pipes, Class: NP3, with ends of the pipes suitable for flush joints conforming to IS: 458/2003 (Fourth Revision) with up-to-date amendment.

NominalDiameterofPipesinmm.

80,100,150,200,225,250,300,350,400,450,450,500,600,700,800,900,1000, 1100,1200,1400,1600&1800.

2.1.Dimensions, Design & Strength requirements of Reinforced Concrete Pipes of Class NP4 shall be as per the Table 3 of IS: 458/2003 (Fourth Revision) with up-to-date amendment.

3.0 **INSPECTION&TESTING**:

Asperprevailingpractice,thefollowingReviewofReportsshallbecarriedout. Review of Reports:

ThefollowingReportsshallbesubmittedtotheInspectingOfficeratthetimeof Inspection for review:

During manufacturing, Compressive Strength Tests shall be conducted by the manufacturers on 150 mm Concrete Cubes in accordance with the relevant requirements of IS: 456/2000 with up-to-date amendment and IS: 516/1959 (Reaffirmed 1999) with up-to-date amendment, as stipulated in clause 5.5.3 of IS: 458/2003 (Fourth Revision) with up-to-date amendment. The manufacturer shall submit the results of Compressive Strength Tests of Concrete Cubes made from the Concrete used for the pipes. Alternatively, if the manufacturers do not have the facilities for Compressive Strength Test on Concrete Cubes, they shall get the Test done at CSIDC laboratory at least once in a month and submit the report to the Inspecting Officer for review.

1. ManufacturershallsubmithisownCertificateformaterialsofconstructio n used in the pipes.
2. ManufacturershallsubmitTestCertificatefortheSteelusedfor Reinforcement.
3. Manufacture'sTestReportofRubberRingsshallbesubmittedfor review (in case of Pipes with Socket & Spigot ends).
4. Manufacture's having E.P.M rate contracts shall have to provide the certification from E.P.M authorities.

4.0 TESTS:

All required tests shall be conducted as per procedure & methods according to IS:458-2003 & IS: 784-1978.

Asperprevailingpractice,thefollowingTests/Checkingshallbecarriedout.

1. Visualexamination,
2. PermeabilityTestand
3. ThreeEdgeBearingTesttoproduce0.25mmcrack.
4. Any other Tests that are mentioned in IS: 458/2003 (Fourth Revision) withup-to-date amendment shall be carried out if desired by the Consignee.

NOTE:

1. The tolerances on Pipes shall be as per clause 8.2 & tolerances on CollarshallbeasperTableNo. 21 ofIS: 458/2003(FourthRevision)withup-to-date amendment.
2. Workmanship & Finish of the Pipes & Collars shall be as per Clause 9 of IS: 458/2003 (Fourth Revision) with up-to-date amendment.
3. The length in which the pipes are to be supplied shall be as per the mutual agreement between the purchaser and the supplier. However, the recommended length above 300 mm Nominal Diameter is 2.5 meters.
4. Curing of the pipes shall be done as per the Clause 7.4 of IS: 458/2003 (Fourth Revision) with up-to-date amendment.

5. RubberRingchordsusedinthePipejointsshallconformType2ofIS: 5382/1985 with up-to-date amendment.

6. ThefollowinginformationshallbeclearlymarkedontheeachFinishedPipe.
   a. Sizeof Pipe,
   b. ClassofPipe,and
   c. Nameof manufacture.
7. The supplier shall guarantee the Pipes and Collars for a period of 12 months from the date of receipt of the materials by the consignee.

5.0 **Transportation:-**

Pipes shall be transported form factory to work site mostly by trucks or trailers. Loading & unloading must be done by mobile cranes or Hydra Cranes & lowered carefully to the bed of carrier trucks with such cushioning material sand or pebblesor Murom as available. The sides of the pipes shall be prevented from rolling & dashing with each other during transportation by suitable wooden wedges fixed securely to the bed of transport vehicle. Similarly while unloading from vehicles at work site due care shall be taken to lower the Pipes to a level surface slowly so as to avoid any jerk or impact. Protection against rolling & dashing against other pipes or hard materials like rock out crops etc., by sand bags of adequate numbers on both sides.

6.0 Layingofpipesinposition,fillingoftrenches.

Laying of pipes will be done inside trenches excavated for the pipes by moveable cranes (Hydra Cranes). Tackles for lifting should be carefully placed so that the pipes are lifted in a horizontal manner & don't tilt or slip during shifting & lowering. Pipes are to be placed on the prepared & compacted bed as for as in a straight line & completely horizontal bedding slowly without any jerk or impact. After lowering a few pipes end to end, they should be carefully aligned and the end faces brought closer so as to form a flush joint. After due checking of levels & the alignment by competent authority, filling up of the sides of the trench should start with selected excavated materials, layer by layer & manually compacted till desired top level is reached.

7.0 **Provisionformanholes**

Suitablemanholesforcleaningshallbeprovided50mapart.

P.S-Contractors may also adopt other systems like RCC barrels of suitable size for the conductor system of raw water to pump houses. Specification of RCC provided in section-III will be followed.

B. M.SPIPELINE

1.0 DETAILEDTECHNICALSPECIFICATIONSOFM.S.PIPELINE

1.1. **APPLICABLECODES&SPÉCIFICATIONS(M.S.PIPES)**

The following specifications, standards and codes are made a part of the specification. All standards, tentative specifications, specifications, codes of practice referred to herein shall be the latest editions including all applicableofficial amendments and revisions.

In case of discrepancy between this specification and those referred to herein, this specification shall govern.

1. IS:2062 Steelforgeneralstructuralpurposes.
2. IS : 814 CoveredElectrodesformanualMetalArcWeldingofcarbon and C-Mn steel.
3. BSEN499 WeldingConsumablescoveredElectrodesforManual MetalArcWeldingofNonAlloyandFineGrainSteel. Classification
4. AWS:A-5.1 SpecificationforMildSteelCoveredArcWeldingElectrodes.
5. IS : 3613 AcceptanceTestsforWireFluxcombinationsforSubmerged – Arc Welding.
6. AWS:A-5.17SpecificationforBareMildSteelElectrodesandFluxesfor Submerged Arc Welding.
7. IS:1377- TechnicalSupplyConditionsforThreadedFasteners
8. IS:1367 TechnicalSupplyConditionsforThreadedFasteners (Parts1to3).
9. IS:2074 ReadyMixedPaint,RedOxideZincChromeandPriming.
10. IS:102 ReadyMixedPaint,Brushing,RedLead,nonsettingPriming.
11. IS : 816 CodeofpracticeforuseofMetalArcWeldingforGeneral Construction in mild steel.
12. IS : 4353 SubmergedArcWeldingofMildSteel&LowAlloySteels – Recommendations.
13. IS : 817 CodeofpracticeforTrainingandTestingofMetalArc Welders.
14. IS : 1182 RecommendedpracticeforRadiographicexaminationof Fusion -Welded Butt Joints in steel plants
15. IS:2595 CodeofPracticeforRadiographicTesting.
16. IS:3658 CodeofPracticeforLiquidPenetrantFlawDetection
17. IS : 5334 CodeofpracticeforMagneticParticleFlawDetectionof welds.
18. ASTME94 GuideforRadiographicTesting
19. ASTME709 GuideforMagneticParticleExamination.
20. ASTME165TestMethodforLiquid Penetrant Examination.
21. IS : 3600 MethodsofTestingFusionWeldedJointsandweldmetalin Steel (Parts 1 to 9)
22. IS : 4853 RecommendedPracticeforRadiographicInspectionof Fusion Welded Butt Joints in Steel Pipes.
23. IS : 3589 SeamlessorElectricallyweldedsteelpipesforWaterGas And Sewage (168.3 to 2540 Outside Diameter)
24. IS:6631 SteelpipesforHydraulicPurposes
25. IS : 7343 CodeofpracticeforultrasonicTestingofFerrousWelded Pipes And Tubular Products
26. IS:2598 SafetyCodeforIndustrialRadiographicPractice
27. IS : 5822 CodeofPracticeforLayingofElectricallyWeldedsteelpipes For water supply
28. IS:1608 MechanicaltestingofMetals.
29. IS:9595 MetalArcweldingofCarbonandCarbon-ManganeseSteels.

30.	IS:2825	CodeofunfiredPressureVessels
31.	IS:5504	CodeforSpiralArcWeldedpipes
32.	I.S.10748	Requirementofweldablehotrolledcarbonsteelstripin coils.

1.2. MATERIALS

1.2.1 SteelPlates/H.R. Coil

The steel used for pipes, fittings, specials and stiffeners shall be of mild steel conformingto IS: 2062,gradeBFe410 orH.R.coilconfirmingto IS: 10748 gradeIII or equivalent ISO. The dimension of HR coils shall conform IS: 2062.The quality of steel, chemical composition and tensile strength of the steel plates shall be as specified in IS: 3589 for steel of grade Fe 410. Positive tolerance as per IS: 3589 shall be allowed for plate thickness, but no negative tolerance shall be allowed.

Steel plates should confirm to IS: 1730, Dimensions for Steel Plates, Sheets, Strips andFlatsforGeneralEngineer-in-ChargePurpose.Thetestcertificatefortheplates shall be issued by Plate Manufacturer.

1.3. MinimumthicknessoftheMSpipe line:

The thickness of the plate for the manufacturing of the MS rising main shall be governedby theeconomicsizingofthepipesanalysedinlinewiththeguidelines of CPHEEOmanual and BIS Standards. Howeverlessthan 8mmthicknessof pipe shall not be acceptable.

1.4. WeldingConsumables

Welding consumables Such as electrodes, filler rods and wires shall conform to IS: 814, IS: 3613, IS: 6419 and IS: 7280.

1.5. StandardLengthofpipes

The MS pipes shall be manufactured in lengths of 10 to 13m with beveled ends. Length of each pipe shall be measured at diametrically opposite four places and average of the four measured lengths shall be considered for measurements ofpipe length.

1.6. Weldingprocess

The pipes shall be manufactured by shop welding from steel plates only byqualified welders, butt welded either spirally or longitudinally by automatic submerged arc welding process using at least two runs, one of which shall be onthe inner side of the pipes. Welding shall be so done that there will be through fusion and complete penetration and shall be free from cracks, oxides, and slag inclusion and gas pockets. Longitudinally welded pipes shall have circumferential weld at not less than 1.5 m centre to centre. Longitudinal weld shall be staggered. Minimum distance between spiral welds should be 1.5 m. The contractor shall certify that the welding of pipes has been done by qualified welders and welding operators.

1.7. **DeviationinLength**

Finished pipe length shall not deviate from straightness by more than 0.2 percent of the total length.

1.8. **StraightnessofPipes**

Finished pipes shall not deviate from straightness by more than 0.2% of the total length checking for straightness shall be carried out using as taut string or wire fromendto endalongtheside of the pipe to measure,the greatest deviation.Pipe ends shall be at right angle to the axis within 1^{o}.

1.9. **Radiographic/Ultrasonictest**

Three percent of all seams of pipes, welded in the fabrication shop, shall be radio graphed at the end of pipe (as per IS: 4853) to render visible inspection of any internal defects such as blow holes, slag, inclusion of cracks. If any defects are detected, the metal at the location shall be gouged out and re-welded. In addition to the radiography of the joints, 100 percent testing by ultrasonic equipment (as per IS: 4260) shall also be done for welding tests. Any defects found out shall be rectified free of cost. Welds found deficient in quality shall be removed by gouging or melting and remade as per specifications. Chipping or cutting the weld shall not extend to the base metal. Gouging of defective welds should be done carefully by experienced welders so that no damage to the original plate base metal occurs.

1.10. **HydraulicTestat Works**

Eachpipeshallbehydraulicallytestedatmanufacturer'sworksbeforeapplyingany coating / lining.

1.11. **Allowabletolerance**

- Allowabletoleranceforoutsidediametershallbe±0.75%ofthespecified diameter.
- Allowabletoleranceforovalityshallnotbemorethan1%ofthespecified diameter.
- Negativetoleranceforplatethicknessshallnotbeallowed.

1.12. **Samplingandtesting**

Sampling and conformity criteria for various tests shall be as given in IS: 4711. The test samples shall be cut from pipes in the final condition of supply. Tests fortensile strength, percentage elongation, guided bend test, shall be carried out and the test values shall be in conformity with those specified in IS: 4711.

1.13. **DestructiveTest**

The destructive test of pipe joints on the field shall be carried out as per IS 3600. It will be one for every rising main and for every two km of manufactured length.

1.14. **Thirdpartyinspection**

The pipes ready in the manufacturer's work yard shall be inspected and tested beforedispatch,bytheemployerandorinspectingagencyappointedbythe

employer. All the tests including hydraulic test shall be carried out on specified number of samples from each lot as specified in IS: 4711, in presence of the inspecting agency. The protective coating as per specification shall be applied tothe pipes only after the inspecting agency is satisfied regarding the test results, which shall be in conformity with the limits specified in IS: 4711. The contractor shall produce the test certificate issued by the inspecting agency.

1.15. **ApplicationofRed oxide**

The pipes cleared by the inspecting agency shall be provided with one shop coatof red oxide as per relevant IS, externally, prior to despatch.

2.0 Manufacture,Supply,LayingandJointingofMSspecials

2.1. **Fabricationofspecialsandappurtenances**

Specials such as bends, tapers, and tees shall confirm to IS: 7322. Specials shall be fabricated by cutting plates / HR coils of required thickness to the required shape, obtained by developing the form of specials on ground. Abutting profiles shall be obtained using templates, which guide the cutting torches as to obtain a uniform cut. No hand cutting shall be permitted. Specifications for using and testing of the plates, electrodes,weldingprocess, etcshall be the same as for the MS pipes.Plain ends shall have beveled edges. Specials shall be manufactured as per the standard drawings enclosed in the tender documents. Stiffeners shall be provided wherever necessary.

2.2. **Requirement**

Specialsasspecifiedbelowmayberequired.Slightvariationmaybepossibleasper the site conditions.

- Horizontalandverticalbends
- Airvalvetees
- Washoutvalvetees
- Accessmanholeteeswithblankflange
- Eccentricreducers(tapers)
- Steelstrapringandbearingplatesatchairsproposedfortheaboveground pipeline.
- StiffenerringsforpipesandspecialsasrequiredandasdirectedbytheEngineer-in-Charge.
- Blankflangesetc.

2.3. **Bends,teesandtapers**

The testing of these specials is not envisaged at the fabrication stage. These shallbe subjected to test when the completed pipeline is tested hydraulically. In viewof this, the contractor shall fabricate these specials with due care so that there is no failure of any welded joint during testing of the completed pipeline, which will invite dewatering the main, repairing and retesting.

2.4. **Eccentrictapers(Reducers)**

The tapers shallbe fabricatedinoneormore piecesas may benecessary according totheirlengthsandplatesizesavailable.Stiffenerringsshallbeprovidedas

necessary and as directed by the Engineer-in-Charge. The tapers shall be eccentric with bottom portion straight and top reducing as shown on drawing.

2.5. **Stiffenerrings**

Stiffener rings shall be provided for the pumping main on each side of air valves, washout valves, on line valves and access manholes to strengthen the pipe at provided openings.

2.6. **Bearingplatesandsteelstraprings**

Bearing plates, equal in width of chairs and thickness as shown on approved drawings shall be provided on the chair / pedestal supports below roller bearingsas shown on drawing. Steel straps of size and thickness as shown on drawings shall be provided and fixed for pipe anchorage with the chair supports. The straps shall be welded to MS angle on either end and anchored with the chair concrete by providing MS bolt as shown on drawing.

2.7. **GasCuttingForMs Pipes**

Cutting of the pipe for providing tees for air valves, washout valves, preparation of manhole openings, etc becomes necessary. The edges of the specials are required to becutto matchwiththepipeedgeforproperjointingandwelding.Platecutting operations at such places are performed with the use of gas cutting.

3.0 PROCEDUREFORRECEIVINGSTEELPIPES

3.1. **General**

To ensure that the work oferecting pipes is not held up at any stage and place, the Contractor shallmaintain an adequate stock of standard specials, flange rings, plug plates, manhole covers, etc. and short length of smaller diameter pipelines, etc. at site in his field stores, in consultation with the Engineer. Wherever possible, the Contractor shall arrange one full month's requirement of pipes, specials, etc. stacked along the alignment.

3.2. **Stackingofpipes,etc.and Inspection**

The Contractor shall keep in each section a responsible representative to take delivery of the pipes, specials and appurtenances, etc. transported from the fabricating stockyard or received from any other work site to the site of laying and tostackalongtherouteontimberskids.Paddingshallbeprovidedbetweencoated pipes and timber skids to avoid damage to the coating. Suitable gaps in the pipes stacked shall be left at intervals to permit access from one side to the other. The pipes, specials, appurtenances so received on site shall be jointly inspected and defects recorded, if any, such as protrusions, grooves, dents, notches, damage to the internal coating etc. shall be pointed out immediately to the Engineer at thesiteandintheacknowledgementchallans.Suchdefectsshallberectifiedor

repaired to the satisfaction of the Engineer entirely at the Contractor's risk and cost.

3.3. **HandlingofPipes,Specials,Appurtenances, etc.**

It is essential to avoid damage to the pipes, fittings and specials, etc. or their coatings at all stages during handling. The pipes and specials shall be handled in such a manner as not to distort their circularity or cause any damage to their surface treatment. Pipes shall not be thrown down from the trucks nor shall they be dragged or rolled along hard surfaces. Slings of canvas or equally non-abrasive materials of suitable width of special attachment shaped to fit the pipe ends shall beusedtoliftandlowercoatedpipestopreventdamagetothecoating.Greatcare shall be taken in handling the pipe right from the first operation of manufacture until they are laid and jointed. The Contractor will provide temporary props inorder to prevent any sagging of the pipes while they are stacked in their yard and while transporting to the site of delivery, i.e. laying. The props shall be retained until the pipes are laid. If at any time these props are found to be dislodged or disturbed, the Contractor shall immediately reinstate them in such a way that the true shape of the pipe shell or specials is maintained to the satisfaction of the Engineer. No defective or damaged pipe or special shall be allowed to be used in the work without rectification to the satisfaction of the Engineer. Any damage to thecoatingshallberepairedby theContractorathisowncosttothesatisfactionof the Engineer.

3.4. **Dents**

Whenever any dent, i.e. a significant alteration of the curvature of the pipe shell is noticed, the depth of the dent shall be measured between the lowest point of the dent and the pipe shell curvature line. All dents exceeding 2 percent of the outer diameter of the pipe shall be removed by cutting out a cylindrical portion of the pipe and replacing the same by an undamaged pieceof thepipe. TheEngineermay permit insert patching if the diameter of the patch is less than 25 percent of the nominal diameter of the pipe. Repairs by hammering with or without heating shall not be permitted. Any damage to the coating shall also be carefully examined and rectified.

3.5. **Marking**

The component partsof the pipes shall be carefully marked for identification in the field. The marking shall be on the side, which will be the inside of the pipe after bending. The marking operation shall be conducted with full size rulers and templates.Onlybluntnosepunchesshouldbeused.Theplatesusedforfabrication of pipes shall be laid out in such a way that when the shells are completed one set of original identification markings for the material will be plainly visible. In case these markings are unavoidably cut out,they shall be accurately transferred by the Contractor to a location where these markings will be visible on the completed work.After hydraulictestson thespecialsandother items,thenumberoftheshell

inthelineasitwillbeerectedandthedirectionofflowshallbestampedina prominent manner on each piece.

Aregistershallbemaintainedinsuitableproformagivingthefollowinginformation for each shell tested:

(a.) SerialNo.
(b.) Shell No.
(c.) Dateoftest
(d.) Thicknessandspecificationofsteel
(e.) Weight of shell tested
(f.) Maximumtestpressure
(g.) Detailsoftest performance
(h.) Detailsofradiographicexaminationofwelds
(i.) NameofEngineer'srepresentativewitnessingtests

Acopyofthesedetailsshallbefurnishedtotheowneratfreeof cost.

4.0 SPECIFICATIONFORLIQUIDEPOXYCOATINGSYSTEMSFORINTERIOR COATING OF STEEL WATER PIPELINES:

Providing & applying internal lining / painting / coating to MS pipe with solvent free food grade epoxy having dry film thickness of 406 microns including scrapping the surface of the pipe.

4.1 General

Buried steel pipeline shall be coated internally, with a single coat two part solvent free high build liquid epoxy lining as per AWWA C210-07 suitable for potable water applicationandshallbe approvedby NSFInternationalStandardNSF/ANSI-612004 or by water regulations advisory scheme (WRAS), UK or Central Food Research Institute, Mysore as per standards BS 6920 UK. Protective lining shall consist of a coating system consisting of 100% solids epoxy comprising of resin & hardener mixed in a proportion as recommended by the manufacturer. The mixed epoxy shall be applied to abrasive blasted steel surface in the coating plant using plural hot airless spray machine with extended boom to apply the lining to a smoothfinish without any drip or sag. The epoxy shall also be capable of application by brush at field joint locations and repair of damages to the spray applied epoxy.

The Contractor shall perform all work in accordance with these specifications and the latest pipeline coating practices, and shall complete the work in all respects to the full satisfaction of the Owner / Owner's Representative. The entire coating operation starting from cleaning and surface preparation till coating shall be performed underthesupervisionofskilledpersonnelwho arewellconversant with the work. Pipes which have been cleaned and primed, or cleaned, primed and coated, without having been inspected and approved shall be rejected.

This specification is not intended to be all inclusive and the use of guidelines set forth here does not relieve the Contractor of his responsibility for the quality and performance of the applied coating system, and to supply coating material capable of performing its intended service.

All steel special sections, connections fittings and field joints to be used for underground steel pipeline shall be internally coated with same liquid epoxy.

4.2 ReferenceStandards

The following standards (latest revision) referenced below are a part of this specification.

Incaseofconflictbetweenthisspecificationandthereferencedstandards,this specification shall apply

(a) ANSI/AWWAC210-StandardforLiquidEpoxyCoatingSystemsforthe Interior & Exterior of Steel Water Pipelines.
(b) NSF/ANSI61–StandardforDrinkingWaterSystemComponents- Health Effects.
(c) ANSI /ASTM D149 - Standard Test Method for Dielectric Breakdown VoltageandDielectricStrengthofSolidElectricalInsulatingMaterials at Commercial Power Frequencies.
(d) ANSI/ASTMD3359-StandardTestMethodforMeasuringAdhesionby Tape Test.
(e) ANSI/ASTMD3363-StandardTestMethodforFilmHardnessbyPencil Test.
(f) ANSI/ASTMD4417-StandardTestMethodforFieldMeasurementof Surface Profile of Blast Cleaned Steel.
(g) ANSI/ASTMD4541-StandardTestMethodforPull-OffStrengthof Coatings Using Portable Adhesion Testers.
(h) ANSI/ASTMD2240–StandardTestMethodforRubberProperty – DurometerHardness
(i) ANSI/ASTMD5000-StandardTestMethodforAbrasionResistanceof Organic Coatings by the Taber Abraser
(j) SSPC-PA2-MeasurementofDryPaintThicknesswithMagnetic Gauges
(k) SSPC-SPI-SolventCleaning
(l) SSPC-SP6/NACENo.3-CommercialBlastCleaning
(m) IS 16676:2017 Specification for solvent less liquid epoxy system for applicationontheinteriorandexteriorsurfaceofsteelwaterpipeline.

4.3 **InternalLiningSystem**

The internal epoxy lining shall consist of chemically cured resin (epoxy) & hardener (curing agent), mixed in the ratio as recommended by the manufacturer and applied to a dry film thickness (DFT) of minimum 406µ.

Table-1Physicalpropertiesoftheinternalliningshallbeasfollows.

Property	Requirement	TestMethod/ Reference
Longtermcontact with potablewater	Noeffectsforhumanconsumption ascertifiedbyNSF International	NSF/ANSI-61
Thickness(appliedmin)	406µ	SSPC-PA2
Thicknessdeviation (min)	- 0/+200µ	SSPC-PA2
Dielectricstrength (min)	450V/mil(15V/µm)	ASTMD149
HardnessShoreD	85(min)	ASTMD2240
AdhesiontoSteel(min)	800psi	ASTMD4541
TaborAbrasion	1560cycles/mil	ASTMD4060
Compressivestrength	70MPa	ASTMC109

4.3.1 CoatingApplicationforbends,jointsetc.

General

For internals of bends, short section of pipes, tees, fittings etc., internal epoxy will be manually spray applied either in the coating plant or in the field using suitable two component airless plural spray machine.

Internalfieldjointcoatingshallbebrushapplied.

Theinternalepoxyliningshallbeappliedonlyonblastedsteelsurface.

4.3.2 Pipepreparation

Metalsurface condition

Internal surfaceofthepipeshall be free frommud,mill scale,mill lacquer,wax,oil, grease, or any other foreign material. Before blast cleaning, surfaces shall be inspected and pre-cleaned according to SSPC-SP 1 to remove oil, grease, and loosely adhering deposits. Visible oil and grease spots shall be removed using a solvent. Only solvents that do not leave a residue shall be used. Preheating to remove oil, grease, and mill scale may be used provided that all pipe is preheatedin a uniform manner to avoid distortion.

After drying and removing all loose adhering foreign materials, the pipe surface shallbecleanedbyblasting withgritorsteelshotstoachieveasurfacepreparation atleastequaltothatspecifiedinSSPC:SP6/NACE3.Theblastanchorpatternor

profile depth shall be 2 mil to 3 mils (50 µm to 75 µm) measured in accordancewith ASTM D-4417.

For consistent surface finish, a stabilized working mix shall be maintained in abrasive recycling blasting machines by frequent small additions of new grit, shot infrequent large editions shall be avoided. The abrasive working mix, abrasive recycling blasting machines shall be maintained clean of contaminants by continuous effective operation of blasting machine scalping and air-wash separators.

The cleaned interior pipe surface shall be in inspected for adequate surface preparation. Surface imperfections, such as slivers, scabs, burrs, weld spatter, and gouges, shall be removed by hand filing or grinding if necessary to preventholidays.

Blast-cleaned pipe surfaces shall be protected from conditions of high humidity, rainfall, or surface moisture. No pipe shall be allowed to flash rust before coating. To ensure a dry pipe surface at the time of liquid epoxy application, the minimum steel substrate temperature shall be 10°C and at least 3°C above the dew point.

4.3.3 Applicationtemperature

The temperature of the mixed coating material and of the pipe at the time of application shall be not lower than 10_0C. Preheating of the coating material by using in line heaters to heat the coating material may be used to facilitate the application. Heating shall conform to the recommendations of the epoxy coating manufacturer.

4.3.4 Applicationofepoxy

The epoxy shall be applied directly to the abrasive roughened steel surface pipe using a hot plural component airless spray equipment, with all necessary ancillary equipment like spraying boom etc, in accordance with the epoxy coating manufacturer's recommendations. Pipe will be rotated at a suitable speed and the boom of the spray machine carrying the spray gun will travel inside the pipe at a pre-determined speed to ensure that thickness of minimum 406 microns is achieved in one single spray application.

4.3.5 Curing

After application of epoxy, curing of the epoxy shall be natural air convection. Typical dry time of the epoxy at ambient temperature of 25-400C shall be between one hour to three hours. Shore D hardness of the epoxy after 10 hours shall be >65. Internalcoatingcutbackoneithersideofthepipeshallbe75mm+/-25mm.

4.3.6 FieldJoints

After the main pipes have been welded in the trench, internal epoxy coating shall be applied on the inside of the pipeline at the girth welds using brush application. Internal epoxy for field joint coating shall be supplied by the same manufacturer andshallbeNSFapproved.Theepoxyshallbesuppliedinsmallcansofappropriate size required per joint with applicator pad. The internal surface of the field joint shall be inspected and weld spatter or slag shall be removed by grinding.

The internal surface shall then be manually blasted toremove rust / contamination etc. The resin & hardener will be mixed and the coating applied to a minimum thickness of 406µ. The internal field joint coating shall overlap the factory applied main line internal coating by 50mm on either side.

4.4 Materialacceptance,inspectionandtesting

4.4.1 Materialacceptance

Proposedinternalepoxy lining materials shall be approved bytheOwner/Owner's representative. Test certificate from independent third party test laboratory shall be submitted conforming compliance to the physical properties as listed in Table I. No deviation to the physical properties shall be acceptable.

When the material is supplied, acceptance of the material shall be based on submission of certificate of conformance of the internal epoxy to this specification along with manufacturing acceptance test certificates for various lots as per manufacturer's quality assurance and quality control requirements.

4.4.2 Coatingapplicationinspection

The entire internal lining operation by the Contractor will be supervised byqualifiedexperts from the manufacturer.The CVof the manufacturer's expert shall be approved by the Owner / Owner's representative. All coating work will be done in the presence of the Owner / Owner's representative.

4.4.3 Thickness

Thickness of the coating system shall be checked in accordance with SSPC-PA 2. Thickness shall be in accordance with the values given in the Table I and shall be checked at a frequency specified by the Owner / Owner's representative.

4.4.4 PullOffAdhesion

The pull off adhesion of the internal epoxy lining to steel shall be checked in accordance with ASTM D-4541. The average value below the limits stated in the Table I shall constitute a failure of the system to meet the adhesion requirement. Thepulloffadhesiontestshallbeconductedatafrequencyspecifiedbytheowner /Owner's representative.

4.4.5 Fieldprocedures

At all times during construction of the pipeline, the Contractor shall use caution to prevent damage to the internal lining on the inside of the pipe. No metal tools or heavy objects shall be permitted to unnecessarily contact the finished coating. Workmenshallnotbepermittedtowalkontheinternalcoatingexceptwhen

necessary. In these cases, they shall wear shoes with rubber or composition soles and heelsorothersuitablefootwearthatwill not damagethecoating. Any damage to the pipe or the protective coating from any cause during the installation of the pipeline shall be repaired.

4.4.6 Coatingrepairin field

All defects visually or electrically discovered either at the coating plant or in the field shall be repaired by applying the same liquid epoxy coating using brush. The minimum over-lap at the damaged area shall be 100 mm all around. The repaired area shall be tested with a holiday detector as per specifications after the repair is completed. The thickness of the coating at the repair area shall be minimum 406µ.

4.5 EpoxyPaintingforInternalSurfaceofPipesandSpecials

The epoxy coatingshallbesolvent-less,liquidepoxy coatingof at least406microns thickness, for the interior surface of steel pipe lines &conforming to IS 3589:2001. Epoxy paint to be used for this work shall be suitable to local environmental conditions / ambient conditions.

4.5.1 General

All steel pipesand fittingsoutsidethepumping station shall be internallylinedwith a spray applied solvent free epoxy approved for contact with potable water under the United Kingdom Water Regulations Advisory Scheme authorized for use under Regulation 31 (4)(a) of the water supply (Water Quality) Regulations 2000 for contact with potable water. The applicable specifications for the coating system shall be suitable to potable water at elevated ambient / air temperature tested as perBS–6920.AWWAC210isreferredstandardforcoatingapplicationasperSec.
4.4. Surface preparation application condition, post treatment of coated surface to be as per manufacturer's specifications.

Paint –NSFstandard61–NACERP–01–75.paintshouldbesuitableforlongtime storing or potable water in the pipeline.

4.5.2 Materials&Workmanship

The coating system shall be factory lined and the lining shall be suitable for application in an environment with black bulb temperature up to 85 deg C.

All steel pipes shall be lined at the factory. Pipes welded on site shall be lined on site to the same standards as for pipes.

Pipe ends – coating shall be held back in from the ends of pipe sections to be jointed by field welding.

Detailed proposals of the lining method, materials and apparatus to be used for bothfactoryandsiteapplicationshallbesubmittedtoandapprovedbythe

Engineer before work starts. Storage and application shall be accordance with recommendations of the coating manufacturer, but as a minimum:

a) A visual examination of the surface to be coated shall be carried out and any slivers or similar deposits removed.
b) Priorto blasting all oil and grease shall be removed from the surface to be coated.
c) Preparation of steel surfaces for both factory and site application shall beto a minimum of Sa 2 ½ in accordance with BS 7079/ ISO 8501-1:2007 specifications /or as per client specifications and roughness should 50-75 micron.
d) The surface to be coated shall be dry, clean and free from foreign material andcoatingshalltakeplace beforeanysurfacerustingandat leastwithin4 hours of blasting.
e) Surfacepreparation and coating shall not be carried out when the relative humidity exceeds 85% or when the surface to be coated is less than 3 degC above the dew point.
f) Thecoatingshallhaveaminimummeandryfilmthicknessof406microns.
g) Coatingsshallbeusedwithinthepotlifespecifiedbythemanufacturer.
h) The materials to be used for the work of each batch, test certificate shallbe reviewed.
i) Paintshallbeappliedbybrush/airlessorconventionalspraymethod.

Pipe linings shall be inspected on site and damaged, defective or otherwise unsatisfactory linings may be condemned. All defective areas shall be made goodto the satisfaction of the Engineer.

4.6 **InspectionandTesting**:

Itwillbedetailedinthecontractor'sQualityPlanandwillbeundertakenas minimum to the following:

a) VisualInspectionofblastedprofileoneverypipetobecoated.
b) Visualinspectionoffinishedcoatingonevery pipe.
c) Measurementofcoatingthicknessatfourpointsoneachpipe.
d) The completed pipe shall be subjected to holiday detection tests which shall be carried out to the satisfaction of the Engineer. The applied voltage shall be hose appropriate to the coating under test as recommended bythe coating material manufacturer.
e) The adhesion test as per clause no. 5.1.6 of AWWA-C-210.07 shall be carried out on one pipe per lot of every 10 pipes. Two parallel knife cuts about 100 mm long and 20 mm apart shall be made through the coating. If necessary, the test knife may be heated to make the cut. The painted surface between two cuts shall be lifted off the pipe with a stiff blade. Ifthe paint film does not pill-off, more than the width of the cut, the bond shall be deemed to be satisfactory. If the width of the peel exceeds the width of the cut, two additional tests shall be made on the same pipe at two different locations. The painted surface shall be accepted if both the testsaresatisfactory.Iftheresultsofeitherofthetestsareun-satisfactory,

the painting work of pipeline shall be rejected. Adhesion test shall be performed on 1 pipe out of 10 pipes. If the adhesion test fails for one pipe, then this test shall be performed on all the remaining 9 pipes of that particular lot.

f) Prior to acceptance and application of the material, the Epoxy coating material shall be submitted by the contractor & shall be tested in an independent third party / vendor's test laboratory designated by the purchaser, in presence of client / consultant and the results shall be in accordance with the specified standards. The frequency of the test shall be minimum 1 sample in every 10000 liters or per batch of the coating material. Tests like: Specific Gravity, Hardness (shore – D), Adhesion to steel, Tabor abrasion, pull-off adhesion tests, will be carried out.

g) Rejection: If the sample of coating material does not comply with the standard, the coating material represented by such a sample shall be rejected.

h) The pull-off adhesion of the internal epoxy lining to steel shall be checked in accordance with the ASTM D – 4541.

i) All holidays visually or electrically discovered either at the coating plant or in the field shall be repaired by applying the same liquid epoxy coating using the brush. The minimum over-lap at the damaged area shall be 100 mmallaround.Therepairedareashallbetestedwithaholidaydetectoras perspecificationaftertherepairiscompleted.Thethicknessofthecoating at the repair area shall be minimum 406 micron.

4.7 Preservation,MarkingandShippingPreservation

4.7.1 Preservation

The bare ends of each pipe shall be painted outside with a removable varnish astemporary corrosion protection during transportation.

BevelprotectorsofatypetobeapprovedbytheEngineershallprotectthebare ends of each pipe.

4.7.2 Marking

In addition to the marking required by API 5L, the specification MO1 "Steel Pipes for Main lines and other applicable project specifications, the Pipe Coating Contractor's unique coating number shall be marked to the internal surface or the pipe with synthetic resin paint.

Further marking details like colour coding etc. shall be agreed upon with the Engineer.

Themarkingshallhaveatleastadistanceor150mmtothepipe end.

4.7.3 Shipping

Shipping and Loading preparation shall be in accordance with API Specification 5L or otherwise stated in the contract documents.

The pipe coating Contractor shall submit detailed loading, stacking- and shippingprocedures for approval by the Engineer.

4.8 Documentation

4.8.1 Pre-ProductionDocumentation

The Pipe Coating Contractor shall submit the following documents to theEngineer for approval prior to commencing production:

a) The manufacturer's trade name and data sheets for all proposed coatingmaterials. This includes cleaning and abrasive blasting consumables.
b) Procedure for identifying or maintaining the identification of each coated item.
c) Handlingprocedure.
d) Stackingprocedure.
e) Materialscontrolandtraceabilityprocedureforthebatchesofcoating materials.
f) Materialscontrolandtraceabilityprocedure(pipeandcoatingmaterials).
g) Procedureforsteelsurfacepreparationincludingmaterials,cleaning,inspectio n, verification of cleanliness and surface profile.
h) Coatingapplicationprocedures.
i) Theresults of the batch tests for batches to be used for pre-qualification tests.
j) Detailsoftestingmethodsincludinginstrumenttypesandcopiesor current calibration certificates.
k) Detailsofinspectionmethodsforbareandcoatedpipe.
l) FulltestresultsfromthecoatingProcedureQualificationTest(PQT).
m) Repairprocedureandresultsortestsondemonstrationofrepairs.
n) ProjectspecificQualityPlan.Workshallnotcommenceuntilthese procedures have been reviewed and approved by the Engineer.

Theselectionofproposedcoatingmaterialsshallbesubjecttoengineer'sapproval

4.9 ProductionRecords

A daily log containing the following data shall be maintained and be available for inspection by the Engineer during and/or after production. Data shall be recorded against the pipe unique identification number.

a) Barepipeinspectiondata
b) Ambienttemperature(every4hours)
c) Humidity(every4hours)
d) Coatingprogress(no.ofitemscoated.Includingitemserialnumbers)
e) Blastpipesurfaceamplitude
e) Testsforcleanlinessofblastsurface
f) Testforcleanlinessorblastmedium
g) Filmthicknessmeasurements
h) Average,maximumandminimumcoatingthicknessduringeach shift
i) Detailsofanycoatingrepairs
j) Theunique identification number of all items that are stripped for recoating – 'RP'
k) Pipecoatingtestresults

ThislogshallbeavailabletotheEngineerthroughoutallcoatingoperations.

4.10 ReleaseDocumentation

The Pipe Supplier and/or Pipe Coating Contractor shall submit to the Engineer the following documentation in hard copy and softcopy (format to be agreed uponwith the Engineer) with each batch of pipes released:

a) Millcertificatesforlinepipe
b) Uniquepipeidentificationnumbers
c) Uniquecoatingidentificationnumber(ifdifferent)
d) Pipelength
e) Lengthofthecoatedportionofeachpipeandtotalcoatedlengthsofall pipes.
f) Reductionsinlengthdueto useintests,damageorrepairs,recordedagainst pipe unique identification number
g) Dateor coating
h) Batchnumbersofcoatingmaterials used

Thisshallbefollowedwithintwoweeksbythe following:

a) Manufacturer'scertificatesforeachbatchofcoatingmaterials
b) Certification/calibrationcertificatesforalltestingandcoatingequipment
c) Inspectionandtestrecords,results,andotherdocumentationofall materials and coating tests

All reports shall be signed by the Pipe Coating Contractor to signify compliancewith the requirements of this specification.

Thefinishedepoxyliningsurfaceshallbeabletodeliveraguaranteed'C_r'valueof (1)oneinmodifiedHazen-William'sformulaforestimatingpipefrictionlossThe arrangement for 'C_r' value testing is to be arranged by the contractor.

5 700MICRONPOLYURETHANEEXTERNALCOATING

5.1 Scope

Technical specification governs requirements for material, equipment, application, inspection, repair and handling aspects associated with the external coating.

5.2 Externalcoating:

External surface of the pipe and specials to be painted with one coat of two part chemically cured polyurethane primer of min 30 micron dry film thickness followed by one of two coats of two part **solventfree polyurethane** provide a high build coatingofdryfilmthicknessof700micronincludingprimercoat.Polyurethane

coating should have good resistance to ultraviolet degradation along with corrosion resistance. PU coating should provide hard yet flexible, with very low water absorption with outstanding adhesion as well as impact and abrasion resistance.

SolventlessPUsystemistobeusedeliminatingsolventhealthhazards.

ExternalcoatingshouldbecarriedoutatsitebyPaintManufacturerasduring transportation coating will get damaged.

5.3 GeneralRequirement:

I) The work shall conform to the following documents / specifications (latest revision or as specified)

a) SSPCSP10/ NACE2/Sa$2^1/_2$ NearwhiteBlastCleaning.

b) SSPCPA2MeasurementofdryfilmCoatingThicknessWithmagnetic gauges

.

c) ASTMD4541MethodforpulloffstrengthusingportableAdhesionTester.

d) NACERP0274–2004High–VoltageElectricalInspectionofPipelineCoatings.

e) NACESP0188-2006Discontinuity(Holiday)TestingofNewProtectiveCoatings onConductiveSubstrates.

f) NACERP0169–2002ControlofExternalCorrosiononUndergroundor Submerged Metallic Piping Systems.

g) AWWAC210 -2007Liquid – Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.

h) IS3589:2001AnnexureBSteelPipesforWaterandSewage Specification.

i) AWWAC222–2000PolyurethaneCoatingfortheInteriorandExteriorofSteel Water Pipe and Fittings.

j) IS13213:2000PolyurethaneFullGlossEnamel(TwoPack)

k) IS10221:2008CoatingandwrappingofundergroundMildsteelpipelines

l) BIS DOC : CHD 20 (1938) PSolventlessLiquidEpoxySystemfor interior& exterior of Steel Water Pipeline.

m) IS 16719:2018 Specification for Polyurethane coating for interior and exterior of steel pipe and fittings.

II) Thesteelsurfacepreparationpriortoactualcommencementofcoatingshall conform to SSPC SP 10 / NACE 2 / Sa$2^1/_2$ (near white metal) with sand blasting.

III) The EPC contactor shall submit a detailed written description in the form of amanual covering coating equipment, procedures, materials inspection test, and repair etc. to the Owner for approval.

IV) The contractor shall also provide copies of test reports from NABL approved laboratory (like National Test House, Kolkata) evidencing that materials (paints / primer) shall conform to the technical specification.

V) The contractor shall also provide certificates from coating manufacturer quoting batch numbers, date of manufacture and shelf life etc. The contractor shall provide Manufacturing Quality Plan (MQP) and field Field Quality Plan (FQP) before supply of material and starting of work.

VI) The coating shall be applied either by coating / paint manufacturer or by their authorized applicator. If done byapplicator, then the same has to be approved by the CE, Megalift.The authorized applicator should have been trained by and certified by manufacturer and shall possesses the necessary specialized equipment, trained crew and experience in spraying epoxy coating.

VII) Applied coating shall be tested for dry film thickness, holiday (electrical inspection for continuity) and adhesion as per relevant standard such as SSPC PA 2, NACERP 0274 and ASTM 4541.

VIII) Thematerialmaybeheatedifnecessaryandappliedbyairlessspray/pluralcomponent spray systemwith minimum wastage.

5.4 COATINGPROCEDUREANDAPPLICATION

5.4.1 SurfacePreparation:

Pipe shall be blast cleaned by sand. The cleanliness achieved prior to application shall be in accordance with the requirement of SSPC SP 10 / NACE 2 / Sa2$^{1}/_{2}$of IS0 8501 (near white metal)

a) The blast pattern or profile depth shall be 40 to 100 micron and shall be measured by dial micrometer.

b) Before sand blasting is started or during blasting or coating, temperature of the pipe surface should be more than 3^{0} C above dew point temperature. Blast cleaned surface should be primed within 4 hours and shall be protected from rainfall or surface moisture and shall not be allowed to flash rust. If the rust occurs, the surface again to be prepared by sand blasting or wire brushing.

5.4.2 ApplicationofPUCoating

a) PU Coating shall be applied when the pipe surface temperature at least 30 C above due point temperature (when R.H. is more than 85 %)

b) Material preparation and application shall be done as per manufacturer recommendation and shall be applied by plural component machine.

5.4.3 TESTREQUIREMENTS:

5.4.3.1 Measurementofdryfilmthickness

Measurement of dry film thickness of coating: coating thickness shall be in the range of ± 20% and as per SSPC PA 2.

(i) Apparatus/ Instrument: The instrument used for dry film thickness may be Type I pull of gauges or Type 2 electronic gauges.

(ii) Procedures

a) No. of measurements. For100 Square feet (9.29 Square meters) five (5) spots per test area (each spot is 3.8 cm.) in diameter. Three gauge readings per spot (average becomes the spot measurement).

b) If the structure is less than 300 Square feet, each 100 squarefeet should be measured.

c) Ifthe structure is between300 and 1000 Sq. ft. select 3 random 100 square feet test areas and measure.

d) For structure exceeding 1000 square feet, select 3 random 100 square feet testing areas for the first 1000 Sq. ft. and select I random 100 Square feet testing area for each additional 1000 Square feet.

e) Coating thickness Tolerance: Individual reading taken to get a representative measurement for the spot are unrestricted (usuallyloworhighreadingsarediscarded).Spotmeasurements (the average of 3 gauge readings) must be within 80 % of the minimum thickness and 120 % of the maximum thickness. Area measurement must be within specified range.

5.4.3.2 ElectricalInspection(Holiday)Test:

a) Allthecoated/Linedpipesshallbetestedwithanapprovedhigh voltage holiday detector preferably equipped with an audio visualsignallingdevicetoindicateanyfaults,holes, breaksor conductive particles in the protective coating.

b) Theappliedoutputvoltageofholidaydetectorshallhaveaspark discharge of thickness equal to at least twice the thickness of the coating to assure adequate inspection voltage and compensateforanyvariationincoatingthickness.Theelectrode shall be passed over the coated surface at approximately halfthe spark discharge distance from the coated surface only one time at the rate of approximately 10 to 20m/min. The edge effect shall be ignored. Excessive voltage shall be avoided as it tends to induce holiday in the coated surface thereby giving erroneous readings.

c) While selecting test voltages, consideration should be given to thetoleranceoncoatingthickness and voltage should be selected on the basis of maximum coating thickness likely to be encountered during testing of a particular pipe.

d) The testing voltage shall be calculated by using followingformula (as per NACE 0274:2004)

e) Testing Voltage V=7900_T± 10 percent where T is the average coating thickness in mm.

f) Any audio visual sound or spark leads to indicate pinhole, break or conductive particle.

5.4.3.3 AdhesivePulloff Test:

After holiday the coated surface is subjected to adhesion pull off test as per ASTM D 4541

a) Apparatus/ Instrument: Adhesion tester consists of three basic components: Ahand wheel, a black column containing a dragging indicator pin and scale in the middle and a base containing three legs and a pulling “jaw” at the bottom and also dollies.

b) Prepare the test surface: Once test area is selected, test area shall be free of grease, oil, dirt, water. The area should be flat surfaces and large enough to accommodate the specified number of replicate test.

c) Prepare Dolly (Test Pull Stub): The dolly is a round, two sided aluminiumfixture.Bothsidesof the dollylookssame,however, one side sloped on top surface while flat on bottom surface. As the surface of the dolly is polished aluminium, roughen thesame using a coarse sand paper.

d) Select an adhesive : Use araldite, a 100 % solid epoxyadhesive. This adhesive requires at least 24 hours at room temperature to cure.

e) Attachthedollytothe surface.

(a) Using a wooden stick,apply aneven layerof adhesive to the entire contact surface area of the dolly.

(b) Carefully remove the excessive adhesive by using a cotton swab.Allowtheadhesiveto fullycure before performing the adhesion test.

(c) Attach the dolly to the coated surface and gently push downward to displace any excessive adhesive.

(d) Pushthedollyinwardagainstthesurface,thenapplytape across the head of the dolly.

f) Determinewhetherscoringisrequired.

g) PerformtheAdhesionTest.

(a) Attach the adhesion tester to the dolly by rotating the hand wheel counter clockwise tolower the jaw of the device.

(b) Slide the jaw completely under the head of the dolly. Position the three legs of the instruments so that they are sitting flat on the coated surface.

(c) Slidethe dragging indicator pin on the black column to zero by pushing it downward.

(d) Firmly hold the base of the instrument in one hand and rotate the hand wheel clock wise to raise the jaw of the devicethatisattachedtotheheadofthedolly.Thedragging indicator pin will move upward on the black column as the force is increased and will hold the reading. Apply the tension using a moderate speed. Continue to increase the tension on the head of the dolly until (a) the minimum PSI/Mpa/Kg.cm2 required by project specification is exceeded and the test is discontinued (b) the maximum PSI/Mpa/Kg/cm2 of adhesion tester has been achieved and dolly is still attached (c) the force applied by the adhesion tester causes the dolly to dislodge.

(e) Readthescaleandrecordtheadhesionvalue.

h) The black column near the middle of the adhesion tester contains two scales and a dragging indicator pin in between. RightscaleisPSIandleftscaleisMPa.ThedraggingindicatorPin will hold the reading until push back to zero. When achieve the end point of test, read the scale across the bottom of the dragging pin.

5.4.4 CoatingRepair

Defecting Coating: Coating shall be repaired in accordance with thefollowing subsections.

Surface Preparation: Accessible areas of pipe requiring coating repairs shall be cleaned to remove debris and damaged coating using surface grinders or othermeans.The adjacentcoatingshallbe featheredby sanding,grindingor other method. Accumulated debris shall be removed by blowing with contaminant free air or wiping with clean rages.

Areasnotaccessibleforcoatingrepairsuchasinteriorsurfaceofsmall Diameter pipe shall be reprocessed and recoated.

Coating Application: The coating system shall be applied to the prepared areas in accordance with procedure.

Repair Inspection: Repaired portion shall be electrically inspected using a holiday detector.

5.4.5 WeldedFieldJoints

Preparation : The weld Joints shall becleaned so asto befree frommud,oil, grease, welding flux, weld spatter and other foreign contaminants. Thecleanedmetalsurfacesoftheweld jointshallthenbeabradedusing rotary abrading pads or emery paper. The adjacent liquid Epoxy / PU coating shall be feathered by abrading the coating surface for a distance of 25 mm.

Electrical Inspection: After curing the coating system applied to the welding joints shall be holiday tested. Any holidays is indicated by the detector shall be marked with chalk to identify the area of repair

6 LOWERING,LAYING&JOINTINGOFPIPE

6.1 General

Unless specified otherwise, the pipeline shall be buried with minimum cover of 1.2 m at top, as shown on drawings. No material shall be erected unless it has been previously passed by the Engineer.

Erection of fabricated shells shall be carried out by the Contractor who shall equip himself,at his cost, with allnecessarytools,machinery, labouretc.required for the purpose.

6.2 Welding

Except for routine welding of joints, no other work shall be done in the absence of Contractor's engineer, either during the daytime or at night.

Chippingshallnotbekeptinarrearsformorethan15joints.

Saddle pieces shall be fixed in position after checking bolts holes, by means of templates. These works shall be done together with the pipe laying work, ifpipeline is to be laid above ground in unavoidable circumstances.

6.3 Temperature

The components of the pipeline such as base plates, top plates and pedestals have been so designed that the centers of the plates and pedestals shall coincide at the Mean Temperature (30^{o}).

For this reason, all works such as fixing flanges, base plate etc. in true alignment, and incorrect position and tack welding pipes shall be done at the mean temperature. For ascertaining the temperature, the Contractor shall provide mercury cups and fix them to the pipe shell from outside and shall also provide thermometers of the required type and range. No extra payment shall be made for this.

6.4 SaddleSupports

Unless otherwise specified pipeline shall be underground. However at unavoidable reaches it shall be on R.C.C. saddles spaced at about 7 m centre to centre. The material and constructionof R.C.C./Steelstructures such as saddles, anchor blocks, crossings etc. associated with the work of pipe line shall conform with the relevant I.S. codes, good engineering practice and as directed by the Engineer. The pipes to be laid on saddle supports shall be erected at mean temperature. Saddle supports shall either be sliding type or fixed type. For both the types of supports a 10mm thick double plate shall be welded to the part circumference of the pipeline that willmakecontactwiththesaddleandanothersimilarplateshallalsobeembedded in the concrete saddle with necessary arrangement to facilitate welding it to the double platewelded to thepipe, in caseof fixed support. In caseof sliding support, the pipe shall be allowed to slide freely over the plate embedded in the saddle. Alternatively to achieve fixity, the pipe shall be anchored by providing suitable anchor block.The rateforlaying thepipeon saddlesupport shall include for laying, aligning, tack welding, provision of rigging screws with screw eyes etc., complete.

In addition to above, the pipe shall be held in position on saddles with twonumbers 50mm x 8mm thick holding down traps fixed to the saddles with holding down bolts and nuts which shall be paid separately under relevant item of bill of quantities.

6.5 ErectionofShells

The erection shall be true to position, lines and grade as shown in the drawings or as modified by the Engineer. The Contractor shall provide at his cost necessary saddles,pads,spideretc.,allnecessary instruments andothermaterials andlabour required for proper erection of shells in position and for the Engineer in checking the correctness of the erection.

Alignment of sections at edges to be butt welded shall be such that the maximum offset is not greater than the values given below:

Thickness‘t’ (mm)	**OffsetinLongitudinal joints (mm)**	**OffsetinGirthjoints (mm)**
Upto 12	0.25t	0.25t
12to20	3mm	0.25t
20to40	3mm	5mm
40to50	3mm	1/8t
Over 50	**Lesserof0.0625tor10 mm**	Lesserof0.125tor20 mm

The best of welders as selected from their work in the Contractor's workshop shall be selected for in-situ welding of the shells. The relevant provision under welding such as qualification standard for welding procedures, tests on welder's work and removal of defects etc., shall also apply to in-situ welding.

6.6 GeneralSequenceofOperations

Before commencing the work of pipe laying, the Contractor shall study the L-section of the pipeline for the section concerned. He shall also study the details of laying i.e. underground or aboveground. The underground pipeline shall be laid on sand cushioning/bedding as shown on the drawing. The difference in depth due to uneven excavations shall be made up by sand cushioning.

Pipe laying shall generally start from the fixity points on either side, the expansion joints if required for pipeline aboveground being provided last. Fixing points are at all anchor blocks. Where such blocks are not required for long lengths, fixity shall be achieved by fixing the pipeline to the special type of R.C.C. or steel saddles as directed. The distance between successive fixity points shall not exceed 300 m.

Anchor blocks shall be constructed before commencing the pipe laying work inany section. The construction of the blocks shall be carried out in 3 stages: in the first stage the lower part upto 150 mm below the invert of the pipeline including concrete chairs to support it shall be constructed; in the second stage the pipeline on this part of the block shall be laid; and lastly, the remaining block around and over the pipeline shall be
constructed.

The fixity saddles and ordinary saddles if the pipeline is aboveground shall be cast-at least 3 weeks before the pipeline is laid on them. After all saddles between successive fixity points have been cast, a line plan showing the actual position thereof shall be prepared, after taking levels and measuring distances. In case of any errors in casting the pedestals, corrections shall be applied. The pipe laying work shall then start from the fixity points and shall proceed towards theexpansion joints. Themethod of jointing the pipes and erecting themon previously cast R.C.C. saddles shall be determined by the Contractor depending upon the type of plant equipment and personnel available with them.

The pipe strakes shall be assembled in position onthesaddles eitherby the cranes, portable gantries, shear legs or any other equipment approved by the Engineer. Normally, not more than two pipes shall be aligned, tacked and kept in position on temporary supports. The Contractor shall not proceed with further work, until the circumferentialjointsofthesepipesarefully welded.Duringassembly,thepipeline shall be supported on wooden sleepers and wedges, with the free end of the pipeline held in position byslings toavoid deflection due totemperaturevariations during the day. In general, the assembly of pipe strakes and one run of welding shall be done during the day time while full welding including the external gouging and sealing runs shall be done after 5 p.m. or so. The Contractor shall maintain the continuity of the work by adding two more pipes on the second day in a similar manner, after full welding of the previous joints is completed during the night. While this new work is being done, the Contractor shall proceed with the work of providing permanent supports for the pipeline assembled and welded previously.

6.7 FixingExpansionJoint

The work of laying pipeline in aboveground, laying starts from the fixity points and proceeds towards the expansion joints. It shall be continued until the gap between the pipeends is less thanthe lengthsofthe expansionjoint plus pipestrake length. At this stage, the exact gap between the pipe ends shall be measured at mean temperature of that locality. Let it be `X'. Similarly, the exact length of the pipe strake and the expansion joint bought at site shall be measured at the same temperature let these be `Y' and `Z' respectively. Normally, the length of the expansion joint (`Z') is standard.

(a) Casewhen`Y'plus`Z'ismorethan`X'orequalto`X'(i.e.fixingof expansion joint without strip)

Atmeantemperaturetheexactgapbetweenpipesshallbe measured.Freeendsof pipes shall be brought in a correct line and level; lateral movement, if any, shall be corrected. Then the gap between the free ends shall be made equal to the exact length of the expansion joint by cutting one of the pipe ends. Choice of the end to be cut must be made from the point of view of bringing the expansion joint to a central position.

The expansion joints are normally supplied without packing. The normal length of the expansion joint shall be reduced by about 100 mm by cutting the inside locks and inserting the inner strake by means of turnbuckles. At mean temperature this expansion joint shall be inserted inside the gap (care being taken to keep the *Volume* –tapered portion on the down-stream side), and both ends shall be tack welded to the pipe ends, after pulling the expansion joint. (Tacks of these twojoints shall be of longer length, approximately 100 mm long).

Welding of these two joints of the expansion joints shall be started only after it is ascertainedby taking observations that the expansionjoint is functioning properly.

Theproceduretobefollowedfortakingobservationsisgiveninclause8.5 (c).

(b) Casewhen`Y'plus`Z'islessthan`X'(i.e.fixingofexpansionjointswith strap)

Theexpansionjoint shallbelaidinlockedposition.Beforelayingthepipesadjacent to the expansion joint, the exact gap between the pipes shall be calculated by taking measurements of the first pipe (upstream of the expansion joint), and the second pipe (downstream of the expansion joint) at Mean Temperature.

If the gap is less than 100 mm, the second pipe shall be cut to make the desiredgap of at least 100 mm. If the gap is more than 200 mm, suitable distance piece of not less than 700 mm shall be inserted after cutting necessary length of the first pipe. The second pipe shall then be laid in position. Then a strap of length equal to three times the gap length shall be welded to the pipe, overlapping the secondpipe by the gap length. The other end of the strip shall be kept free.

At mean temperature the other end of the strap shall be tacked to the first pipe, after checking of the line and level. Simultaneously, all the locks of the expansion joint shall be removed and chipped off properly.

Welding of the joints between the strap and the first pipe shall be started onlyafter observations are over and it is ascertained that the expansion joint is functioning properly.

(c) Observations

Before fixing the expansion joint, two mercury cups - one on the left and the other on the right side - shall be fixed on the pipe near the upstream side of the expansion joint.

Immediately after the expansion joint in case (a) above or the strap in case (b) above is tack welded, observations for total expansion or contraction shall be started and continued for 48 hours round the clock. Similarly, the central and end fixity pedestals shall be kept constantly under observation.

The expansion and contraction shall be measured by making a temporary marking on the inner strake (on the upstream side) and measuring the distance between this mark and the edge of the gland of the expansion joint.

Theobservationsshallberecordedinthefollowingproforma;

Reading No.	Time	Shelltemp on upstream side	Shelltemp on downstream side	Atmospheric temperature	Distbetween edgeofgland andmarking
1	2	3	4	5	6

In case the pipeline is laid in trenches as shown on the drawing, after welding and field testing, the trench shall be filled with selected material upto 300 mm above pipes. This backfill shall be provided in layers not more than 150 mm, with adensity more than 95% of the standard proctor density. Samples shall be tested as directed by the Engineer. Remaining depth of trenches shall be filled with ground backfill material.

7 SPECIALS

7.1 General

Specials, such as tees, Y-pieces, bends (single or composite), tapers, etc. shall necessarily be in steel and shall be manufactured as per standards and tested and laid in the same manner as the pipes. Small branches, single piece bends, etc. may be fabricated at site, care being taken to ensure that the fabricated fittings have at least the same strength as the pipeline to which they are to be jointed.

7.2 Bends

(a) Bends shall be fabricated taking into account the vertical and horizontal angles for each case.

(b) Thebends shall have welded joints and the upstream and downstream ends of each bend shall have a straight piece of variable lengths as required.

(c) Bends shall be designed with deflection angle of maximum 10 deg. Between segments.

(d) When the point of intersection of a horizontal angle coincides with that ofa vertical angle, or when these points can be made to coincide, a single combined or compound bend shall be used, designed to accommodate both the angles. The combined bend should have a pipe angle equal to the developed angle, arrived at from appropriate formula.

(e) Alljointsinbendsshallbethermallystressrelievedasspecified.

(f) Detailsof thrust collars anchor bolts, holding down straps, saddle plates should be furnished together with full specifications in Contractor's fabrication drawing.

7.3 Manholes

(a) Manholes of 600 mm diameter shall be provided at locations generally 2.5 km apart, with additional manholes at both the sides of butterfly valves. Manholes in the pipeline shall be placed in suitable position in the top quadrant.

(b) The Contractor shall fabricate different parts of manhole in conformitywith relevant IS Specification, well established practices and as directed by the Engineer.

(c) The manhole shall be provided with MS blank flange on top. The required MS nut, bolts & rubber packing shall be fixed of standard quality for fixing of flange.

7.4 ClosingorMakeupsections

Closing or make up sections shall be furnished at appropriate locations on the line to permit field adjustments in pipeline length to compensate for shrinkage in field welded joints, differences between actual and theoretical lengths anddiscrepancies in measurements.

7.5 Heads

Test heads may be ellipsoidal, standard dished as per ASME code or hemispherical heads. They shall be welded in the shop and removed after the test. Allowance shouldbemadeinthelengthofthepipesectionreceivingthetestheadforthe

welding and removal of the head and preparation of the plate edges for the final weld after testing.

Noseparatepaymentwillbemadeforsuchtestheads.

7.6 Walkways,Stairs,Ladders,HandRailsetc.

Walkways, stairs, rungs, ladders, hand rails, etc. shall be provided as shown in the drawings and/or as directed by the Engineer. They shall conform to wellestablished design and construction for each accessory concerned.

7.7 Flanges

Flanges shall be provided at the end of pipes or special where, butterfly, air valve, scour valve, sluice valves, blank flanges, tapers, etc. have to be introduced. The flanges received from the manufacturers will have necessary boltholes drilled. The Contractor shall assemble the flanges in the exact position by marginal cutting, if necessary, so as to get the desired position of the valves, etc. either vertical or horizontal and shall then fully weld the flanges from both sides in such a way that no part of the welding protrudes beyond the face of the flanges. In case thewelding protrudes beyond the flanges and if the Engineer orders that such protrusions shall be removed, the Contractor shall file or chip them off. If required and when ordered by the Engineer, the Contractor shall provide and weld gusset stiffeners, as directed on site. The drilling pattern shall be matching with thedrilling pattern of flanges of valves.

7.8 BlankFlanges

Blank flanges shall be provided at all ends left unattended for the temporary closure of work and also for commissioning a section of the pipeline or for testing the pipeline laid. For temporary closures, non-pressure blank flanges consisting of mild steel plates, tack welded at the pipe ends may be used. For pipes subjectedto pressures, the blank flanges or domes suitably designed as per Engineer's requirements shall be provided.

7.9 StiffenerRings

The Contractor shall provide stiffener rings wherever required by design. The Contractor shall weld the same to the pipes with one circumferential run on each side. All fillet welds shall have a throat thickness of not less than 0.7 times the width of welding.

8 FIELDHYDRAULICTEST

After each section of the pipeline has been completed, it shall be tested for water tightness before being covered. The contractor shall at his own cost fill up water in pipeline & give necessary hydraulic test section by section & the pipeline shallstand the pressure which shall exceed the working pressure by (a) 50% of the highest pressure in the section (b) 30 M whichever us less without showing any leakage or sweating anywhere in the pipe joints, specials, valves, etc. If any defectis found, the contractor shall make good the same at his own cost.

Any leaking joint shall be made good & above test pressure is to be lowered gradually after satisfactory test is over.

The hydraulic test shall be given again if considered necessary by the SUPERINTENDING ENGINEER
or his representative to show that no further leakages or sweating is there. The contractor shall have to make necessary arrangements for water testing as well as plugging the opened pipe, etc. as directed without claiming any extra cost.

It the contractor does not able to manage section wise hydraulic test, hydraulictest shall be observed as below:

After completion of entire pipeline work and commissioning of pump sets (i.e. the project is ready for commission), the entire pipeline shall be hydro tested.

The contractor shall have to take the permission for drawal of water for field-testing of pipe. The cost of hydraulic testing of the installation by providing necessary testing equipments, creating and maintaining pressure and thenecessary bulk heads and their fixtures and their subsequent removal andrestoring the installation to working stream shall be included in the rate for laying and testing of the pipe. Water charges and electricity charges for field hydraulic testing shall be borne by the contractor.

The pressure test shall be conducted in dry weather to observe whether any leakage takes place or not. For field hydraulic test water will pass through entire pipe line with a working pressure of maximum working pumps for a period ofseven days continuously after attaining the required pressure and water reachesat the outlet of transmission main. A leakage equivalent to 0.267 litre per mm of pipe dia. per kilometre of pipeline per day for testing at working pressure applied is permissible. Any leakage beyond that specified herein above shall be rectified to the satisfaction of the Engineer.

Water shall not spout, ooze or sweat either through joints-welded or bolted or the body of the pipe. If any leakage noticed shall be repaired by the Contractor, which shall include coating and repairing of the damaged portion. Repairs and replacements and further testing including the cost of the plates and other raw materials shall be carried out by the Contractor at his own cost. If any leakages are observed during the defects liability period due to defective workmanship or material supplied by the Contractor, he shall repair the same to the entire satisfaction of the Employer, at his own cost.

After completion of field hydraulic test as specified above and if no leakage isfound in the entire pipeline / joints and all welded portion, then this may be considered as field hydraulic test and after commissioning of the pipeline system, amount retained at the rate of 3% can be released. (Maximum number of working pumps will work continuously to achieve required pressure specified in thetender).

Till the contractor gives satisfactory field hydraulic test & commissioning of the pipeline an amount at the rate of 3% of testing commissioning as per Price Schedule shall be withheld.

9 PROGRESSINLAYING

The Contractor shall submit along with the tender his detailed bar chart for manufacturing and laying of the pipeline. While preparing his bar chart, the Contractor shall plan his activities such that the laying of pipes shall closely follow the manufacturing schedule and no pipes shall remain stacked in factory or at site for a period more than one month.

It is mandatory that he shall submit an approach note on how he will carry out this Work within the contractual period and on the compatible resources in terms of construction equipment and other facilities that he shall utilize to complete the tendered Work.

9.1 LoweringandJointing

Thepipeshallbeloweredinto thetrenchesby removingonly oneortwo strutsata time. It shall be seen that no part of the shoring is disturbed or damaged and, if necessary, additional temporary struts may be fixed during the lowering operations. It shall also be necessary to see that the gunite coating of pipe is not damaged in any way during the lowering and assembling. After the pipe is lowered into the trench, it shall be laid in correct line and level by using the leveling instruments, sight rails, theodolite, etc. Care shall be taken to see that the longitudinal joints of two consecutive pipes at each circumferential joints are staggered by 90°. While assembling the pipes, the ends shall have to be brought close enough to leave a uniform gap not exceeding 4mm. If necessary, a marginal cut may be taken to ensure a close fit of the pipe faces. For this purpose, only experienced cutters who can make uniform andstraight cuts, shall be permitted to cut the faces of the pipes. No extra payment shall be made for such marginal cutting.ThereshallbenolateraldisplacementbetweenthepipefacestobejoinedIf necessary, spiders from inside and tightening rings from outside shall be used to bring the two ends in perfect contact and alignment. It may also be necessary to use jacks for this purpose. In no case shall hammering or longitudinal slitting be permitted. When the pipe is properly assembled and checked for correct line and level, it shall be firmly supported on wooden beams and wedges and tack welded. Some portion of the trench may be refilled at this stage so as to prevent the pipeline from losingits alignment.The tack weldedcircumferentialjoints shallthen be welded fully. Only experienced welders, who shall be tested from time to time shall be permitted to carry out the welding work.

On completion of the pipe jointing and external protection, the trench and the welding pits shall be cleaned of guniting rebound. The welding shall be filled and compacted in 150mm layers with the bedding material.

Backfillingshallbecarriedoutasdetailedhereunder.

ProvidingSteelPropsinsidethePipeline(Dia.1200mmandabove)

It is necessary that the roundness of the pipes is maintained circular. To achievethe same, steel adjustable screw type props of screw or similar approved make consisting of minimum six (three on each side) legs shall be fixed inside the pipe. The deflection of the pipe should be limited to 1% of the average diameter. In no case shall the limit be exceeded, even under the full load, in case of pipes laid underground. The design and drawings of the props that the Contractor intends to use should be got approved by the Engineer before starting the work. While laying the pipes underground, the Contractor shall provide this propping arrangement from inside to maintain circularity. These props shall be fixed vertically and at intervals of not more than 1.8 metres or as directed by the Engineer. In case the Engineer finds it necessary, they will have to be fixed in any position. The props should be kept in position at least for three days after the encasing of the pipe in that section is completed or till refilling is done to the full height of fill over thepipe in case the pipes are not encased. The props shall be removed only after obtaining permission from the Engineer. The height of earth fill over the pipe top shall normally be such as to avoid floatation under submerged conditions and to have a minimum earth cushion of about 1.00 metres over the pipe whichever is greater. It is also necessary that, in case of buried pipe, adequate side supports from thebackfilledmaterialsisdevelopedto keepthediametricaldeflectionwithin the specified limits.

Backfilling of the excavated trenches, particularly below the pipe and along the sidesshall,therefore,havetobedonewithpropercareandcompactionasdesired. No extra payment will be made for the above work.

9.1.1 PrecautionsagainstFloatation

When the pipeline laid underground or above ground in a long narrow cutting gets submerged in water collected in the trench of cutting it is subjected to an uplift pressure due to buoyancy and is likely to float if completely or partly empty. In the design of pipelines, provision is to be made to safeguard against floatation providing sufficient overburden or by providing sufficient dead weight by means of blocks,etc.Factorof safetyfor calculations for check against floatingshall be taken as 1.2.

In the case of works extending over one or more monsoon seasons, however, special care and precautions are necessary during the progress of work on this account.TheContractorshallclosedownpipelayingoperationswellintimeforthe monsoon. The work of providing blocks, refilling the earth to the required level, compacting the same, etc. shall always be done as soon as the pipeline in the cutting has been laid.

The Contractor shall see that the water shall not be allowed to accumulate in open trenches. Where work is in an incomplete stage, precautionary work, such asblank-flanging in the open ends of the pipeline and filling the pipeline with water etc. shall be taken up as directed by the Engineer.

Such works shall be to the Contractor's account and no separate payment shall be made for the same. The Contractor's rate for pipe laying shall be deemed toinclude such precautionary measures against floatation.

Protectionofthe pipeline against floatation during the Contract Period shall be the responsibility of the Contractor. Should any section of the pipeline float due to his negligence, etc. the entire cost of laying it again to the correct line and level shallbe to his account.

Electric and telephone line, cable and pole if required to be shifted, necessary charges for shifting to be paid to respective authorities shall initially be paid by the contractor to the concern department and the same will be reimbursed by GOVT. to contractor on producing receipt of challan of concern department.

L - section of route is tentative. Contractor has to prepare a fresh Longitudinal Sectionbeforestartingthework,showingallservicelinescomingacrossorparallel.

Alignment of pipeline may required to be changed on same route due to any obstructs or service lines. No extra payment made to contractor.

Manhole chamber and all other structure required to be constructed on road areto be Designed for “AA” class loading and same shall be got approved from Engineer-in-charge.

All necessary actions required for diversion of the traffic on State high way, or any other routes are to arranged by the contractor at his own cost as per the requirement of the traffic rules.
During the execution of work any damage occurred to the private / Govt. property is to be reimbursed by the contractor to the owner.

Asphaltcuttingforpipelineexcavationincludedinthescopeofworkandthedebris of asphalt cutting shall have to be carted and dumped at the place shown by the Engineer in charge so that GOVT. can sort it out and reuse the same in other work. The contractor has to bring the road to its original position without any extra cost.

10 ADDITIONALREQUIREMENTFORPIPETOBELAIDBYPUSHINGMETHOD

For insertion of casing pipe boring shall be carried out by auger type boring device with cutting head to drill a horizontal bore. The hole drilled shall be of suitable size to accommodate casing pipe. The casing pipe shall beinserted along with boringto keep the formation supported to prevent any settlement. The casing pipe shall be installed with even bearing throughout its length. The work will be done under the supervision of canal authority as per restrictions & precautions as may bestipulated by the canal authority.

The casing pipe will be minimum 1.2 m below the canal bed level & 0.9 m belowthe natural G.L. The lengthof casing pipe shall be uptothe boundaryof canal bank. Casing pipe shall be provided with minimum 50 mm dia GI pipe of 2 m heightabove G.L. with screen at top. Rates are inclusive of bottom & side rollers of suitable size to be provided inside casing pipe at 4 m interval to facilitate insertion of carrier pipe of required dia. The ends of casing pipe shall be suitably sealed.

The casing pipe is to be provided with epoxy treatment as below on outer face of the pipe before lowering.

ZincRichEpoxyPrimer

Description	Twopackzincrichconsistingof –
Base	FineZincDustGroundinEpoxyResinSolution,suppliedinpaste form
Catalyst	Abducttype-thenonvolatileportionofthematerial(mixed)should consistof92%ZincDust&8-10%EpoxyResin&curingagent
Shade	Grey
Characteristics	Thepaintshallprovideacompleterustinhibitivebarriercoatingof highmechanical&abrasionresistance.Thefilmshallbecompatible for fusion & spot weld.
Pot-life	4-6 hours
MixingRatio	Theproportionofmixingofbase&hardenershouldbeasspecified by the Manufacturer by weight & volume. The mixed primer shall conformtothespecificationsdetailed.
Viscosityof ready mixedpaint	15-22inFortCupNo.4 at30^{o}C
Drying time	i. Dustfree–10-15minutes ii. Chambercuring–24-28hours
Thickness	4mils(406microns)

11 BACKFILLINGOFTRENCHES

On completion of the pipe laying operations in any section, for a length of about 100m and while further work is still in progress, refilling of trenches shall be started by the Contractor with a view of restricting the length of open trenches. Pipe laying shall closely follow the progress of Trench Excavation and the Contractor shall not permit unreasonably excessive lengths of trench excavation to remain open while awaiting testing of the pipeline If the Engineer considers that the Contractor is not complying with any of the foregoing requirements, he may prohibit further trench excavation until he is satisfied with the progress of laying and testing of pipes and refilling of trenches. If the excavated earth is unsuitable for backfilling,The selected earth is to be brought from outside within 3 km. distance. The selected soil brought from outside shall only be used for filling trenches form bottom of pipe to 50 cm. on above top of pipe including on both sides of the trench. Only soft earth of good quality free from stones and free from boulders, roots, vegetation etc., shall be utilisedafterthelumpsarebrokenforrefillingintrench.Fillingshallbedonein

layers not exceeding 150mm and compacted to 85 percent of the maximum dry density as per part VII of IS:2720. Care shall be taken during backfilling, not to injure or disturb the pipes, joints or coating. Filling shall be carried out simultaneously on both sides of the pipes so that unequal pressure does not occur. Walking or working on the completed pipeline unless the trench has been filled to height of at least 30 cm over the top of the pipe except as may be necessary for tamping etc., during backfilling work.

The remaining portion of the trench may be filled in with a mixture of hard and soft material free from boulders and clods of earth larger than 150 mm in size ifsufficient quantity of good earth and morrum are not available. Filling in shall be done in layers not exceeding 225 mm in thickness accompanied by adequate watering, ramming etc. Water contents of the soil shall be as near the optimum moisture content as possible. The trench shall be refilled so as to build up to the original ground level, keeping due allowance for subsequent settlement likely totake place. No extra payment will be made for material brought from outside.

To prevent buckling of pipe shell diameters 1200 mm and above, pipes shall be strutted from inside while the work of refilling is in progress, for which no separate payment shall be made.

Strutting shall be done by means of strong spiders having at least 6 arms which shall be sufficiently stiff to resist all deformation. Spiders shall be provided at a maximum interval of 4 m.

The Engineer shall, at all times, have powers to decide which portion of the excavated materials shall be for filling and in which portion of the site and in what manner it shall be so used.

IfanymaterialremainsassurplusitshallbedisposedoffasdirectedbytheEngineer, which includes loading, unloading, transporting and spreading as directed within a distance of 15 km. If the Contractor fails to remove the earth from site within 7 days after the period specified in a written notice, the Engineer may arrange to carry out such work at the Contractor's risk and cost or may impose such fine for such omission as he may deem fit. Particular care shall be taken to keep the trench dry during the entire refilling operation.

If suitable material for refilling is not available from excavation the Contractor shall bring earth, murrum of approved quality as directed by the Engineer. No extra payment will be made for material brought from outside.

No mechanical plant other than approved compacting equipment shall run over or operate within the trench until backfilling has reached its final level or the approval of the Engineer has been obtained.

Subsidence in filling in : Should any subsidence take place either in the filling of the trenchesornearaboutitduringthemaintenanceperiodof12monthsfromthe

completion of the Contract Works, the Contractor shall make good the same at his own cost or the Engineer may without notice to the Contractor, make good thesame in any way and with any material that he may think proper, at the expense of the Contractor. The Engineer may also, if he anticipates occurrence of any subsidence, employ persons to give him timely notice of the necessity of making goodthe same, andtheexpensesonthis account shall be chargedtothe Contractor.

12 SANDBEDDING

The sand bedding of minimum 150 mm thickness & level shall be provided below pipe, prior to laying the pipe in trenches. It shall be compacted with a light hand rammer. Any reduction in thickness due to compaction shall be made up by adding sand during ramming. For the purpose of the bedding under this item only screened fine sand of grain size not larger than 2 mm shall be used. The sand shall be clean, uncoated & free from clay lumps, injurious amounts of dust, soft particles, organic matter, loam or other deleterious substances.

If the sand supplied is unclean, it shall be washed. In no case shall sand containing more than 3.5% by dry volume or 5% by wet volume of clay, loam or silt beaccepted. Tests specified for determining silt in sand & organic impurities as described in IS : 383 shall apply. Sieved & washed sand shall be stored on the works in such a manner as to prevent intrusion of any foreign matter, including coarser particles of sand or any clay or metal or chips. Tests as indicated above shall be performed if called for by the Engineer at the expense of the contractor.

During the work of providing sand bedding and laying the pipeline over it, loose material from the sides or edges of the trench shall be prevented from falling inside the trench, by providing shoring and taking other measures

13 PIPELINEMARKERS

13.1 Intent

This specification covers the minimum requirements for supply, fabrication and erection of pipeline markers to be installed at various locations along the pipe route.

Following two (2) types of pipeline markers are proposed for the transmission mains.

(i) PipelineWarningSigns

(ii) KilometreMarkers

The pipeline markersshallbe installed,asfar aspossible,at locationswhere no hindrance to the regular use of the land or to the traffic is caused.

13.2 General

13.2.1 DISTANCEINDICATORSANDMARKINGS

The Contractor shall supply and fix indicators at all points of change of direction,at all valves and at everyonekilometre intervals along the buried pipe line. Indicators shall consist of 10 cm x 10 cm pre-cast concrete posts 1.25 metre long, set 0.75 metre into the ground and painted white above ground level. The description shall be written in blue at one face of the pre-cast post.

In case of the pipeline laid above ground details such as chainage, Invert levels of pipe, appurtenance number, pedestal / saddle number, culvert number, anchor / thrust block. number etc., shall be suitably marked either on the pipeline or the supporting structure etc., in distinct colour. The Contractor / Contractor shall include the cost of this in his rates for the other items.

13.2.2 PipelineWarningSign

Pipeline warning signs shall be generally installed at the following crossings: Roads (excepting cart roads &kuchha roads), Rivers, Nallahs.

Pipeline warning sign will indicate existence of the buried pipeline at the crossing and display the name address of the client, name of the project and telephone number (for contact in case of emergency).

For the rest of the crossings as mentioned above, the warning signs shall be generally installed at a distance of 50 M on the upstream side only.

The warning sign shall be located 500 mm to the left of the pipe outside diameter, viewing in the direction of flow and shall face the item being crossed (i.e. road, river, rail track etc).

13.2.3 KilometerMarkers

Kilometer markers shall be installed along the pipe route at every one Kilometer interval.

Markers will display the distance (in full kilometer) from the upstream pumping station (in caseof rising mains) or upstream reservoir(in case of gravity mains) and name of the client. Kilometer markers shall be located 500 mm to the left of the pipe centreline viewing in the direction of flow.

13.2.4 Schemeof Painting

The underground steel structure except that embedded in concrete shall bepainted with coal tar epoxy of minimum 300 micron DFT. For over ground steel structure, one coat of primer & two coats of colour paint shall be applied.

Colour scheme to be adopted for the markers shall be subject to Employer's approval.

Followingcolourschemeisproposedforreference:

WarningSign

i. Allllettersshallbepainted blackexceptfortheword"Warning"whichshall bepainted red. Background colour shall be yellow.
ii. Postshallbepaintedwith250mmwidealternatebandsofblack&white paint.
iii. Allabovegroundsteelstructureshallbepaintedyellow.

KilometerMarkers

i. AllabovepointsforwarningsignshallbeequallyapplicableforKilometer markers also.
ii. FiguresshallbestenciledonbothsidesofthepostS.

13.2.5 Language

Pipeline warning sign plates &kilometer markers shall be prepared in regional language in line with guideline for providing information as above & shall be approved by the client.

14 ANCHORINGOFPIPELINE

For anchorage, RCC thrust blocks in M-20 shall be provided at each bend, tee, taper, end piece to prevent undue movements of the pipeline under pressure.They shall be constructed as per the as per design approved by Engineer considering the highest operation or testing pressure of the pipes, the safe bearing pressure of the surrounding soil and the friction coefficient of the soil.

15 ENCASINGPIPELINE

Encasing of pipeline with M-20 shall be done wherever adequate cover on pipeline is not available as per site condition.

16 ROU/ROW

To lay pipeline as per requirement for which required permissions are to be obtained by the contractor. The standing crop, otherdamages compensations, etc. are to be borne by the contractor to the farmers. Only statutory charges paid bythe contractor will be borne by the department including compensation for ROUin land as per Government rules. Additional expenses over & above are included in scope of the tender.

The contractor will have to submit consent & NOC of each farmer & authority before entering into the land / property / crossing & restoration after completionofwork respectively. Inany case ifanyclaimordisability duringconstructionandO & M arises due to negligence of the bidder, the same shall be recovered from the contractor.

17 PlainandReinforcedCementConcrete

17.1 General

Plain concrete is proposed as levelling course below RCC walls of valve chambers andchairs providedforabove groundpipeline andreinforcedconcretewithmixM 20 grade is proposed for MS pipeline thrust blocks, chair / saddle supports, anchor blocks and pipe encasing at road crossings.

Reinforced concrete chambers shall be constructed for air valves, washout valves and on line butterfly valves as per the standard chamber drawings approved. The RCC walls shall have 200 mm thickness and top slab shall have 150 mm thickness. 600 mm x 600 mm size S.F.R.C. cover shall be provided over access opening in the top slab.Puddle flanges,shall be provided in themiddle ofchamber wall/walls for

properanchorageofthespecialstoresistthethrustduetowaterpressure.For detailed specification of concrete refer Section-III Concrete Works.

C. PSCPIPELINE

18 SPECIFICATIONFORPRE-STRESSEDCONCRETEPIPES(INCLUDINGFITTINGS)

18.1 Scopeofwork

a. **Providing ISI standard pre-stressed concrete pipe of**appropriate class &dia including cost of all material & labour required cost of all taxes,inspection charges, transportation charges, unloading & stacking etc.complete.

b. Lowering, laying &jointing in proper grade alignment pre-stressed cement concrete pipes with rubber ring joint including cost of conveyance to site of work all level involved giving hydraulic testing.

c. Whenever manufacturer is separate & contractor for lowering, laying, jointing&testinginseparatethecontractorshallenterintoanagreementof P.S.C. pipe manufacturer for satisfactory manufacturing, transporting,lowering, laying & jointing & testing of pipes.

18.2 ManufactureofPipes

a. Allpre-stressedpipes andjointingmaterials shallstrictly conform to IS:784 – 2001-2nd revision& ammendment-2003, IS: 733, IS:1343 (Latest edition and amendments thereto).

b. Cement used for manufacturing shall conform to IS:12269-1976 (53 grade ordinary Portland cement), IS: 8112 (43 grade ordinary Portland cement), IS:1489-portland pozzolana cement, IS:455-portland slag cement.

c. AggregatesusedshallconformtoIS:383-1970.

d. Concretemixandstrength

The mix shall confirm to the required laid down for design mix concrete vide IS:1343 latest edition and quality control shall be exercised in accordance with IS:456-2000. The strength requirement will be as specified at clause 8.1.2 of IS:784 latest revision.

e. Steeltobeused

The wires conforming to IS: 1785/Part-I and IS: 1785/Part-II (1967) shall beused for pre-stressed reinforcement of pipe.

f. Dimensionandtoleranceofallpipesshallbe thoroughlycheckedforandshe adhere to clause 4 and 9 of IS: 784 latest revised editions.

g. The contractor shall design the pipes and suitable to withstand specific hydrostatic test pressure. The pipes shall withstand all the tests stipulated in IS:784 (latest revised). The contractor shall submit the design to Engineer-in-Charge and after approval for the design; he shall start the manufacturing of pipes.

h. Blow out resistance of joint assembly shall be designed for the most unfavourable combinations of joint deflection and tolerance of pipe ends

i. Necessary precautions against chemical attacks and corrosion shall be taken inmanufacturingthesepipes.Aspectshouldbestudiediftreatmentisrequired that will be paid extra.

j. The pipe shall be cured by immersing them in water or by automatic sprinkler system for a period of not less than 7 days as per IS 764-1978 the concrete core and that of the cover shall be done in two separate operations.

k. The pipe manufactured at factory shall be stacked property. The marking on each pipe shall confirm to IS: 784. In addition to this the detail shaft is boldly painted with good quality long lasting oil paint.

   i. The Serial Number of pipe (from insideas well as from outside of the pipe both near the socket and spigot ends).

   ii. TestpressureinKg/sq.cm.

l. The programme of inspection and testing shall be fixed by mutual discussions. The pipeswill be tested by the owner or by the third party inspecting agency engaged by the owner.

18.3 RubberRings

a. Rubber gasket shall comply with IS 5382-1969. The manufacturer of pipes shall test each gasket by stretching it to 33-1/3percent in excess of its original length.

b. Everyringshallbevisuallycheckedparticularlyatjoint.

c. Gaskets shall be clearly labelled in bundle to Indicate type of jointsand its test certificate.

d. The contractor shall procure adequate number of rings required for thework irrespective of number of pipes.

18.4 CartingofPipes

a. Pipes manufactured at factory to be carried to site of work either directly or stacked suitably excluding cost of taxes nearby the work site

b. All pipes shall be loaded in trucks by mechanical crane and unloaded at site by mechanical crane only. No loading of pipes on type wilt be allowed in any case. Stacking, lowering of pipes by chain pulley block with tripod will be allowed.

c. Extreme care shall be taken while handling the pipes, damage during transit and handling shall be the contractor's account and will not be payable. Damaged pipe shall be rejected outright. The discretion of SUPERINTENDING ENGINEER in this behalf shall be final and binding on the contractor.

d. Payment of excise entry tax. octroi tax and all other taxes shall be the responsibility of contractor.

18.5 Lowering,Laying,JointingAndTestingofP.S.C.PipeLine

a. All pipes shall be thoroughly inspected before laying, damaged pipe if any shall not be used and shall be removed from the site immediately.

b. MurumsandbeddingshallbedoneasdirectedbyEngineer-in-Charge.The consolidation of bottom shall be done with ramming

c. Lowering, laying and jointing of pipes, the provision in IS:783 shall be strictly followed.Layingshallnot bestarted tillthebeddingisapprovedbyEngineer-in-Charge.

d. Pipes shall be lowered in trench very carefullywith mechanical appliances such as crane, chain pulley block with tripod arrangements etc. only.

e. Thepipesshallbelaidtruetolineandalignmentwithspecifiedgrades.

f. Thetrenchshallbekeptfreeofwatertilltthejointingmaterialisproperlyset

g. Whenevertherearechancesofrainwaterentering,intotrenches,careshallbe taken to prevent pipe line from floating during construction. The contractor shall suggest the position, number and size of concrete blocks in C.C.M-10 to avoid the floating of pipes and seek approval of the Engineer-in-Charge, and shall provide sufficient number of C.C. blocks before onset of monsoon. The contractor should note that even in case after due care, pipes are lifted up or disturbed to uplift, the contractor will have to rectify the defect, including replacement of pipes wherever required entirely at his own cost.

h. Line should be laid on gradient flatter than 1 in 12 if due to some special reasonsit is notpossibletodo so,then contractorshall pointout the sameand shall suggest the anchor block as per IS 783-1985. Table 3 and shall contractthe same approval of the Engineer-in-Charge.

i. Unless otherwise specifically required the jointsof pipes and fittings shall beof semi-flexible spigot and socket type, so manufactured that when fitted withthe correct rubber ring the joint shall be self centering and flexible. A rubber rings of adequate strength shall be placed on the spigot which shall be forced into socket of the pipe previously laid This shall compress the rubber ring as it rolls into the annular space forced between spigot at socket and forms a flexible and water tight joint. Jointing includes jointing pre-stressed concrete pipes to pipes and P.S.C. pipes to M.S. specials. Before jointing it should be checked that joint and ring are smooth and clean. The ring should be well stretched and tension is uniform along entire circumstances. Ring should give positive seal under all circumstances of tolerance in dimensions. After Jointing is completed, it should bee checked that rubber ring is properly placed in position etc. For this purpose feeder gauge (simple metal strips of 15 mmwidth and 0.5 mm thickness) may be used and record of checking of joint should be kept. If ring is not in proper position then pipe must be pulled out.

j. The contractor should note that the laying work shall be taken up only after adequate number of M.S. bends and other specials are fabricated and brought at site and no gap left by contractor for want of providing M.S. machine ends barrel pipes etc. will not be paid by the Board to the contractor and suchlength of M.S. gaps works will be paid at rate of P.S.C. pipe of relevant class of pipes in which position the gap.

18.6 **HydraulicTesting**

After laying the pipe line shall be tested for the 1.5 times of working pressure of that location in the respective sections or as per design criteria which is minimum. The line shall be filled completely with water and kept for a week. The pressure shall then be increased gradually to full test pressure required in that section; this pressure shall be maintained at least for 24 hours.

Hydraulic test pressure test at site should be as per Para 5.4.3.2 of Govt. of India. Manual on W.S.&T and Para 15.5 of IS: 783-1985 and site test pressure will be as mentioned in the design criteria. If the sectional length of pipe line fails in this hydraulic testing, contractor has to locate the leakage and to remove them and reset that sectional length. No section will be acceptable unless it is water tight.

18.7 ProvidingAndCaulkingTarredYarninAnnularSpaceofTheJoint

After right joint is done and pipe line is tested the annular space in between spigot and socket shall be Ailed with spun yarn dipped in bitumen or any suitable means and shall be property caulked No extra payment for this shall be made and cost shall deemed to be included in the rate quoted in Schedule 'B' for providing and laying of P.S.C. pipes.

P.S-SpecificationsaslaiddowninIS:784-20012nd revisionandsubsequent amendments shall be explicitly followed in all aspects of provision of P.S concrete pipes.

D. HDPEPIPELINE

19 Supply,layingandjointingofHighDensityPolyethylene(HDPE)Pipes&Fittings.

19.1 Scope

This specification covers the requirements for successfully designing, manufacturing, supplying, laying, jointing and testing at works and site of High Density Polyethylene Pipes used for water supply. Use of HDPE Pipes shall be Pressure Classof minimum PN 6or above.The minimum outer dia for network upto 20 Ha chak shall be DN 200. The minimum outer diaof the pipe beyond 20 Ha chakshall notbe less than DN 75.

19.2 **ApplicableCodes**

The manufacturing, testing, supplying, laying, jointing and testing at work sites of HDPE pipes shall comply with all currently applicable statutes, regulations, standards and Codes. In particular, the following standards, unless otherwise specified herein, shall be referred. In all cases the latest revision of the Codes shall be referred to. **If requirements of this specifications conflict with the requirements of the standards/codes, standards / codes shall govern.**

Others Codes not specifically mentioned here but pertaining to the use of HDPE pipes form part of these Specifications.

19.3 Designation

Pipes shall be designated as per IS 4984, according to the grade of material, followed by pressure rating and nominal diameter, for example, PE 100 PN 10 DN 200 indicates a pipe pertaining to material grade 100 having a pressure rating 1.0 MPa and outside nominal diameter 200 mm.

19.4 Colour

Thecolourofthepipeshallbeblack.

19.5 Materials

The material used for the manufacturer of pipes should not constitute toxicity hazard, should not support microbial growth, should not give rise to unpleasant taste or odour, cloudiness or discoloration of water. Pipe manufacturers shall obtain a certificate to this effect from the manufacturers of raw material by any internationally reputed organization as per the satisfaction of the Engineer-in-Charge in charge.

Code No.	Title/Specification
IS4984	HighDensityPolyethylenePipesforWater Supply
IS2530	Methodsoftestforpolyethylenemouldingmaterialsandpolyethylene compoundsGRPPipes,JointsandFittingsforuseforPotableWaterSupply
IS5382	Rubbersealingringsforgasmains,watermainsandsewers
IS4905	Methodsforrandomsampling
IS7328	Highdensitypolyethylenematerialsformouldingandextrusion
IS7634	Laying&JointingofPolyethylene(PE)Pipes
IS9845	Methodofanalysisforthedeterminationofspecificand/oroverallmigrationof constituents of plastics material and articles intendedto come into contact with foodstuffs
IS10141	Positivelistofconstituentsofpolyethyleneincontactwithfoodstuffs, Pharmaceuticalsanddrinkingwater.
IS10146	Polyethyleneforitssafeuseincontactwithfoodstuff,Pharmaceuticalsand drinkingwater.

19.6 RawMaterial

a) RawmaterialusedtomanufacturetheHDPEpipesshallbe100%virginPE100, compounded or Natural black PE resin confirming to IS: 4984, IS: 7328 and ISO: 4427. For this a certification has to be given by the resin manufacturer as per clause 3.2.3 of IS: 4984. The resin proposed to be used for manufacturing ofthe pipes should also comply with the following norms as per ISO 9080

b) The resin should have been certified by an independent laboratory of international repute for having passed 10,000 hour long term hydrostatic strength(LTHS)testextrapolatedto50yearstoshowthattheresinhasa

minimum MRS of over 10MPa. Internal certificate of any resin manufacturer will not be acceptable.

c) Certificate for having passed the Rapid crack propagation test -S4 as per ISO 13477 or FSRCP as per ISO 13478 preferably certified by a Reputed International laboratory. High density Polyethylene (HDPE) used for the manufacture of pipes shall conform to designation PEEAA-45-T-003 of IS 7328. HDPE conforming to designation PEEAA-45-T-012 of IS 7328 may also be used with theexceptionthatmelt flow rate(MFR) shall notexceed 1.10 g/10 min. In addition the material shall also conform to clause 5.6.2 of IS 7328.

d) The specified base density shall be between 940 kg/ m³ and 958 kg/ m³ (both inclusive) when determined at 27°C according to procedure prescribed in IS 7328 The value of the density shall also not differ from the nominal value by more than 3 kg/ m³ as per 5.2.1.1 of IS 7328. The MFR of the material shall be between 0.20 and 1.10 (both inclusive) when tested at 190°C with nominalload of 5 kgf as determined by method prescribed in IS 2530. The MFR of the material shall also be within ± 20 percent of the value declared by the manufacturer.

e) The resin shall be compounded with carbon black. The carbon black content in the material shall be within 2.5 ±0.5% and the dispersion of carbon black shall be satisfactory when tested as per IS 2530.

19.7 Anti-oxidant

The percentage of anti-oxidant used shall not be more than 0.3 percent by mass of finished resin. The anti-oxidant used shall be physiologically harm less and shall be selected from the list given in IS 10141

19.8 ReworkedMaterial

No addition of Reworked/ Recycled Material from the manufacturer's own rework material resulting from the manufacture of pipes is permissible and the vendor is required to use only 100% virgin resin compound.

19.9 MaximumQualityofPipe

The outside diameter of pipes, tolerance on the same and Quality of pipe shall be as given in table 2 of IS 4984. Quality shall be measured as the difference between maximum outside diameter and minimum outside diameter measured at the same cross section of the pipe, at 300 mm away from the cut end. For pipes to be coiled the Quality shall be measured prior to coiling. For coiled pipes, however, re-rounding of pipes shall be carried out prior to the measurement of Quality.

19.10 Detectability

HDPE Pipes should be detectable when buried underground, by providing a copper wire of1.20mm +/- 0.2 mm Ø, co extruded or firmly secured by self adhesive tapes along the entire length of the pipes duly ISI marked or any other equivalentmethod enabling measurement/detectability from the top of ground including supply of 3 sets of such instrument.

Copper wire shall have PE (Polyethylene) insulation, if laid separately and secured by self adhesive tapes on the Pipe. The insulation shall be free from voids and shall be strong enough to withstand mechanical and thermal stress of underground buried conditions. The thicknessofthePEinsulationshall notbe lessthan 1.25mm or more, if specified in the relevant BIS standards.

Manufacturer of PE insulated copper wire shall perform Type, routine and acceptance tests strictly as per applicable BIS standard specifications. The Contractor will get copiesof such tests certificates, approved from the Engineer-in-Charge, before dispatch.

The Engineer-in-charge reserves the right to witness all tests and the Contractor shall provide all facilities, to the Engineer-in-Charge in this regard and shall inform sufficiently in advance to enable the Engineer-in-Charge to depute his representative to witness the same HDPE pipes should preferably to with co-extruded copper wire.

19.11 LengthofStraight Pipe

Thelength ofstraight pipe used shallbe morethan 6 m orasagreed by Engineer-in-Charge in charge. Short lengths of 3 meter (minimum) up to a maximum of 10% of the total supply may be permitted.

19.12 Coiling

The pipes supplied in coils shall be coiled on drums of minimum diameter of 25 times the nominal diameter of the pipe ensuring that kinking of pipe is prevented. Pipe beyond 110mm dia shall be supplied in straight length not less than 6m.

19.13 Workmanship/Appearance

Pipes shall be free from all defect including indentations, delaminating, bubbles, pinholes, cracks, pits, blisters, foreign inclusions that due to their nature degree or extent detrimentally affect the strength and serviceability of the pipe. The pipe shallbe asuniform ascommercially practicableincolouropacity,density andother physical properties as per relevant IS Code or equivalent International Code. The inside surface of each pipe shall be free of scouring, cavities, bulges, dents, ridges and other defects that result in a variation of inside diameter from that obtainedon adjacent unaffected portions of the surface. The pipe ends shall be cut clearly and square to the axis of the pipe. IS 4984 :1995 will be followed for visual appearance.

19.14 Handling,TransportationStorageandLoweringofpipes

During handling, transportation, storage and lowering, all sectionsshall behandled by such means and in such a manner that no distortion or damage is done to the section or to the pipes as a whole.

The following procedures should be followed so as to eliminate potential damage to pipes and fittings and to maintain maximum safety during unloading, lifting and lowering.

- Pipes must not be stored or transported where they are exposed to heat sources likely to exceed 60°C.
- Pipes shall be stored such that they are not in contact with direct sunlight, lubricating or hydraulic oils, petrol, solvents and other aggressive materials.
- Scores or scratches to a depth of greater than 10% ormore of wall thickness are not permissible; any pipes having such defects should be strictlyrejected.
- PE pipes should not be subjected to rough handling during loading and unloading operations. Rollers shall be used to move, drag the pipes across any surface.
- Only polyester webbing slings should be used to lift heavy PE (>315mm) pipes by crane. Under no circumstances, chains, wire ropes and hooks be used on PE pipes.
- Pipes shall not be dropped to avoid impact or bump. If any time during handling or during installation, any damage, such as gouge, crack or fracture occurs,thepipeshallberepairedifsopermittedbythecompetentauthority before installation.
- Duringcoilingcareshouldbetakentomaintainthecoildiameteratorabove the specifiedminimum to preventkinks. Coiling shall be done when the pipe attains the ambient temperature from the extruder. In uncoiling or recoiling care should be taken that sharp objects do not scour the pipe.
- When releasing coils, it must be remembered that the coil is under tension and must be released in a controlled manner. The end of the coil should be retained at all times, then the straps released steadily, one at a time. If the coil has bands at different layers of the coil, then they should be released sequentially starting from the outer layers.The amount of theenergy locked up in the coil will depend on the size of the pipe, the SDR of the pipe, andthe size of the coil.
- Straight lengths should be stored on horizontal racks giving continuous support to prevent the pipe taking on a permanent set.
- Bare coils shall be wrapped with hessian cloth for long distance (> 300Kms) transportation. The truck used for transportation of the PE pipes shall be exclusively used of PE pipes only with no other material loaded – especially no metallic, glass and wooden items. The truck shall not have sharp edges that can damage the Pipe.
- Pipes manufactured at factory are to be carried to the site of work directlyor stacked suitably and neatly along the alignment/road side/elsewherenear by the work site or as directed by the Engineer-in-Charge.
- Damagesduringtransit,handling,storagewillbetotheContractor'saccount and replacement for such pipes has to be made by the Contractor without any extra cost as directed by the Engineer-in-Charge.

19.15 Lowering,LayingofPipes

- Each pipe shall be thoroughly checked for any damages before laying and only the pipes which are approved by the Engineer-in-Charge shall be laid.

- As the HDPE pipe is flexible and hence smaller deflection can be avoided by bending the pipe while laying. The cold bending should be such that the minimumradiusofcurvatureshouldnotbelessthan25timetheouterdiaof pipe. Cold bending shall be allow at apex having deflection angle up to 10 Degree.
- For apex having deflection angle more than 10 Degree the pre fabricatedbends or bend at site by hot bending shall be allow subject to requirement of Anchore Block.
- While installing the pipes in trenches, the bed of the trench should be level and free from sharp edged stones. In most cases, the bedding is not required,aslongas the sharpandprotrudingstonesare removed,by sieving the dug earth, before using the same a backfill material. While laying inrocky areas suitable bed of sand or gravel should be provided. The fill to about10to15cmabovethepipeshouldbefinesandorscreenedexcavated material. Where hard rock is met with, bed concrete M15, 15 cm or 20cm thick sand bed as approved by the Engineer-in-Charge may be provided.
- As PE pipes are flexible, long lengths of fusion-jointed pipes having joints made above ground can be rolled or snaked into narrow trenches. Such trenches can be excavated by narrow buckets.
- During the pipe laying of continuous fusion jointed systems, due care and allowance should be made for the movements likely to occur due to the thermal expansion/contraction of the material. This effect is most pronounced at end connections to fixed positions (such as valves etc) and at branch connections. Care should be taken in fixing by finishing the connections at a time the length of the pipe is minimal (lower temperature times of the day.)
- For summer time installations with two fixed connection points, a slightly longer length of PE pipe may be required to compensate for contraction of the pipe in the cooler trench bottom.
- The final tie-in connections should be deferred until the thermal stability of the pipeline is achieved.
- The flexibility of polyethylene pipes allows the pipe to be cold bend. The fusion jointed PE pipe is also flexible as the plain Pipe. Thus the total system enables directional changes within the trench without recourse to the provisionofspecialbendsoranchorblocks.However,thepipeshouldnotbe cold bend to a radius less than 25 times the OD of the pipe.
- The Installation of flanged fittings such as connections to sluice/air/gate valves and hydrant tees etc., requires the use of stub ends (collars/flange adaptors complete with backing rings and gaskets. Care should be taken when tightening these flanges to provide even and balance torque.
- Provisionshould be made at all heavy fittings installation points forsupports (such as anchoring of the flange in the soil) for the flange joint to avoid the transfer of valve wheel turning torque on to the PE flange joint.
- PE pipe is lighter than water. Hence care should be taken for normal installations where there could be apossibility offlooding of the trench thus thetrenchshallbekeptfreeofwatertillthejointinghasbeenproperlydone

- When flooded, some soils may lose cohesiveness, which may allow the PEpipe to float out of the ground. Several design checks are necessary to see if groundwater flotation may be a concern. Obviously, if the pipeline typically runs full or nearly full of liquid, or if groundwater is always below the pipe, flotation may not be a significant concern.
- However, weights by way of concrete blocks (anchors) are to be provided so that the PE pipe does not float when suddenly the trench is flooded and the soil surrounding the pipe is washed away. Thus site conditions study is necessary to ensure the avoidance of flotation.
- Pipe embedment backfill shall be stone-free excavated material placed and compacted to the 95% maximum dry density.
- When pipe crosses the road, suitable protective measures shall be taken. For unsurfaced road crossing, the pipe shall be encashed by M20 CC and forcarpetroadthepipecrossingshallbewithcasingpipeofNP4havingsufficient larger dia.
- While crosses the drain minimum soil cover of 1 to 1.5 mt as per draincapacity shall be provided. The pipe shall be encased by M20 CC. with necessary protection of rubble pitching or launching type protectivemeasures.

19.16 JointingofPipes

The pipe shall have Electro-fusion jointing system that shall provide for fluid tightness for the intended service conditions.

19.17 Bedding,BackfillingandCompaction

19.17.1 Bedding

Incase of sandy strata no separate beddingis required.Howeverthe bottomface / trench bed where pipe shall be placed shall be compacted to provide a minimum compaction corresponding to 95% of maximum dry density. The pipe bedding should be placed so as to give complete contact between the bottom of the trench and the pipe.

Theminimumcoveroverburiedpipeshouldbe1m.

19.17.2 BackFilling

Backfilling should be placed in layers not exceeding 15cm thickness per layer, and should be compacted to a minimum of 95% maximum dry density. The refilling should be done on both sides of pipe together & height difference in earthfill on each side should not be more to cause lateral movement of pipe.

Most coarse grained soil are acceptable. This may comprise of gravel or sand. However if the excavated earth is unsuitable for backfilling, the selected earth is tobe brought from outside approved borrow areaforbackfillingas per IS Code.

It is very important that the pipe zone backfill material does not wash away or migrate in to the native soil. Like wise, potential migration of the native soil in to the pipe zone backfill must also be prevented.

Heavy earth moving equipment used for backfilling should not be brought untilthe minimum cover over the pipe is 90 cm in the case of wide tracked bulldozers or120 cm in the case of wheeled roaders or roller compactors.

19.17.3 Compaction

Vibratory methods should be used for compaction. Compaction within distances of 15 cm to 45 cm from the pipe should be usually done with hand tempers. The backfill material should be compacted not less than 95% of maximum dry density.

19.18 ThrustBlock

RCC thrust block should be suitably designed & provided at bends and at places of reduction in cross section to take care of thrust. The eligibility for requirement of the Thrust Block has to be ascertained prior to laying.

19.19 Fittings& Specials

All HDPE fittings/ specials shall be of minimum PN 6 or above Pressure class, fabricated in accordance with IS: 8360 (Part I& III). PE Injection moulded fittings shall be as per IS: 8008 (Part I to IX). All fittings/specials shall be fabricated or moulded at factory only. No fabrication or moulding will be allowed at site, unless specifically permitted by the Engineer-in-Charge. Fittings will be welded on to the pipes or other fittings by use of Electro- fusion process. Recommended makes for PE / PP fittings / specials are Georg- Fischer, Glynwed, Astore, Magnum and GPS.

19.20 Bends

HDPE bends shall be plain square ended conforming to IS: 8360 Part I & III Specifications. Bends shall be moulded. Combine bends for Horizontal deflection and Vertical deflection shall be avoided.

19.21 Tees

HDPE Tees shall be plain square ended conforming to IS: 8360 Part I & II Specifications. Tees may be equal tees or reduced take off tees. Tees shall be moulded.

19.22 Reducers

HDPE Reducers shall be plain square ended conforming to IS: 8008 Part I & VII Specifications. Reducer must be moulded.

19.23 FlangedHDPEPipeEnds

HDPE Stub ends shall be square ended conforming to IS: 8008 Part I & VI Specifications. Stub ends will be weldedon the pipe. Flange will beof slip on flange type as described below.

19.24 Slip-OnFlanges

Slip-on flanges shall be metallic flanges covered by epoxy coating or plastic powder coating. Slip-on-flanges shall be conforming to standard mating relevant flange of valves, pipes etc. Nominal pressure rating of flanges will be PN10.

19.25 WeldingProcedure

Jointing between HDPE pipes and specials shall be done as per the latest IS: 7634 part II. Methodofjointingbetween thepipestopipesand pipes tospecialsshallbe with Electro-fusion welding using automatic or semi automatic, hydraulically operated, superior quality Electro-fusion machines which will ensure good quality fusion welding of HDPE pipes.

19.26 SiteFabricationofPEFittings

Two or more PE specials coming at one place (like PE Tee, Reducer, Flanged end etc.,)shallbejointedat contractor'sworkshopandtransportedto the siteofworks for final installation with proposed PE pipelines. In no case, jointing of three or more welds in one place, at site will be allowed.

19.27 Training

The Contractor shall provide on-site trainingon PE pipe laying, jointing, testing and maintenance etc., to the personnel authorized by EMPLOYER.

19.28 Manuals

Technical Manual on PE pipes including precautions to be taken during operationof the pipeline.

19.29 Flanges

Allflangesemployedintheprojectmustbecompatiblewhatevermaterialused.

19.30 Marking

Allpipesshallbemarkedatmaximumintervalof1m.

Themarkingshallindicateatleastthefollowinginformation.

1) Manufacturer'sname&/ortrademark.
2) Thedimensions(nominaloutsidediameterXnominalwallthickness)
3) Theoutsidediametertolerance(AorB)
4) Thedesignationofpipesmaterial(PE100,PE80etc)
5) Thenominalpressure(PN)
6) Theproductionperiod(dateorcode)
7) TheBISstandardnumberandISIlogo.
8) Theword"Water"shallalsobeincluded.

Apart from online marking on pipes, pipe shall have screen printing on both end of pipes conforming to IS:4984-2016.

19.31 Packing&Transport

The pipes should be preferably transported by road from the factory and stored as per the manufacturer specifications to protect damage.

19.32 SummaryofqualityTests:

1. QualityMark:Pipe:IS4984
2. Material:AsperIS4984.Howeveronlyvirginresinisallowed,reworked material is not allowed.

3. GradeofMaterial:PE100asperIS4984(Certificatefromrawmaterial manufacturer is required).
4. PressureRating:PN-6.
5. Colour:asperIS 4984
6. Dimensionsof Pipe:
   Diameter:Thenominaldiameter(outside)
   Wall thickness: As per IS 4984.
   Length:
   i. Fordiameter90mmand110mm:100 meter
   ii. For diameter more than 110 mm : minimum 6 meter. (Tolerance as perIS 4984)
7. VisualAppearance:asperIS4984.
8. Testandsampling:asperIS 4984.
9. Special Test : Notch hydraulic Test for the HDPE pipe made from PE- 100 grade raw material as per ASTM 1474 OR ISO 13479 at manufacturers laboratory or independent laboratory and should pass the Hydraulic test as per IS:4984:1995 for a minimum 165 Hours. The test reports shall not be more than three months old.
   Pipe shall convey water under variable temperature conditions ranging from 4 degree centigrade to 45 degree centigrade.
10. Jointing of pipes (pipe end): More than 110 mm diameter: Electro-fusion (Heat Fusion Process)
11. QualityAssurance:
    Quality Assurance Plan shall be got approved from the employer before production start.

Note:Allremainingparameters/specificationsareasperrespectiveIS.

20 FieldHydraulictestingofthepipelines

20.1 Sectionaltests

After laying and jointing the pipeline shall be tested for tightness of barrels and joints, and stability of thrust blocks in sections approved by the Engineer-in-Charge in Charge. The length of the sections depends on the topographical conditions. Preferably the pipeline stretches to be tested shall be between two chambers (air valve, scour valve, bifurcation, other chamber) The length of the test section shall be from 1 Km to 2 Km and as directed by the Engineer-In-Charge.. The hydraulic testing shall have to be commenced immediately after laying and jointing of 1 km reach is completed.The design test pressure shall be as per IS.

The water required for testing shall be arranged by the contractor himself. The Contractor shall fill the pipe and compensate the leakage during testing. The Contractorshallprovideandmaintainallrequisitefacilities,instruments,etc.for thefieldtestingofthepipelines.Thetestingofthepipelinesgenerallyconsistsin three phases:
preparation,pre-test/saturationandtest,immediatelyfollowingthepre-test.

Generally,thefollowingstepsarerequiredwhichshallbemonitoredandrecorded in a test protocol.

- Completesettingofthethrustblocks.
- partialbackfillingandcompactiontoholdthepipesinpositionwhile leaving the joints exposed for leakage control
- openingofallintermediatevalves(ifany)
- fixingtheendpiecesfortestsandaftertemporarilyanchoringthem against the soil (not against the preceding pipe stretch)
- atthelowerendwithaprecisionpressuregaugeandtheconnection to the reciprocating pump for establishing the test pressure
- atthehigherendwithavalveforairoutlet
- If the pressure gauge cannot be installed at the lowest point of the pipeline,anallowanceinthetestpressuretobereadatthepositionof the gauge has to be made accordingly
- Slowlyfillingthepipefromthelowestpoint(s).
- thewaterforthispurposeshallbereasonablyclearandfreeof solids andsuspended matter
- Completeremovalofairthroughairvalvesalongtheline.
- Closingallairvalvesandscourvalves.
- Slowly raising the pressure to the test pressure while inspecting the thrust blocks and the temporary anchoring.
- Keepingthepipelineunderpressureforthedurationofthepre-test / saturation of the lining by adding make-up water to maintain the pressure at the desired test level. Make up water to be arranged by Contractor himself at his own cost.
- Startthetestbymaintainingthetestpressureatthe desiredlevelby adding more makeup water; record the water added carefully and the pressure in intervals of 15 minutes at the beginning and 30 minutes at the end of the test period.

The pipeline stretch will pass the test if the water added during the test period is not exceeding the admissible limits. No section of the pipe work shall be accepted by the Engineer-in-Charge in Charge until all requirements of the test have been obtained.

20.2 HydraulictestforMSpipesandPSCpipes

20.2.1 Fieldtest pressure

The sections of MS/PSC Raw Water Pumping main shall be tested for the pressures as worked out in detailed designed.

20.2.2 Testrequirement

The quantity of water added in order to re-establish the test pressure should not exceed 0.1 litre per mm of pipe diameter per km of pipeline per day for each 30 m head of pressure applied.

All pressure testing at site should be carried out hydrostatically. The pipes shall be accepted to have passed the pressure test satisfactorily, if the quantity of water required to restore the test pressure does not exceed the amount calculated as above.

20.2.3 Failuretopassthe test

All pipes or joints which are proved to be in any way defective shall be replaced or remade and re-tested as often as may be necessary until a satisfactory test shallhave been obtained. Any work which fails or is provedby test to be unsatisfactory in any way shall be redone by the Contractor.

20.2.4 Backfilling

Water used for testing should not be carelessly disposed off on land which would ultimately find its way to trenches.

On completion of a satisfactory test any temporary anchor blocks shall be brokenout and stop ends removed. Backfilling of the pipeline shall be completed.

20.2.5 Flushinganddisinfectingofpipelines

After testing and commissioning the contractor shall flush the pipes with a velocity not less than 1 m/s or as approved by the Engineer-in-Charge in Charge. Disinfection of drinking water pipelines should be done by Contractor.

21 TechnicalQualificationsforprocurementofpipesduringconstruction:

21.1 Pipe manufacturer : Successful bidders shall source all types of pipes and specials from reputed manufacturers. If the bidder is also manufacturing pipes, should produce documentary evidence of such production Certification ofIndian Standards. Manufacturer must not have been debarred/black listed by any Government Department of India.

21.1.1 M.S.Pipe:

The Pipe manufacturer should have an annual installed production capacity of minimum 15,000 MT.

ThePipemanufacturershouldhavemanufacturedandsuppliedatleast200Km. M.S.Pipeofminimum500mmorabovedia.includingatleast30Km.M.S.Pipeof minimum 1000 mm or above dia., during past 5 years.

21.1.2 P.S.C.Pipe:

The production capacity of P.S.C pipe of diameter 800 mm to 1200mm shall be minimum 50 Km per year.The manufacturer should have also successfully supplied the above pipes for a length of 50 Km during last year.

The manufacturer should hold valid IS license under IS: 12709 consecutively for last three years to manufacture ISI marked pipes.

21.1.3 H.D.P.E.Pipe:

ThePipemanufacturershouldhaveanannualinstalledproductioncapacityof minimum 10,000 MT.
The manufacturer should hold valid IS license under IS: 4984 consecutively for lastthree years to manufacture ISI marked pipes.

21.1.4 D.I Pipes

The Successful Bidder shall source all Ductile Iron pipes and fittings from manufacturers having experience of supplying for at least five years and whose Ductile Ironpipes andfittings are insatisfactory performance forat least three years in Indian projects.
The D.I Pipe manufacturer should have an annual installed production capacity of minimum 15,000 MT.

ThemanufacturershouldholdvalidISlicense.

E DUCTILEIRON(DI)PIPELINE

22 GENERAL

This specification covers the specific requirement of design, material, manufacture / fabrication, constructional features, inspection & testing, transportation, handling, layingand site testing of **Ductile Iron (DI) Pipes, Joints, fittings and specials.**

22.1 CODEAND STANDARDS

The material, design, manufacture, dimensions, tolerances, mechanical properties, internal cement mortar lining, external zinc coating along with bituminous finished layer, inspection and testing of DI water pipes shall comply with the latest Indian Standard, "IS 8329 (Centrifugally cast (spun) ductile iron pressure pipes for water, gas and sewage – specification)" or equivalent international standard unless otherwise specified elsewhere in this Technical Specification. The various referred National and International codes generally used in the design, manufacture and testing of DI pipes are as mentioned below:

Sl.No.	Code No.	CodeTitle
1.	IS8329	Centrifugallycast(spun)ductileironpressurepipesforwater,gas andsewage– specification
2.	IS9523	Ductileironfittingsforpressurepipesforwater,gasandsewage– specification
3.	IS5382	Rubbersealingringsforgasmains,watermainsandsewers
4.	IS638	SpecificationforSheetRubberJointingandRubberInsertion Jointing
5.	IS12288	CodeofpracticeforuseandlayingofDuctileIronpipes
6.	IS11606	MethodsforsamplingofCastIronpipesandfittings
7.	IS455	Portlandslagcement
8.	IS12330	SulphateresistingPortlandcement
9.	IS6452	Specificationforhighaluminacementforstructuraluse
10.	IS6909	Specificationforsuper-sulphatedcement
11.	IS8112	43gradeordinaryPortlandcement
12.	IS1387	Generalrequirementsforsupplyofmetallurgicalmaterials

Sl.No.	Code No.	CodeTitle
13.	IS1500	MethodsforBrinellhardnesstestformetallicmaterials
14.	IS1608	Mechanicaltestingofmetals -tensiletesting
15.	ISO2531	Ductileironpipes,fittings,accessoriesandtheirjointsforwater applications
16.	ISO4179	Ductileironpipesandfittingsforpressureandnonpressure Pipelines--Cementmortarlining
17.	ISO4633	Rubberseals--Jointringsforwatersupply,drainageand seweragepipelines-Specificationformaterials
18.	ISO8179	Ductileironpipes--Externalzincbasedcoating--Part1:Metallic zincwithfinishinglayer
19.	ISO8179	Ductileironpipes--Externalzinccoating--Part2:Zincrichpaint withfinishinglayer
20.	ISO8180	Ductileironpipelines--Polyethylenesleevingforsiteapplication
21.	ISO10802	Ductileironpipelines--Hydrostatictestingafterinstallation
22.	ISO10803	Designmethodforductileironpipes
23.	ISO16132	Ductileironpipesandfittings--Sealcoatsforcementmortar linings
24.	AWWAM41	Ductile-Ironpipeandfittings(guidelinecodefordesign, manufacturing,testing,jointing,laying&installationetc.)
25.	BSEN545	Ductileironpipes,fittings,accessoriesandtheirjointsforwater pipelines-Requirementsandtestmethods

22.2 DUCTILEIRON(DI)PRESSUREPIPESFORRISINGMAINS&DISTRIBUTARYMAINS

22.2.1 DesignRequirements

Classification

The classofDIpipestobeprovidedshallbeasspecifiedinthedatasheetattachedwiththis sub section. The external diameter and wall thickness of socket and spigot pipes for the specified Class shall be as per IS 8329 or equivalent international standard.

Pressure class and thickness class of pipe flanges shall be as specified in the data sheet attached with this sub section and shall conform to the requirements of IS 8329 orequivalent international standard.

Length

SocketandSpigotpipesshallbesuppliedinstandardworkinglengthsof5.5mor6mand flanged pipes in lengths of 4m / 5m / 5.5m as per requirements.

Tolerances

Tolerances on External diameter, ovality, thickness and length of pipes etc. shall conform to the provisions of IS: 8329 or equivalent international standard.

MaterialRequirements

Themetalusedformanufacturingthepipesshallbeofgoodquality,commensuratewiththe mechanical requirements laid down in IS 8329 or equivalent international standard.

ManufacturingRequirements

Pipes supplied shall be centrifugally cast (spun) Ductile Iron pipes conforming to IS 8329 or equivalent international standard. The pipes shall be stripped with all precautions to avoid warpingorshrinkagedefects,detrimentaltotheirgoodquality.Thepipesshallbesoundand free from surface or other defects.

Externallayer

The DI pipes supplied shall be provided with external protection ofmetallic zinc coating with finishing layer of bituminous paint as per IS 8329 or equivalent international standard.

Internallining

The pipes shall be provided with suitable cement mortar internal lining as per IS 8329 or equivalent international standard.

Joints

Push on flexible joints shall be provided for pipe to pipe connection as per IS 8329 or equivalent. Wherever, flange joints are required e.g. at terminal points, valves, over ground and underground pipe connection etc., Welded on flanges shall be used.

Rubbergaskets

Rubber gasket used with push on flexible joints shall conform to the requirements of IS:5382 or equivalent. Rubber gaskets for use with flanged joints shall conform to IS 638 or approved equivalent.

22.2.2 DIFITTINGS&SPECIALS

General

DI Fittingsshould preferably bemanufactured bythemanufacturerof thepipes.In casethey are not, it will be the responsibility of the manufacturer of the pipes to have them manufactured through a suitable manufacturer under its own supervision and have it tested at his/sub contractor's premises as per the contract. The pipe manufacturer will ensure the compatibility of the pipes and fittings by prescribed type test with its own pipe and the outsourced fittings.

ThemanufacturingunitshouldhaveISO9001certification.

The company should have fully equipped laboratory with in-house microscope to check nodularity and to check chemical composition along with tensile, hardness & elongation by universal testing machine. The laboratory of the manufacturer should be accredited byNABL. Sincethesocketdesignisnotgiveninthestandardthemin.socketthicknessoffittingsatany point must not be lesser than minimum body thickness given in the standard.

22.2.3 DesignRequirements

Classification

The class of DI fittings to be provided shall be as specified in the data sheet attached withthis sub section. The external diameter and wall thickness of fittings for Push on joints forthe specified Class shall be as per IS 9523 or equivalent.

ThePressureclassofflangedfittingsshallbeasspecifiedinthedatasheetattachedwiththis sub section and shall conform to the requirements of IS 9523 or equivalent.

Permissibledeviationsonlengthoffittings

Thepermissibledeviationsonthelengthoffittingsshallbeasper IS:9523orequivalent.

Tolerances

Tolerances on external diameter, Raised face height, thickness and Flange drilling of fittings etc. shall conform to the provisions of IS: 9523 or to the provisions of international equivalent standard to which they are supplied.

22.2.4 MaterialRequirements

Themetalusedformanufacturingthefittingsshallconformtotheappropriategradeas specified in IS 1865, in commensurate with the requirements of IS 9523 or equivalent.

22.2.5 ManufacturingRequirements

The fittings shall be stripped with all precautions to avoid warping or shrinkage defects, detrimental to their good quality. The fittings shall be sound and free from surface or other defects.

LiningsandCoatingsforDuctileIronFittings

The DI Fittings are to be lined with Cement Mortar Linings with a sand cement mixture and theliningthicknessshouldbeasperTable33(AnnexB)ofIS9523.TheCoatingstoDIfittings shall be similar in line with the provisions of DI pipes. All fittings must be painted with Zinc rich paint as per Annexure A of IS 9523. Bitumen being used for External coating should be approved By WRAS or similar approval authority. However, in soil conditions where soil resistivity is less than 1000 ohm-cm with or without water table, fusion bonded epoxy lined and coated DI fittings to be used in place of other type of lined and coated fittings.

FittingswithFlexiblePush-onjoint

Flexible joints shall be of spigot and socket “push-on” type suitable for angular deflection in any direction and capable of axial movement to compensate for thermal expansion or contraction and ground movement.

FittingswithFlangedjoint

Fittings with Flanged joints will be with raised face and they shall be supplied complete with approved gaskets, hot dipped galvanized or cadmium plated bolts, nuts.

FittingswithMechanicaljoint

Where Fittings with mechanical type joints are specified, proposed and approved they shall besuppliedcompletewithapprovedgaskets,glands,hotdippedgalvanizedorcadmium

platedbolts,nutsandallothernecessaryaccessories.

FittingswithRestrainedJoints

DI fittings with restrained joints shall be utilized in underground application where pipelines have to cross roads through existing ducts or in areas with restricted accessibility where the use of concrete anchor blocks is prohibited, or as directed by the Engineer-in-Charge. The CONTRACTOR shall submit with his bid with full details of the type of restrained joint he proposes to use.

Whenever in the course of work the CONTRACTOR intends to utilize restrained joints heshall obtain prior approval from the Engineer-in-Charge.

Calculation of the number of pipe lengths with restrained joints required on both sides ofthe fitting shall follow the manufacturer's recommendation and shall be subject to the Engineer-in-Charge approval.

Restrained joints shall be designed in accordance with ISO 10804-1. The permissible angular deflection will be as declared by the manufacturer. The performance **Type test** of this Jointin line with ISO 10804-1/EN545 has to be established by the manufacturer by getting it witnessed by aNABCB (National Accreditation Board for Certification Bodies) or IAF (International Accreditation Forum) or EA (European Cooperation for Accreditation) accredited institution / certification agency.

Rubber ring for joints shall be of a type that will not deteriorate when stored under manufacturer's guidelines or during operation**.** The rubber gasket shall be of EPDM elastomer in accordance with IS:5382 suitable for water supply.

Jointsbetweenpipeandfittings

Push on flexible joints shall be provided for pipe to fitting connection as per IS 9523 or equivalent.Flangejoints,whereverrequired,shallconformtotherequirementsofIS9523or equivalent.

Rubbergaskets

RubbergasketusedshallconformtoIS:5382:1985oramendeduptodate.Otherrequirementsofgas ketsareasperclause-7ofIS 9523:2000.RubberGasketstobeISImarkedEPDMquality.

22.3 TYPETESTS

The contractor / manufacturer shall carry out the type tests as listed in this specification on thepipestobesuppliedunderthiscontract. Thebiddershallindicatethechargesforeachof these type tests separately in the relevant schedule of Section VII (Forms & Procedures) and the same shall be considered for the evaluation of the bids. The type tests charges shall be borne by the EPC contractor for the test(s) actually conducted successfully under this contract and upon certification by the Employer.

The type tests shall be carried out in presence of the Employer's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the Employer's approval for the type test procedure before conducting the type test. The type testprocedureshallclearlyspecifythetestset–up,instrumentstobeused,procedure,

acceptance norms, recording of different parameters, interval of recording, precautions tobe taken etc. for the type test(s) to be carried out.

In case the contractor / manufacturer has already conducted such specified type test(s), he may submit the type test reports to the Employer during detailed engineering for consideration of waiver of conductance of such type test(s) or otherwise as deemed fit by Employer. Such test(s) should have been either conducted at an independent laboratory or duly approved by accredited third party agency. The Employer reserves the right to waive conducting of any or all the specified type test(s) under this contract.

The type test shall be performed whenever a significant change is made in the design, material or process of manufacture or a new size or size range of the product is being supplied by the manufacturer.

Thefollowing**typetests**shallbecarriedout:

JointLeakTightnessTest

a) Tests for joints (push on flexible joints) shall be conducted as per the guidelines of ISO 2531 to establish adequatejoint performance with respect to internal pressure, external pressure and vacuum pressure under both normal alignment of joints and deflected alignment of joints as dictated in ISO 2531.

b) Testsfor Leak tightness and mechanical resistance of **flanged joints** shall be conducted asper ISO 2531.

CementLiningSmoothnessTypeTest

The contractor / manufacturer should have carried out Cement Lining Smoothness test to establish C value (Hazen & William's constant) of the offered DI pipe as 140. Necessary certificate for the same shall be furnished to the employer.

In case the contractor / manufacturer has not carried out the test, the same shall be carried out by the contractor / manufacturer within the scope of this contract.

Ringbend test

Ring bend test for 3% deflectionwith respect to external diameterofDI pipeoffered shall be conducted by contractor / manufacturer to prove that internal cement mortar lining doesnot come off the substrate surface of Ductile Iron on random basis for each manufacturing lot.

If the contractor / manufacturer of pipes do not have the facility for this type test at his own works, the same can be arranged by him to conduct and demonstrate the test.

22.4 TRANSPORTATIONANDDELIVERYOFPIPES

Bidder shall have to submit a write up for safe handling and stacking of pipes during transportation and at site. It shall conform to the requirements stated in IS: 12288 or equivalent.

All pipes fabricated in the factory and temporarily stacked in the Contractor's yard or factory shall be transported to site after shop testing & cleaning them internally. The loading in the factory shallbe carriedoutby meansofeitheracrane,gantry orwithshearlegs,so asnotto cause any damage to the finished material. Similarly, while unloading and stacking, greatcare shall be taken to ensure that the material or lining inside is not damaged or dented.

The material being delivered at site shall be jointly inspected by the Employer and the Contractor. Defective or damaged pipe shall be rejected by Employer or in case of minor damage, the Employer may allow repair of the pipe by the Contractor to the satisfaction of the Employer as per guideline of IS 8329.

Props of proven designs shall be fixed to the pipes during transit to avoid undue sagging and consequent distortion. After the pipes are carefully stacked, props may be removed and re used for subsequent operations.

Incaseoftransportbyship,packingshallbeseaworthysoastoensuresafedeliverytillsite.

All the DI fittings shall be properly packed with jute cloth. Rubber rings shall be packed in polyethylene bags. Rubber rings in PE bags and nuts, bolts etc. shall be supplied in separate jute bags.
At site, pipes shall be stacked in such a way that suitable gaps shall be left in the pipes at intervals to permit access from one side to the other.

22.5 MARKING

Each Pipe shall have as cast or stamped or legibly and indelibly painted on it with the following marks:

a) TheManufacturer'snameortrademarkoneach pipe
b) Thenominaldiameterofpipesandbatchnumber.
c) ClassofPipesand fittings
d) Awhiteringlineshowinglengthofinsertionatspigotend
e) StandardISIcertificationmarkforthepipesconformingtoISOrinternational standard mark to which they are supplied.
f) Thelasttwodigitsoftheyearofmanufacture
g) Anyimportantinformationthatthemanufacturerdeemsfittobeinscribedon pipe.

22.6 LAYINGANDJOINTINGOFDIPIPES

Laying, erection and jointing of DI pipelines at field / site shall be under the directsupervision of Manufacturer (Supplier) from whom pipe is sourced / procured.

LayingUnderground

Pipes shall be lowered into the trench with tackle suitable for the weight of pipes. Forsmaller sizes, up to 250 mm nominal bore, the pipe may be lowered by the use of ropes but for heavier pipes suitable mechanical equipment shall be used.

All construction debris shall be cleared from the inside of the pipe either before or just after a joint is made. All persons shall vacate any section of trench into which the pipe is being lowered.

The assembly for the pipes shall be made as recommended by the pipe manufacturer and using the suitable tools.

The socket and spigot ends of the pipes shall be brushed and cleaned. The chamferedsurface and the end of the spigot end have to be coated with a suitable lubricant recommended by the manufacturer of the pipes. Oil, petroleum bound oils, grease or other material, which may damage the rubber gasket, shall not be used as lubricant. The rubber gasket shall be inserted into the cleaned groove of the socket. It shall be checked for correct positioning. Thetwopipesshallbe alignedproperlyinthepipetrenchandthespigotendshallbepushed axially into the socket either manually or with a suitable tool specially designed for the assembly of pipes and as recommended by the manufacturer. The spigot has to be inserted up to the insertion mark on the pipe spigot. After insertion, the correct position of thesocket has to be tested with a feeler blade.

Deflection of the pipes, if any, shall be made only after they have fully been assembled. The deflection shall not exceed 75% of the values indicated by manufacturer.

On gradients of 1:15 or steeper, precautions shall be takenby anchor block to ensure thatthe spigot of the pipe being laid does not move into or out of the socket of the laid pipe during the jointing operations. As soon as the joint assembly has been completed, the pipe shall be held firmly in position while the trench is back filled over the barrel of the pipe. The backfill shall be well compacted.

Special provisions in trench shall be made for accommodating socket (Bell) of each pipe, as applicable so that barrel is uniformly rested on even trench bed surface, which is well compacted as recommended in codes / standards.

Attheendofeachworkingday andwheneverworkisinterruptedforany periodoftime,the free ends of laid pipes shall be protected against the entry of dirt, water or other foreign matter by means of approved plugs or end caps.

Layingaboveground

The following is applicable only when no additional bending moments except that those due to self weight of pipe and its content are present. If any additional moments are present, piping contractor has to suitably support the pipe in consultation with manufacturer and Employer.

a) Socketandspigotpipes

Socket (Bell) and spigot pipes shall be provided with one support (usually pedestal or steel pipe support) per pipe. The supports shall be positioned behind the socket of each pipe.

Pipes shall be fixed to the supports with mild steel straps so that axial movement due to expansion and contraction resulting from temperature fluctuations is taken up at individual joints in the pipeline. Joints shall be assembled with the spigot end withdrawn 5 to 10 mm from the bottom of the socket to accommodate thermal movements.

The designed anchorage shall be provided to resist the thrusts developed by internal pressure at bends, tees, etc.

Where a pipeline crosses a watercourse, the design and method of construction shall take into account the characteristics of the watercourse to ascertain the nature of bed, scour levels,maximum velocities,highfloodlevels,seasonalvariation,etc.,whichaffectthedesign and laying of pipeline.

b) Flangedpipes

The maximum unsupported span for flanged pipes shall not be more than 8 m. The supports shall be located at the centre of every second pipe.

The maximum unsupported span at water course shall also be not more than 8 m. The relative position of pipe joints and pipe supports shall be as per IS 12288 or equivalent.

Thesupportsofallflangedpipeworkspansshallbestableandunyieldingduetomovements in the pipeline.

The straps shall prevent any lateral movement or lifting of the pipelines but not restrict expansions and contractions caused by temperature fluctuations.

Cuttingofpipes

The cutting of pipe, if required, for inserting valves, fittings etc. shall be done in a neat and workman like manner without damage to the pipe or lining so as to leave a smooth end at right angles to the axis of the pipe. Cuttingof pipes shall be reduced to a minimum required.

CuttinghastobemadewithsuitabletoolsasperIS12288orequivalentandaccordingtothe recommendations of the manufacturer. The spigot end has to be chamfered again at the same angle as the original chamfered end. If there is no mark for the insertion depth on the spigot ends of the (cut) pipe it shall be marked again according to the instructions of the manufacturer.

Pipelineanchorage

Pipeline shall be securely anchored at dead ends, tees, bends, tapers and valves to resist thrust arising from internal pressure. Suitable thrust blocks made of concrete shall be designed and cast-in-situ.

All specials like bends, tees etc. and appurtenances like valves etc. shall be laid in synchronization with the pipes. The Contractor has to ensure that the specials and accessories are available at site ready to be installed together with the pipes.

22.7 EXTERNALPROTECTION

ThedetailsofsoilresistivitydatashallbeverifiedbytheContractor.

The contractor shall carry out soil resistivity survey along the ROW of the pipeline using Wenner's 4 pin method in the presence of Employer's representatives.

On completion of all field work, a report incorporating resistivity (on semilog graph sheets) data shall be prepared by the contractor and submitted to the Employer.

In case of highly corrosive soil (soil resistivity less than 1000 ohm cm), polyethylene sleeving shall be provided for encasement of the pipes, fittings and joints against corrosion. This encasementshallbesodesignedtopreventthecontactofpipe,fittingsandjointswiththe

surrounding backfill and bedding material. It shall conform to the requirements of IS 8329 & IS 12288 or equivalent international standards.

22.8 HYDRAULICTESTINGOFPIPELINES

After laying and jointing, the pipeline shall be tested for soundness and leak tightness of pipes, fittings and joints, and soundness of any construction work. The pipeline may be tested in sections.

Water and other facilities as required for such hydro testing shall be arranged by the Contractor. Each section shall be properly sealed off with special stop ends secured by adequate temporary anchors. The thrust on the stop ends shall be calculated and the anchors designed to resist it. All permanent anchors shall be in position and, if of concrete, shall have developed adequate strength before testing begins.

HydraulicTestingofSections

Thesectionundertestshallbefilledwithwater,takingcarethatalltheairisdisplacedeither through vents at the high points or by using a pig or a sphere.

After filling, the pipeline shall be adequately pressurized for a period of time to achieve stable conditions.

The pipeline is then pressurized up to the full test pressure as stipulated in the data sheet attached with this sub section and the section under test completely shall be closed off. The test pressure shall be maintained for a period of not less than 10 minutes to reveal any defects in the pipes, joints or anchorages. The test pressure shall be measured such as to ensure that the required test pressure is not exceeded at any point in the entire pipeline.

If the test is not satisfactory, the fault shall be found and rectified. Methods employed for finding faults shall be as per IS 12288.

HydraulicTestingofCompletePipeline

After all the sections have been joined together on completion of section testing, a test on the complete pipeline shall be carried out. This test shall be carried out at a pressure as specifiedinthedatasheetattachedwiththissubsection.Duringthetest,thepressureatany point in the pipeline shall not exceed the pressure as specified in the data sheet attached with this subsection.

22.9 QAREQUIREMENTSFORDIPIPES,FITTINGSANDSPECIALS

Following tests / inspections to be carried out on the finished pipes, Joints, Gaskets, DI Fittings & specials as per relevant IS/ISO standard:

1. Pipesproducedaresubjecttofollowingchecks;
    a. VisualInspectionforworkmanship,marking,visualdefectetc.
    b. MechanicalPropertiesasperrelevantgoverningStandard
    c. Dimension
        - InsideDiameter

- OutsideDiameter
- Wall Thickness
- OvalityofPipes
- Lengthof Pipes
- Straightness

d. HydrostaticLeakTightnesstobecarriedoutasperrelevantstandard.
e. Zn coating & Bituminous painting on external layer DI pipes shall be carried out as per relevant standard / Technical Specifications.
f. Identification – Manufacturer Logo, Nominal Diameter, Class, length indication for cutting of pipe at site, ISI certification mark, pipe no.

2. Internalliningofsuitablecementmortarshallbedoneasperrelevantstandard/Technical Specifications.
3. Rubbergasketsshallconfirmtotherequirementofrelevantstandard/TechnicalSpecifications.
4. Jointsforpipe,DIFittings&specialsshallbeasperrelevantstandard/Technical Specifications.
5. TypeTests:Pleasereferrelevantsectionsofengineeringportionoftechnical Specification.

DATASHEETFORDIPIPES,FITTINGS&SPECIALS

Sl.No.	Description	Units	Parameters
1.	PipeMaterial		Ductile Iron (DI) pipe internally cement mortar lined and externally coated with metallic zinc &finishinglayerof bituminouspaint
2.	Applicablestandards		IS/ISO/AWWA /BSas listed in technical specification
3.	Hazen&William'sconstant		140
4.	Pipe Class		K7/K9basedonapproved designasperIS8329or equivalent
5.	PipeJointtype		Pushonflexiblejointsas per IS 8329
6.	PipeJointtypeatvalves, pumps andother piping		Flange Joints as per IS8329&IS 9523
7.	WeldedonFlange(asapplicable) Pressure Class		PN16
8.	DIfittingsclass		K12asperIS8329or equivalent
9.	DIfittingsflange(asapplicable) class		PN16/asperapproved design
10.	Restrain mechanism atbends, specialsetc.		ThrustBlocks
11.	OtherRequirements		Aspertechnical specification

F GLASSFIBERREINFORCEDPLASTICS(GRP)PIPELINE

23 GENERAL

This specification covers the specific requirement of design, material,manufacture fabrication, constructional features, inspection & testing;transportation,handling,lowering,laying,jointing,hydrotestingandannualmaintenancecontractofGlassFibreReinforcedPlastics(GRP)Pipes,Joints,fittingsandspecials.GRPpipesfrommobileplantswillnotbe allowed.

GRPpipeswillnotbeusedinthefollowingapplications:-

Inrocky stretches,

In stretches where the highest water table is above the crown level of thepipe,

Where there is a chance of future excavation by other service providers within 2 m radial distance of pipeline.

24 CODEANDSTANDARDS

The design, manufacture, inspection and testing of GRP water pipes shall comply with the latest Indian Standard, IS: 14402 (GRP Pipes, Joints and Fittingsforuseforsewerage,Industrialwasteandwater(otherthanpotable) or ASTM 3517 (Standard Specification for Fiber glass (Glass Fiber Reinforced ThermosettingResin)PressurePipeinthecaseofpressurepipes)or AWWAC950(Standardforfiberglasspressurepipe)&AWWAM45 (Fiber glass Pipe design) unless otherwise specified elsewhere in this Technical Specification.

The various codes used in the design, manufacture and testing of GRP pipes are as follows:

Sl. No.	Code No.	CodeTitle

1.	IS14402	GRP Pipes, Joints and Fittings for use for sewerage, Industrialwasteandwater(otherthanpotable) -specification
2.	IS12709	GRPPipes,JointsandFittingsforusefor potable watersupply-specification
3.	IS5382	SpecificationforRubbersealingringsforgasmains, watermainsandsewers
4.	IS13916	InstallationofGRPPipingsystem- code ofpractice
5.	IS6746	Unsaturatedpolyesterresinsystems-specification
6.	IS11273	WovenrovingfabricsofEglassfibre
7.	IS11320	Glassfibrerovingsforthereinforcementof polyesterandofepoxideresinsystems
8.	IS11551	Glass fibre chopped strand mat for the reinforcementofepoxy,phenolicandpolyester resinsystems
9.	IS1367(Part 1to 20)	Technical supply conditions forthreaded steel fasteners
10.	AWWAC950	Standardforfiber glasspressure pipe
11.	AWWAM45	FiberglassPipedesign
12.	ASTMC33	StandardspecificationforConcreteaggregates
13.	ASTMD 638	Standard Test MethodforTensile Properties of Plastics
14.	ASTMD 695	Standardtestmethodforcompressiveproperties ofrigid plastics
15.	ASTMD 1599	StandardTestMethodforResistancetoShort-Time HydraulicPressureofPlasticPipe,Tubing,and Fittings
16.	ASTMD 2105	Standard Test Method forLongitudinal Tensile Properties of Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Tube
17.	ASTMD 2290	Standard Test Method for Apparent Hoop TensileStrengthofPlasticorReinforcedPlasticPipe by SplitDisk Method
18.	ASTMD 2412	Standard Test Method for Determination of ExternalLoadingCharacteristicsofPlasticPipeby Parallel-PlateLoading
19.	ASTMD 2563	Standardpracticeclarifyingvisualdefectsinglass reinforcedplasticlaminatedparts
20.	ASTMD 2583	StandardTestMethodforIndentationHardness ofRigid PlasticsbymeansofaBarcolImpressor
21.	ASTMD 2992	Standard practice for obtaining hydrostatic or pressuredesignbasisforFiberglassPipeand Fittings

22.	ASTMD 2996	StandardspecificationforFilament-WoundFiber glass(Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe
23.	ASTMD 3262	Standard Specification forFiberglass (Glass-Fiber Reinforced Thermosetting Resin) Sewer Pipe, in the caseofgravitysewer pipes.
24.	ASTMD 3517	Standard Specificationfor Fiberglass (Glass Fiber ReinforcedThermosettingResin) Pressure Pipe
25.	ASTMD 3567	Standard practicefor determiningdimensions of Fiberglass (GlassFiberReinforced Thermosetting Resin) Pipe and Fittings
26.	ASTMD 3681	StandardTestMethodforChemicalResistanceof Fiber glass (Glass-Fiber-Reinforced Thermosetting - Resin) Pipe in a Deflected Condition
27.	ASTMD 3754	Standard Specification for Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Sewer and Industrial PressurePipe.
28.	ASTMD 3839	Standard guide for underground installation of FiberglassPipes.
29.	ASTMD 4161	Standard Specification for Fiberglass (Glass Fiber ReinforcedThermosettingResin)PipeJointsUsing FlexibleElastomericSeals
30.	ASTMD 5365	Standard Test Method for Long-Term Ring-Bending StrainofFiberglass(Glass-Fiber-Reinforced Thermosetting-Resin)Pipe
31.	ASTMD 5421	Standardspecificationforcontactmolded"Fibreglass "flanges.
32.	ASTMF477	Standard Specification for Elastomeric Seals (Gaskets) forJoiningPlasticPipe
33.	BS5480	British Standard Specification for Glass reinforced plastics (GRP) pipes, joints and fittings for use for watersupplyorsewerage
34.	ISO1172	Textile-glass-reinforcedplastics–Prepregs,moulding compoundsandlaminates-- Determinationofthetextile-glassandmineral-fillercontent– Calcinationmethods

25 DESIGNREQUIREMENTS

25.1 NormalDiameter

The nominal diameter of the pipe shall be as specified in the data sheet. The inside diameters and tolerances on diameters for the specified nominal diameter shall conform to the requirements stated in IS: 14402 / AWWA C 950 / ASTM D3517.

25.2 Length

Pipesshallbesuppliedinnominallengthsof6m/9m/12masper requirements.Thetolerancesonnominallengthsshallbeasperrelevant IS /AWWA/ASTMstandardsto whichtheyare supplied.

25.3 WallThickness

TheaverageWallthicknessofthepipeshallnotbelessthanthe minimum wall thickness published in latest manufacturer's catalogue. However, minimum wall thickness in these published wall thicknesses of manufacturer shall conform to the tolerance limit as given in relevant IS / AWWA / ASTM standards to which GRP pipes are supplied.

Contractor shall submit design calculations as per AWWA M 45 & AWWA C 950toestablishtheadequacyofpipesize,pressureclassandstiffness class selected for the GRP pipes.

25.4 PressureClass

GRP pipes shall have the pressure class as per the data sheet attached atthe end of this subsection.

25.5 StiffnessClass

The pipe shall be stiff enough to meet the design requirement withparticularregardtoinstallationmethod,burialdepths,deflection limits,bucklingandvacuumrequirements.

GRPpipesshallhavethestiffnessclassasperthedatasheetattachedat the end of this subsection.

25.6 HoopandLongitudinalTensilestrength

GRP pipe system shall meet the minimum hoop tensile strength and minimumlongitudinaltensilestrengthrequirementsspecifiedinIS14402 / AWWA C 950 /ASTM D3517 for the pressure class specified in the data sheet attached at the end of this subsection.

26 MATERIAL REQUIREMENTS

26.1 Resin:Athermosettingpolyesterresin(isopthalicresin)tobeusedand qualityparametersshallbeasperrelevantIS/AWWA/ASTMstandards.

26.2 GlassFiberReinforcement:Glassfiberreinforcementshallbeof commercial grade 'E' type and shall conform to IS 11273, 1S11320 or 1S11551 as appropriate or relevant ASTM standards.

26.3 OtherMaterials

Othermaterialsusedinthemanufacturingofpipelikeaggregates,fillers and additives shall be in accordance with the relevant IS I AWWA I ASTM standards.

27 MANUFACTURINGREQUIREMENTS

The pipe shall be manufactured through Filament winding process (ContinuousFilamentWindingprocessusingadvancingmandrelmethod or Helical Filament Winding process) by winding continuous glass fibre filamentssaturatedwithliquidresinorpreimpregnatedwithpartially curedresin(subsequentheatingmayberequiredtopolymerizetheresinsystem)o ntotheoutsideofamandrelinapredetermined patternundercontrolledtensionasdescribedinASTMD2996toresult in a corrosion resistant, composite structure to meet the operating conditions.

27.1 Wallcomposition

Structure of pipe shall have chemical resistant liner, reinforced structural layer and outer surface layer.

GRP Pipes (as required) shall have to be provided with UV stabilizers and flame retardants in the resin coat of outer surface layer.

27.2 JOINTS

The pipeline shall have a jointing system that shall provide for fluid tightness for the intended service condition.

All GRP pipes and fittings shall be joined with unrestrained sleeve couplings (Double REKA joint) or un-restrained double O' ring bell-Spigot joints. Thrust blocks are to be provided at each bends irrespective of buried as well asovergroundGRPpiping.Forovergroundpiping,anchorsaretobe provided at reducers, branch offs, Tee-offs, expanders and terminal pointsof other suppliers apart from at points in straight run separated by an interval of 90 meters approx as per AWWA- M45 (for pipes up to 400mm dia.) and as per system requirements for large sizes.

FlangedJoint

Flanged joints shall be used for connecting GRP pipes with valves, pumpsand other materialpipingetc.FlangedjointsshallbeusedwithEPDM gasketandhotdipgalvanized bolts. The flanged joint is made from the same material as the pipe.

Rubbergaskets

Rubber gasket used with push-on flexible joints shall conform to the requirements of IS: 5382 I ASTM F 477.

Rubber gaskets for use with flanged joints shall conform to IS 5382 or equivalent.

TECHNICALREQUIREMENTS

28 GRPFITTINGS&SPECIALS

28.1 General

All GRP fittings, such as bend / elbows, ends, tees, flanges and reducers etc.shall be equal to or superior in performance to pipe of the same classifications and shall be smoothly finished internally.

Generally,allGRPfittingsaretobemanufacturedinfactory.Dimensionsofthefittingsshallbeasperrelevantstandardsand drawingsshallbesubmittedtoEmployer for approval.

Only in exceptional circumstances, specific required fittings may be permitted(Employer's approval) to be fabricated / laminated at site under the supervision of manufacturer of pipes. However, such site fabricated / lapped fitting / branch off shall be hydro tested at pressure no less than 1.5 times the pressure class along-with the pipes.

28.2 Fittingsmadefromstraightpipe

Fittings shall be fabricated from complete pipes or portions of straight pipe complying with IS 14402 / ASTM standards as applicable for the pipe classifications. Thefittingshallcomplywith thedeclareddesign requirement and be suitably mitred. The mitre shall be over wrapped externally and internally with liner, woven roving and/orchopped strand mattoensurethelongitudinalandcircumferentialtensilestrengthisat leastequalbydesign tothatofthepipewith which thefittingsistobe used. All fittings shall have sufficient end length of pipe to accommodate over wrapped length of fitting and pipe.

28.3 FittingsmadebyMoulding

Moulded GRP fittings shall be made by hand lay-up, contact moulding, hotor cold press moulding or tape winding with internal liner.

29 TYPETESTS

29.1 Thecontractorshallcarryoutthetypetestsaslistedinthisspecification onthepipestobesuppliedunderthiscontract. Thebiddershallindicate thechargesforeachofthesetypetestsseparatelyintherelevant schedule of Section - VII- (Forms &Procedures) and the same shall be considered for the evaluation of the bids. Thetype tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Employer.

29.2 The type tests shall be carried out in presence of the Employer's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the Employer's approval for the type test procedure before conducting the type test. The type test procedureshall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.

29.3 The Long term type tests stipulated in Cl.8.05.00 below should have been conducted by the manufacturer or its technology provider on the pipes similar to those proposed to be supplied under this contract, at an independent laboratory or duly approved by accredited third party agency. BiddershallsubmitthesetypetestreportstotheEmployeralongwith the bid. The manufacturer shall however carry out the short term reconfirmation/ requalification tests as stipulated in Cl.8.05.00 below.

Further, the Employer reserves the right to waive conducting of any or all type tests(short term/ reconfirmation tests) under this contract. In casesuch type tests are waived for any reason whatsoever, the type test charges shall not be payable to the contractor.

29.4 NotUsed.

29.5 Thefollowingtypetestsshallbecarried out:

a) LongtermhydrostaticstrengthILongtermhydrostatic pressure

Manufacturer or its technology provider should have already carried out the full typetestingasdescribedinmethodAofIS12709!Procedure-Bof ASTM 2992, duly approved by accredited third party agency.

Further, the manufacturer shall carry out the requalification test asdescribedinmethod B of IS 12709/ reconfirmation test of ASTM 2992 onthesamepressureclass&stiffnessclassasspecifiedforthepipesunder this package.

b) ChemicalresistanceofpipeinadeflectedconditionManufactureroritstechnologyprovidershouldhavealreadycarriedout the full type testing as described in method A of IS 14402 I Procedure-A orProcedure-B of ASTM3681, duly approved by accredited third party agency.

Further, the manufacturer shall carry out the requalification test asdescribedinmethodBofIS14402Ireconfirmationtestof ASTM3681 onthesamepressureclass&stiffnessclassasspecifiedforthepipes under this package.

c) Jointtesting

All joints shall meet the laboratory performance requirements of section 7of ASTMD4161. It shall be conducted on joint prototypes of elastomeric gasketsealedcouplingsinaccordancewithsection7ofASTMD4161on the pipes supplied under this package.

d) LongtermStiffness-Materialcreep

Manufactureror his technology provider should havealready carriedout the full type testing following the guidelines of ISO 10468 and analyzedaccording to ISO 10928,method B.

Further, the manufacturer shall carry out the reconfirmation test for1000hrs on the same pressure class & stiffness class as specified for thepipes under this package. The test procedure for this reconfirmation test shall remain same as the Long term Stiffness test stipulated above. The acceptancecriteriaforthistestshallbeasgiveninClause11ofASTM D 5365 oras per alternative method proposed bymanufacturersubject to Employer's approval.

e) LongtermRingbendingstraintest

Manufacturerorhis technology providershouldhavealready carriedout the full type testing using guidelines of ASTM D5365.
Further,themanufacturershallcarryouttheshortterm reconfirmationtestinaccordancewithASTMD5365onthesame pressureclass&stiffnessclassasspecifiedforthepipesunderthis package.

30 MARKING

Themarkingonpipeshallincludethe following:

a) StandardmarkforthepipesconformingtoISIAWWAIASTM standards to which they are supplied.

b) Themanufacturersnameortrademark

c) Thenominalpipediameter

d) Classofpipe(Pressure&Stiffness)

e) Batchno.ordateofmanufacture

f) Colourbandsforovergroundpiping

31 TRANSPORTATIONANDDELIVERYOFPIPES

31.1 GRPpipeshallbehandled,storedandtransportedinstrictaccordance totheManufacturer's instructions. Bidder shall have to submit a write up for safe handling and stacking of pipes during transportation and at site.

31.2 All pipes fabricated in the factoryand temporarily stacked in theContractors yard or factory shall be transported to site after shop testing & cleaning them internally. The loading in the factory shall be carried out by means of either a crane, gantry or with shear legs, so as not to cause any damage to the finished material. Similarly, while unloading and stacking, great care shall be taken to ensure that the material is not damaged or dented.

31.3 The material being delivered at site shall be jointly inspected by theEmployerandtheContractor.Defectiveordamagedpipeshallbe rejected by Employer or in case of minor damage, the Employer may allow repair of the pipe by the Contractor to the satisfaction of the Employer.

31.4 Props of proven designs shall be fixed to the pipes during transit to avoid undue sagging and consequent distortion. After the pipes are carefully stacked, props maybe removed and re-used for subsequent operations.

In case of transport by ship, packing shall be sea worthy so as to ensure safe delivery till site.

31.5 Atsite,pipesshallbestackedinsuchawaythatsuitablegapsshallbeleft in the pipes at intervals to permit access from one side to the other.

32 **LOWERING,LAYING,JOINTINGANDHYDROTESTING(LLJT)OFGRPPIPES**

32.1 Lowering, laying, jointing and hydro testing of pipe shall take place in the supervisionofpipemanufacturer.LoweringandLayingshalltakeplace only after the trench and the surface supporting the pipes have been prepared according to the sub-section IIIB - 01 (specification for Civil worksof GRP pipes / DI pipes.

32.2 Beforeplacingapipeinthetrench,itisnecessarytocleananyremains ofearth,sandormudfromtheinsideofthesocketandfromthe opposite end bearing the rubber ring gasket/packing. When cleaning has taken place, run a hand around insidethesockettoensurethatthereare noresiduesofhardenedresinwhichcanberemovedreadilywitha chisel. It is also necessary to check that the groove has an even depth andhas not been damaged.

32.3 For a coupling type of joint, two rubber ring gaskets shall be first fixed into thegrooveinsidethecouplingandthenthecouplingisfixedatthe coupling area of the pipe.

32.3.1 Pipesshallbeloweredinthetrenchwithappropriatemechanicalmeans like chain pulley block, excavators etc.

32.3.2 Place the pipe in the trench, taking care to dig a small hollow at each end so that the groove and the socket are well separated from the sand gravels in the bottom of the trench.

32.3.3 Anchor the first pipe section laid according to the method described and leave itsends free along a space enough for insertion of the next sectionand for checking.

Place the next pipe section in the trench and leave enough space for the operator to be free to move and to work between the two pipe sections so as to carry out the cleaning and checking operations.

32.3.4 Clean the coupling area of the joint once more with a cloth and also cleanthe flared portion of the lead-in using suitable lubricant.

32.3.5 Clean the groove again, take the rubber ring gasket and lubricate it by running it between the hands and checking at the same time, it being ingoodcondition.Itshallbeensuredthateveryportionoftheringor insideofthesocketmustnotlackslubricantasitwillimpairgood insertion of the pipe.

32.4 Forsocketandspigottypeofjoint,passtherubberringunderthepipe until it settles into the groove, then pull it forcibly upwards and follow the ring with the hands so that three quarters of it is positioned in the groove, then lift the ring above the upper generating line of the pipe forcibly and then release it so that it falls into the groovethus being freed of ant twists.

32.4.1 Run the hands around the pipe to check that the whole of the packing is inits seating and, in the case of large diameter pipes, smear lubricant again above the inserted rubber ring gasket/packing.

32.4.2 Alignandbringtogetherthetwopipesectionsuntilrubberringtouches the flared portion of the lead-in.

Whenthishastakenplace,examinethepositionoftheringandabove all, ensurethat there are no sand or other foreign bodies present.

32.4.3 Fit the socket onto the spigot very slowly, dwelling halfway along the coupling area, and check the position of the packing visually.

32.4.4 Proceed with the joint until the socket is halted by the abutment ledge. The next pipe section shall not be fitted until the previous pipe section has been anchored with an overlay of sand.

32.4.5 Checktherubberringgasket/packingafterthejointhasbeencoupled. This check must alwaysbecarried out and is performed with ablade of steel or ofanother metalhavingathicknessof0.4/0.5mm,awidthof15mm and any length greater than 200mm, the blade being inserted into the annular space between the socket and spigot.

This check shall be conducted along the entire circumference where the packing is compressed so as to ensure that the rubber ring has a homogeneous depth and is therefore correctly positioned in its seating. Ifthe ring is found to be seated differently at one point than other points or if there is any doubt, disconnect the joint, check the rubber ring and replace it if shows any permanent signs of faulty seating, check once more thecoupling area of the joint, the flared lead-in of the socket and the groove on thespigot.Whenre-insertingthepipesection,takeextracaretoalign the pipes perfectly. When uncoupling pipe sections, never use chains orsteel cables in direct contact with the pipes.

Check once againthepositionofthe ringwiththeblade

32.5 Checking the installed pipe - Initial diametrical deflection shall not exceed3% of diameter. Bulges, flat areas, or other abrupt changes of pipe wall curvature are not permitted. Deflection checks shall be done when the first installed pipes have been backfilled to grade and continued periodically throughout the entire project. Layingshall not get too far ahead before verifying the installation quality.

Pipes over 3% deflection shall be replaced completely. No attempt to jackorwedgetheinstalledoverdeflectedpipeintoaroundconditionshall be made to avoid damage the pipe.

32.5.1 Correcting over deflected pipe - Pipes installed with initial diametrical deflectionsexceedingtheapprovedvaluesshallbecorrectedto ensure the long term performance of the pipe. Damaged pipe shall be repaired or replaced as directed by the employer. Re compact/ backfill to grade and check the pipe deflections to verify they have not exceeded the values to the satisfaction of Employer.

32.6 Misalignmentofthejoint-Whenforreasonsofthelay-outoftheline thejointhastobemisaligned(butsuchmisalignmentmustremainwithin

the limits provided by the supplier of the pipes),such misalignment at the predeterminedangleshouldbeappliedonlyafterhavinginsertedthe pipe and the joint is thoroughly checked for its water tightness.

32.7 ThrustBlock-RCCthrustblockshallbeprovidedatbendsandatplacesofreduction in cross section to take care of thrust.

32.8 GRPpipesshallcrossminorroad/nallahthroughHumepipeswhen buried GRP pipes are crossing roads &nallahs. Sand bags shall be put around GRP pipes within Hume pipe. For railway crossing and / or high waycrossings of underground GRP pipes, culverts or MS encased pipe with pushing technology shall be adopted.

32.9 Site lapping of last joint during erection shall be done at a de-humidified condition by skilled worker to ensure correct curing.

33 FieldHydrostaticTests

Thepipelineshallbehydrotestedinstretchesof suitablelengthat1.5 times the pressure class. Water and other facilities as required for suchhydro testing shall be arranged by the Contractor.

Finallyentiresystemshallbehydrotestedat1.5timesthepressureclass ofthepipe/fittingswhenerectioniscompleteandpumpcharginghas been done. The detailed Filed Hydrostatic Testing Procedure based on International standard shall be submitted to Employer for Approval.

34 **ANNUALMAINTENANCECONTRACT(AMC)TERMS&CONDITIONS**

The Contractor tie-up with the GRP pipe manufacturer, to provide Annual Maintenance Contract (AMC) for 2 years after completion of the warrantyperiod.The following services shallbe included underAMC:

a) RoundtheclockmonitoringofGRPpipeinstallationforanyleakage /rupture/damageofthepipeline.
b) Arranging all material (temporary & permanent), manpower (includingskilled&unskilledlabour),machineries,testingequipment, fixtures, maintenance tools &tackles consumables etc. for repair, maintenance, re-erection/ re-commissioning of any or wholeportion of GRP piping system.
c) Repairingthedamagedpipes/joints,replacingthedamagedpart of piping/joints including fittings with new pipes / fittings, wherever necessary, making good damaged or excavated bed & trench of GRP pipe and restoring the trench bed to the original specified bed conditions.

d) Recharging, testing and re-commissioning the entire GRP pipe installationto thesatisfactionoftheEmployerwithin24 hoursofthe reporting of leakage / rupture /damage of the pipeline.

DATASHEETFORGRPPIPES,FITTINGSANDSPECIALS

Sl. No.	Description	Units	Parameters
1.	PipeMaterial		GlassfibreReinforcedPlastic Pipe
2.	Applicablestandards		IS/ASTM/AWWAaslistedin technicalspecification
3.	DesignFlow	m3/hr	
4.	Workingpressure	mWC	115(approx.)
5.	Vacuumpressure	Kg/cm 2	-0.8
6.	Maximumservice temperature	^{o}C	36
7.	HazenWilliam'sconstant		150
8.	PipeNominaldiameter	NB	1100-3000
9.	PipeLength		ReferSub-Section-IA;Scope ofSupply&Services
10.	PressureClass		PN15
11.	StiffnessClass		C
12.	StiffnessValue	KPa	248 (minimum) at 5% deflection
13.	Glass fiber reinforcementclass		E
14.	PipelineJointtype		unrestrained sleeve couplings (Double REKAjoint)orun-restraineddoubleO'ring bell-Spigotjoints
15.	PipeJointtypeatvalves, pumpsandother piping		FlangeJoints

SECTION-VI

PART-B

APPURTENANCES&MISCELLANEOUSITEMS

Section-VI

APPURTENANCESANDMISCELLANEOUSITEMS

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PART-IIAPPURTENANCESANDMISCELLANEOUSITEMS

1.1 SluiceValves

1.1.1 General

The sluice valves shall confirm to IS: 14846. Double flanged short body, Gland less (stem sealing rings)type Sluice valves with appropriate pressure rating.The materialto besupplied underthissub-sectionshallinclude, but not be limitedto,thefollowing: Allnecessary fittings including bolts, nuts,gaskets, backing rings, counter flanges, jointing material, strainersetc.shall besupplied as required.AlltheGlandless(stemsealingrings)sluicevalve shall be provided with ballthrust bearing and spur gear arrangement or Ductile Iron Double Flanged Resilient Seated Nonrisingstem typeGateValveconfirmingtoEN558-1,DIN 3352 F4/BS5163 can also be considered .

1.1.2 Scope

The Gland less (stem sealing rings) sluice valves shall be with non rising stem type. The valves will be used for water supply on line installations in upright positions, with double flange, and cap or hand wheel for manual operation. The valves shall be suitable for continuoususe at theirPN ratingwithin thetemperaturerange of -10" C to 65"C.

1.1.3 Nominalpressureanddimensions

The working pressure on the valves shall be appropriate to the working conditions and approved bythe Employer.Theflangesandtheir dimensions of drillingshall bein accordance with IS: 1538(part-1toXXII).

1.1.4 Material

Themakes givenare acceptablemakes however thematerial fordifferentcomponentparts of sluice valve shall conform to the requirements given below:

51. No.	Component	Material	Ref.toIS	Grade/Designation
1	Body,bonnet, dome,stoolcover, wedge,stuffingbox,gland,thrust plate,handwheelandcap.	S.G. iron	1865	Gr.400/15
2	Stem	Stainlesssteel	6603	12C,1304C,18Ni 10 04C,17Ni12MO2
3	Wedgenut	Leaded tin bronze	318	LTB-2
4	Bodyseatring,wedgefacingring andbushes	bronze	318	LTB-2
5	Bolt	Carbonsteel	1363(Part1)	Class4.6
6	Nut	Carbonsteel	1363(Part3)	Class4
7	Gasket	EPDMRubber	11855	-
8	Glandpacking	StemSealing Ring	5414	nil
9	Gear	Spheroidal graphiteiron	1865	G,500/7
10	Gearhousing	S.G.iron	1865	Gr.400/15
11	Pinion andpinion shaft	Wrought carbonsteel	1570(Part3)	C5SMn7S

1.1.5 Marking,TestingandInspection

The standard marking and packing of thevalves shall bedone as per Clause 11and 13of IS: 14846. The direction of rotation for OPEN, CLOSEposition shall be marked on the hand wheel and onthe bonnet ofthe valve. Hydraulictesting of each sluice valve shall bedone for closeend testin accordancewithIS: 14846 AnnexB,to the testpressure and testduration as specified intable 5 and 6of the IS.

All the valves shall be inspected for flaw detection test inaccordance with IS: 14846,clause 10.2.The design, construction material, manufacture, inspection, performance and testing shall comply with all applicableIndianStandards and Codes. Nothinginthe specification will be construed to relieve the supplier of this responsibility.

1.1.6 Manufacturer'sTestcertificate

The manufactureshallprovide a testcertificateconfirming thatall the valves have been tested in accordance with IS: 14846 and statingthe pressures and medium used inthe test.

1.1.7 Thirdpartyinspection

Theinspectionandtesting of the sample valvesfromalotwillbecarried outbythe employer and or inspecting agency appointed by the employer, in the manufacture's workshop,before application of any paint.All thetests as requiredas perthe IS: 14846 shall be carried out on samples from each lot (Number of samples from a lot shall be as per the relevantISfor sampling and testing), in presence of the inspecting agency. The valvesshall be dispatched only after issue of the test certificate bythe inspecting agency for satisfactory performance of the tested valves. The inspection charges for such tests shall befirst paid by the contractor to the inspecting agency, which shall be reimbursed on production of the documentary evidence for the payment made.

1.1.8 Acceptablemakesforthevalves

Acceptablemakes for the sluice valves shallbe as per the approved vendorlist.All the valves shall have the same make. Contractor should not place order with any other manufacturer for the above said item till has been approved in writing by employer for the makes listedabove.

1.1.9 Installation

The installation ofthe sluice valves shall bedone at the locations shown on L-sections ofthe pumping main aswashout valves and isolatingvalves for air valves.Thejob covers supply of the valves at work site with cost of allthe required material and alltypes oftaxes and duties, cost of packing, loading, transportation, unloading, stacking and installation at the specified location with cost of alljointing materials such as nuts and bolts, EPDM rubber gaskets etc. Thejob also covers field hydraulic testing ofthe valves after installationfor the specified test pressureforthe respective pipelinesection.

1.1.10 GateValves

Electrically operated, Double flanged, Outside screw rising spindlefor Real-time operation and controlshallbe installedat theinletpointsof all theMinorandsub-minorsoff taking from risingmain/ducts/ BR's.

1.2 BUTIERFLYVALVES

1.2.1 GENERAL

The Butterflyvalves shall confirm to IS: 13095. Doubleflanged short body butterflyvalves of required nominal diameterand pressure rating shallbe supplied. The material to be used shall include, but not be limited to, that as shownin the table given below. Allnecessary fittings including bolts, nuts, gaskets, jointing material etc. shall be supplied as required. ButterflyvalvesofConcentricDesignandVulcanizedtypegenerallyasperEN593,BS5155, API 609 can be also considered .

1.2.2 SCOPE

The butterfly valves shall be with disc and shaft and shall be designed to withstand the maximum pressure differential across the valve in either direction of flow. The valves shall have novisibleleakage past the disc inclosed position under test conditions. The shaft may be of one piece design or intwo pieces separately attached to the disc. The valveswill be usedforwatersupplyonlineinstallationsinuprightpositionswithactuation.Thevalves shallbesuitable for continuoususe at theirpressurerating withinthe temperaturerange of -10°Cto65°C.

1.2.3 NOMINALPRESSUREANDDIMENSIONS

The working pressure on the valves shall be appropriate to the working conditions and approved bythe Employer.Theflangesandtheir dimensions of drillingshall bein accordance with IS: 1538(part-1toXXII).

1.2.4 MATERIAL

Themakes givenare acceptablemakes however thematerial fordifferentcomponentparts of butterfly valves shall conform to the requirements given below:

Sl.No.	Component	Material	Ref.tolS	Grade
1	Body	Spheroidalgraphite Iron/DuctileIron	1865	Gr.400/15
2	Disc	Spheroidalgraphite Iron/DuctileIron	1865	Gr.400/15
3	Shaft	Stainless steel	6603	-
4	Seatingring/ Sealretaining ring	IntegralNicolCrominium Welding /Stainless Steel	6603	-
5	Seat	EPDMRubber	-	-
6	Shaft bearing seals	Bronze/brassbearingwith '0'rings	-	-
7	Internal fasteners	Stainless steel	Manufacturer's standard	Suitablefor duty
8	External bolting	Carbonsteel; tensile strength390Mpa	-	-

1.2.5 OPERATION

All valves shall be capable of being operated at a differential pressure across the disc as marked on the valves. Lever, worm gear /travelling nut type or any other suitable type of operator can be used.

Manually operated valves shall be closed by turning hand wheel or lever in a clockwise direction when facing the hand wheel or lever.The design of lever when fitted shall be such thatthelevermayonlybeassembledtothevalvesothatitisparalleltothedirectionof flow when the valve is open.

Allgearnutoperatorsshallbeprovidedwithsuitablestopstopreventmovementofthe shaftbeyond the limit corresponding to the fully closedposition of the disc.

All gear /nut operators shall beself lockingtype. All leaveroperated valves shallbecapable of being locked at at-least three intermediatepositions. The operatinghand wheels shall be marked'CLOSE'or'SHUT'toindicatethedirectionofclosure.

Theoperatorshallbeprovidedwitharrangementtoindicate discposition.

1.2.6 TESTING

All valves shall be hydraulically testedby the manufacturerbefore dispatch. The pressure shall be applied without any significant hydraulic shock. Testing shall be carried out before applicationofpaint or other similar treatment.

1.2.6.1 **Bodytest**

The body ends shall be blanked.Thevalve disc shall beinslightly open position and thepressureequivalentto1.5 timesthemaximum permissibleworkingpressure shall be applied with water. The duration of test shall be 5 minutes for 1600 mm diameter valve.

1.2.6.2 **Seattest**

Seat test shall be carried in accordance with clause 17.3 of IS: 13095 for 3 minute duration.

1.2.6.3.**Discstrengthtest**

The test shall be conducted with the body flanges in horizontal position. The test pressure shall be 1.5times the maximum permissible pressure. With disc in closed position, hydrotest pressure shall beapplied tothe lowerface ofthediscfor duration as pertable3 of theIS: 13095.Thereshallbe no damage to the valvedisc or any part of the valve, or disc shall not be permanently deformed.

1.2.7 MANUFACTURER'SCERTIFICATE

The manufactureshallprovide a testcertificateconfirming thatall the valves have been tested in accordance with IS:13095/Equivalent Standard. Themanufacturershallalso providedocumentaryevidenceofhavingmanufacturedandsuppliedBFVofsimilar designandspecifications, working satisfactorily in India,throughPerformanceCertificate.

1.2.8 THIRDPARTYINSPECTION

Theinspectionand testingof thesamplebutterfly valvesshallbe carriedoutbythe employer and or inspecting agency appointed bythe employer, inthe manufacture's workshopbefore applicationof any paint.All the tests as required as per the IS: 13095 shall beconducted inpresence ofthe inspectingagency onthesamplevalves from the lot (Number of valves to be tested from a lot shall be as per the relevant IS for sampling and testing). The valves shall bedispatched only after issue of thetest certificate bythe inspecting agency for satisfactory performance of the tested valves. The inspection charges for such tests shall be first paid by the contractor to the inspecting agency, which shall be reimbursed on production of the documentary evidence for the payment made.

1.2.9 MARKING

Marking shall be cast integral on thebody or on aplate securely attached to thebody. Markingshallbeasspecified under clause 21of IS:13095.The design,constructionmaterial, manufacture, inspection, performance and testing shall comply with all applicable Indian Standards and Codes. Nothinginthe specification will beconstrued to relievethe supplier of thisresponsibility.

1.2.10 ACCEPTABLEMAKESFORTHEVALVES

Acceptable makesforthedoubleflanged butterflyvalves shall beasperthe approved vendorlist.Allthevalvesshallhave thesamemake.Contractorshouldnotplacedorder withanyothermanufacturerfortheabovesaiditem tillhasbeenrecommendedin writing by employer for the makes listed above.

1.2.11 INSTALLATION

The installation of the butterfly valvesshallbe done at the locations shown on Lsections of the pumping mainas online valves.Thejob covers supply ofthevalves at work site including alltype of taxes and duties, cost of packing, loading, transportation, unloading, stacking and installation at the specified location with cost of alljointing materials such as nuts and bolts, EPDM rubber gaskets etc.Thejob covers field hydraulic testing of the valve after installation for the specified test pressure for the respective pipeline section.

1.2.12 ACTUATORSOPERATEDVALVES

i) Actuatorswillbe withLimit and Torque switches for either end of travel for control and interlocking purpose .

ii) The characteristics ofthe actuators to be locatedonthe valves are indicated in the actuators specification.

iii) Should the actuator be located on the control column, all connecting accessories shall be supplied (extensions,joints, articulations etc.).

iv) Thevalves350NBandaboveshallalsobeprovidedwithhandwheel drivearrangementsuitableformanualoperation.Manualoperationof valveshallbethroughwormandgeararrangementhavingtotally enclosedgearing withhandwheeldiameterandgearratiodesignedto meettherequired operating torque.It shallbe designed tohold the valve disk in intermediate positionbetween fullopenand fullclosedposition withoutcreepingorfluttering.Adjustablestopsshallbeprovidedto preventOVOTtravel'in either direction.

lv)Limit and torque switches shall beenclosedinwater tightenclosuresalong with suitable space heaters.

1.2.13 MATERIALS/DESIGNDETAILS"

Materials, design andother specific requirements ofvarious categories of BFvalves shall be as indicated below .

51.No.	Description	Requirement.
a)	Design	AsperIS13095/BS5155/API609
b)	Type	Doubleflanged/WaferSeries
c)	Material	
	i)BodyandDisc	CaststeelgradeASTM-A27674dGr.WCB

51.No.	Description	Requirement.
		orSGIronasperIS1865gr.500/7,Ductile Iron GGG 40/50,ASTM A 536
	ii)Shaft	StainlesssteelAISI:431/410/Equivalent
	iii)BodySeat	Monel60integral/StainlessSteel
	iv)Disc Seat	EPDM/SS
51.No.	**Description**	**Requirement.**
	v)Bearing	PTFELINEDST.ST./Bronze
	vi)Testing	AWWA-C-504/IS
	vii)OtherRequirement	Tightshutoff

1.2.14 SPECIFICPERFORMANCEGUARANTEE

For the rubberseatedvalves,thecontractor shallguarantee that in the closed position and with a disc differential pressure as specified the valves shall be water tight.

The contractorshall guarantee that the operating mechanism shall open and close thevalve underthespecified maximum differential pressurewithinthetime specified.

The valve shall be suitable for frequent operation during initial commissioning operation after a long period of inactivity.

MARKING

1.2.15 The mark statedby theEmployerin theMaterial Request shallbe printed on the body, ofall valvesandrelevantaccessories (control columnsand relevant connecting elements to the valve, counter flanges. valves for the auxiliary control if separately supplied. etc.).

The face of each hand wheel shall beclearly marked "Open" and "Shut" with arrows indicating thedirectionofrotationtowhichtheyrefer.Eachhandwheelshallalso be fitted with a circular name plate indicating the service for which the valve is intended andvalve tag number.The name platesshall beengraved in black lettering Each spare part shall be individually marked with metal plates suitably punched for aneasyidentification

TESTINGANDINSPECTION

1.2.16 All valvesshall be checked for correctnessin respect of flange details as specified.

Thevalves shall betestedas perthe requirement ofAWWAC-504(latestversion} IS .Proofofdesign-testedvalveshallnotbesuppliedforthe project.

Forcastconstruction:Bodyand Discshall besubjected to MPI/LPIandshaft shall be subjected to UT and LPI..

ForFabricatedConstruction: AllButtweldshavingthickness20mmandaboveshall be subjected toRadiographyand, stressrelieving. Only qualified weldersshallbe usedfor the purpose of carrying out welding shaft shall besubjected to UTand LPI. **SITE TEST**

1.2.17 The valves shall be tested at site for opening and closingtime, valve operation etc.The valve should operate withoutany flutter,noise, and vibration.

A. ELECTRICMOTOR ACTUATORSFOR BUTTERFLY VALVES

DESIGNREQUIREMENTS

1.2.18 Electric actuators shall essentially consist of electric motors, limit switches, hand wheelandgeartrains,mechanicalpositionindicators,internalwiringandterminal

block.

The electrical actuator assembly inclusive of drive motor and unit switches compartmentshallconform toIP 55degreeofprotection. Actuatorsshallbe sized so as to. open / close the valve at the rated speed against the design differential pressureat 90% of thenominalvoltage.lostmotionhammerblow featureshallbe

provided for seating / unseating the valve when theoperating torque exceeds 11 kg/m. Operatorsshallbe designedtobe selflocking (i.e. maintainsthestem position)uponlossofelectricpowersupply.Motorsshallbeinstalledon the operatorpriortoshipmenttothevalvemanufacturer.Actuatorsshallbeprovided withlifting lugs forhandlingit along withthebonnetActuatorassemblyshallhave all metalgear trains. Operators shall beflange mountedonthevalve bonnet. Welding of operators onto bonnets is not permitted. All actuators shall be as per the approved vendorlist or as approved bytheemployer.

1.2.19 **OPERATINGSPEED**

All actuators shall have operating speeds as per the manufacturer's standard. However, this shall meet .operating requirement of the system. Actuator operating times (opening arid closing) shall befurnished with actuator details.

1.2.20 SERVICECONDITIONS

Theactuatorshallbesuitableforoperationinahot,humidandtropical atmosphere.Unlessotherwisestatedin theequipmentspecification,theambient air temperature shall be taken as 50 dg. C, relative humidity 100% and mean sea level less than1000 meters.

1.2.21 RATING

The actuator shall bedesigned for operation on a415 V +10%,3-Phase 50 Hz+5% solidly grounded system. The combined voltage &frequency variation shall be +1-10%.The control circuit voltage shall be2401110 VA.C.or 220V D.C.

The actuator shall be ratedfor three successive open-close operation of the valve or 15 minutes, whicheveris longer.

The normal torque ratingof each drive unit shall have adequate margin and at least equal to theoretical brake torque required to drive the equipment under full load, includingalllossesinspeedreducersandpowertransmission.

The drive shall take into account valve operating speeds and differential and static pressure required for the service. The contractor shall select operating speeds and designpressure to satisfyrequirementsof the equipmentfurnishedand acceptable to the Employer. Motor actuator assemblies shall have all metal gear trains. Fiber gears are not acceptable.

1.2.22 PERFORMANCE

Theactuatorshallopenand close the valvecompletelyandmakelead-tightvalve close, without jamming.

The actuatorshall attain full speedoperationbefore valveload is encounteredand impart an unseating blow to start the valvein motion (hammerblow effect).

The actuator shall operate the valve stem at standard stem speed andshall function against design differential pressure across the valve seat.

Themotorreductiongearingshallbe sufficienttolocktheshaftwhenthemotoris de energized and prevent drift from torque switch spring pressure.

Theentire mechanism shallwithstand anyshock resultingfrom closingwith improper setting of limit switches or from lodging of foreign matter under the valve seat.

SPECIFICREQUIREMENT

1.2.23 Construction

Theactuatorshallessentiallycompriseof thedrivemotor, torque/limitswitches, gear train, clutch, hand wheel, position indicator I transmitter, space heater and internal wiring. The actuator enclosure shall betotally enclosed,. dust tight, whether proof suitable for outdoor use without necessity of any canopy. All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficult.

MotorDrive

Thedrivemotorshallconform tosub-sectionE2ofthisspecification

The drive motor shall be three phase, 415V, squirrel cage, induction machine with class B insulation and IP-55 enclosure, totally enclosed and self ventilated and designedforhigh torquelow inertiaandreversingservicesuitableforoperationat 50 deg. C ambient temperature

The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current

All motors shall have TEFC enclosures with space heaters to maintain the internal temperatureabovedewpoint when the motoris idle. Spaceheatersshallbe rated for 240VAC.

The motorsshall becapable of operatingthevalve against the maximum loadonthe valve disc. with drive bearings indry and dirty condition.

Each motor shall be provided with two direct temperaturesensing thermostats to preventthermaloverload.

Allmotorsshall have0-ringsealsto providecomplete environmental protection when the motor is idle.

Earthingterminalsshallbeprovidedoneithersideofthemotor.

Double shielded grease prelubricated, regreasble, antifriction bearings having a minimumlife rating of 1,00,000 hours shall befurnished.

Limitswitch

1.2.24 PositionLimitSwitches

a. Each actuatorshallhave rotary drumpositionlimit switches, two{2} foropenand two (2) for close position, each with adjustable setting between fully open and fully close positions. Each rotarydrum position limitswitchshall havetwo normally closed (NC} and two normally open (NO) independent contacts. The adjusting 'mechanism for the limit switches shall be easily accessible.

b. Torquelimitswitches

Eachactuator shallhavetwotorque limitswitcheswithsuitablearrangementto limit the opening / closing thrust. The torque switch, actuated by the torque' clutch whenthevalveisrestrictedduringopening/closingshallstopthemotorthereby

protecting the motor from overloading torque. The torque switches shall be set as nearaspossible to thepull out torqueof themotorwithoutdamaging the valveof theoperation.

Eachtorque switch shall havetwo normally open (NO) andtwo normally close (NC) independent contacts

Thetorquelimitswitchadjustingmechanismshallbeeasilyaccessible.

Limitswitches alongwith all necessary electrical wiringshall be housed inaweather proof NEMA-3 enclosure and shall have gasketted cover and space heater to maintain the temperature above dew point.

Each torque / position limit switch shall have 2 NO + 2 NC potential free contacts. Contacts shallbe rated tomake andcarry continuously10Aat110V -Cand 0.5A (inductive)220V DC.

Manualoperation.

All actuatorsshallhave mechanicallyindependentmanual drive arrangementwith hand wheel and motor declutchingmechanism. The manual drive shall be provided withclutchandgearingasrequiredtolimithandwheeleffortto25kg maximum alongwithsuitablelatchandlockingarrangementtokeepthehandwheelin engaged position using manual operation.

Thehandwheelshalldisengageautomaticallyduringmotoroperation.

1.2.25 **Positionindicator /Transmitter**

All actuatorsshallhave one(1)built-inlocal position indicatorfor0.-10.0.%travel. Allactuatorsshallbeprovidedwithmechanical3-pointdialpositionindicators.

Risingsteamvalveshall

additionallyhavevisualposition indicationthroughplasticstemcovers.

Whererequired.valvesshallbeprovidedwithcontinuousremoteposition indicators of the potentiometric type. The available voltage sources for the potentiometric positiontransducers are220V DCand240VAC.Thetransducer shall be suitable for stablished 4-20 mA current signal. The associate dwiring for the transducers shall be housed inthe limit switch compartment.

SpaceHeater

A space heater shall be included inthe limit switch compartmentsuitable for 240. V AC,SO.Hzsupply220.VDC.

Wiring

All electrical devices shall be wired up to and terminated in a terminal box. The internal wiringshallbe of sufficientsize forthepowerrating involvedbut no case less than 1.5mm copper. All wiring shall be identified at both ends with ferrules. Internal wiring diagram shall be neatly pasted on the rear side of the terminal box cover

Motor power, heater and all control wiring shall be wired at shop to suitably rated masterterminalblockslocatedwithinthelimit switchcompartment.Allinternal wiring shall be of 650/1100 V grade flexible standard copper conductor cables with tropical fungicidal treatment andthe insulation shall beflame resistant

The limit switchterminals should be capable of terminating two nos.2.5 mm copper cable

Terminalboxesshallbeprovidedwithremovableundrilledglandplatesto terminate following sizes of cable.

I) 1no.-14core2.5^2(Cu)

II) 1no..,10cores-do-

Ill) 1no.-2pair

lv) 1no.- 10pair

v) 1no.-Powercable

TerminalBox

Actuatorterminalboxshallbesuitabletoreceiveandterminatethefollowing cables:

a) 1No.powercabledetailsofthisshallbeintimated later.

b) 3Nos.19Cx2.5copperconductor PVCinsulatedunarmouredcontrolcable

Actuator terminalboxshallbeprovidedwitharemovablefrontcoverplateandan undrilled detachable gland plate

1.2.26 DATATOBEFURNISHED

Motor datasheet for each type of actuator shall befurnished along with internal wiring diagram, suggested control schematic and torque I limit switch contact development.

B) ELECTROHYDRAULICACTUATORS

1.2.27 DESIGNCRITERIA

Eachelectro-hydraulicactuatorshallbeprovidedwithitsownpowerpack.Each actuatorshallconsistofadoubleactingcylinder,controlcabinetandaccessories to cater for following operationalrequirements.

Inthe closed position the valve shall be held closed by a substantial counter weight or byanyother mechanicaldevice.

Start-up sequence of pump shall initiate powered opening of butterfly valve hydraulicactuator.Theactuatorshallbeadequatelysizedtoopenorclosethevalve againstanunbalance.Pressureequaltopumpshut-offpressureineitherdirection withinthetimeperiodasspecified.Thenecessarylimitswitchesshall beprovided onthevalvessothatatapre-determinedposition,thepumpcircuitbreakershallbe closed to start the pump.

Valve shall remain open during normal runningof the pump. No disc flutter shall take placeinthe position norshallthere beanycreep inthisfullyopen position.

A limit switch be provided (set at about 3 deg from open position) to sense the creeping. Switch shall start the oil pump and return the valve to the fully open position.

Whenthevalveisfullyopenandelectricsupply inthevalvecontrol systemfailsthe butterflyvalveshallremainopenwhiletheCWpumpcontinuestodeliverwater.

Normal operational shut down shall enable valve to close at a slow closing rate, whichshallbeadjustablebetween30to60seconds.

In case of any faultcausing pump motor trip, the correspondingbutterfly valve shall start closing at a fast rate initially and thereafter at a slow rate. The emergencyclosingfacilitiesshallbeduplicatedeachwithitsownsolenoidvalvein the hydraulic circuit.

Provisionforlocalmanualoperation shallbemade.
Thelowerparttothecylindershallhaveafixedorificeespeciallydesignedto achieve a minimum valve closingtime incase of failure of oil pipeline.
A locking device shallbe provided so that the valve can be maintained in open/shut position during maintenance and inspection.

The hydraulic controls for each valve shall be housed inindependent cabinet located on an operating floor near the valve. This shall consist of pumping unit,oiltank, and accumulator of adequate -capacity to hold the valve disc at any position and to prevent any surge includingdisc flutter duringvalve travel and to fully open position. Accumulator will also have enough capacity for 2strokes ofoperation without external electric AC power. The hydraulic power pack will consist of necessary pressure switches, pressure gauges, flow regulators, solenoid valves; transformers, rectifiers etc. for DC power supply for solenoid valves contactors, relays, fuses, indicating lamps, push buttons etc.for control of solenoid valves and pumping units; throttle valve, filters, non-return valves etc. arranged in a logical circuit to meet operationrequirement

All oil pipelines /flexible hoses interconnecting the control cabinet tothe valve shall be in bidders scope
The electrical controls for the valve such as relays, contactors and fuses shall be housedinthe common panel(local) for CW pumpsorinaseparate panel. Reversible starters for the valves shall however, be provided bythe Employer
Each butterfly valveshallhave fourlimit switches, eachcapable ofbeing set of at any point between full open to full close position to meet desired functions.In addition, one more extra limit switch to be set at an intermediate position shall be provided, each limit switch shall have 2 NO. and 2N C contacts. Limit switch enclosure shall conform to NEMA4x standard

1.2.28 SUBMITTALS

The contractor shall submit with his offer full details of valve operating mechanism and hydraulic diagram with description.

1.2.29 TESTSANDINSPECTION

The Contractor shall furnish type test certificates from a recognized test house certifying evaluation of accuracy, reliability and repeatability.
Eachvalve actuator assembly shall be given a complete operation test at the value manufacturer's shop to demonstrate that each operator is functional and all limit switches have been properly set.
Testsshallbealsodonefor speedoftravel,torqueratingand calibration.
When practicable, each valve assembly shall be shop tested to open and close against the maximum differential pressure.

All the componentsof actuatorsshallbe subjectto testsat the worksof ManufacturerasperrelevantMaterialSpecificationsandManufacturer's established practices, to ensure reliability. Details of the same shall befurnished to the Employer
Functionaltestonaccumulators,OilPumpsandcompletelyassembledunitof

Actuators shallbecarriedoutasperapprovedprocedureandDataSheet.

ContractorMust ConductProof ofDesign Teston the Actuatorsasper A\NWA-C-504

1.3 KineticAirvalves

1.3.1 General

Kineticair valvesarerequired withpressurerating appropriatefor the workingconditions andapproved bythe Employer, confirming to IS: 14845/AWWAC512.

1.3.2 Scopeandgeneraldesignfeatures

Theair valvesshallbe capableofexhaustingair frompipeline automaticallywhen being filled. Airshallbe releasedat sufficientlyhigherrate so that thereshallbe no restriction for theinflow rate. Similarly, the valvesshallbe capableof ventilatingpipeline automatically when being emptied. The air inflow rate should be sufficiently highto avoid development of vacuumin thepipeline.

The design shallbe such that,higher therateof flow the greater theresultantdown thrust, keepingthe ball 'glued' to its seatuntilthe last drop of air isexpelled from the pipe system. Each air valve shall be provided with an isolating sluice valve with flangedend connection. The possible air velocity(inflow and outflow)must beat least 10*mls.*

1.3.3.Constructionfeatures

Theflow ofair should beas unobstructed as possible.The low pressure orifice shall beinthe sameaxisasthemaindischarge*/*incomingairflowandmusthaveadiametersufficiently large. Thevalvebodyshallbe designedin suchawaythatthe turbulentairatthe timeof fillingofpipelineshallnotcirculateandcausetheball tobecaughtin thedischargingair streamandblowingthevalveshutpermanently.Theconeangleofthelowpressure(large orifice)chambershallbe such thatevenatacritical velocityof air escaping at 344m*/*sec the total impact force onthe Stainless steel ball is lessthan the suction force onthe annular areabetweenthe balland cone.The annulus around the low pressurevulcanite covered ball istobegenerouslyproportionedfordischargeofairundervariousdifferentialpressures. Normalrangeofconeangleis450to600.

Theorificeshallbecarefully profiled toallowtherequisite flowofairundervarying differential pressures. It shall be in moulded synthetic rubber such that even after extended contact the, Stainless steel ball does notstickto it,when the line pressure becomes zero.

The high pressure chamber having small orifice shall be so designed that the orifice is effectivelysealedin workingcondition. Theorificeshallbeprofiledin suchamannerthat the rubber covered ball is not damaged even after extended contact. There should be machined guide in the chamber which ensures that the ball travels vertically and makes contact with the nipple and seals off the orifice without fail. The orifice size shall not be less than 2.5 mm and tapering to 10mm suitable to release accumulated air within the pipeline. High pressure orifice may be fitted from bottom side of the cover.

1.3.4 **Material**

The makesgiven areacceptable makes however the materialfor different componentsparts of the air valve shall conform tothe requirements given below:

SI.No	Component	Material	Referenceto ISNo.	Gradeof designation
1	Body,cover,valve disc, stuffing box, valveguide,cowl, gland,cap,joint	SG.iron/ Ductileiron GGG 40/50, ASTM A 536	1865	Gr.400/15
2	LowPressureseat ringandfacering	Naturalrubber	11855	
3	Highpressure orifice	Leaded tin bronze	318	LTB-2
4	Bolts	Carbonsteel	1363	Class4,6
5	Nuts	Carbonsteel	1363	Class4
6	Gasket	Rubber	638	TypeB
7	Float	Stainless steel/Polypropelene/ Polycarbonate	-	-
8	Floatguide	Leaded tin bronze	318	LTB-2

1.3.5 **Floats**

Minimum floatdiametersforkineticair valvesshallbe asindicatedintable3 ofIS 14845. The inner core of the floats shall be made from stainless steel having sufficient bearing strength and equivalent specific gravity.

1.3.6 **Testing**

TestingofalltheairvalvesshallbecarriedoutinthesuppliersworkshopasperIS:14845.

Followingtestsshallbecarriedforeachvalve.

- Functionandperformancetestasperclause12.4.1
- Highpressureorificetestasperclause12.4.2
- Lowpressureorificetestasperclause12.4.3
- Bodytestasperclause 12.4.4

Theperformanceofthevalvefortheabovementionedtestsshallbeasspecifiedunder clause 12.1,12.2and 12.3of IS14845.

1.3.7 **Manufacturer'sTestcertificate**

The manufacture shall provide a test certificate confirming that all the air valves have been tested inaccordance with the relevant standards and performance ofthe test results observed.

1.3.8 Thirdpartyinspection

Theinspectionandtestingofthesampleairvalvesshallbecarriedoutbytheemployerand or inspecting agency appointed by the employer, in the manufacture's workshop before application of any paint. All the tests as required as per IS 14845 shall be conducted in presenceoftheinspectingagencyonthesamplevalvesfromthelot(Numberofvalvestobe testedfromalotshallbeasperthe relevant ISforsamplingandtesting).Thevalvesshallbe dispatched only after issue ofthe test certificate bythe inspecting agency for satisfactory performanceofthetestedvalves.Theinspectionchargesforsuchtestsshall befirst paidby the contractor to the inspecting agency, which shall be reimbursed on production of the documentary evidenceforthepayment made.

1.3.9 Marking

Eachvalve shall be permanentlymarked with a plate securely fixed to the body with the informationasspecifiedunderclause15.1ofIS14845.

The design,construction material,manufacture,inspection,performance andtestingshall complywithallapplicable IndianStandards andCodes.Nothinginthespecification willbe construedtorelievethesupplierofthisresponsibility.

1.3.10 Acceptablemakesforthevalves

Acceptable makes for thekinetic double orifice air valves shall be as per the approved vendor list. All the valves shall have the same make. Contractor should not placed order with any other manufacturer for the above said item till has been approvedin writing by employer for the makes listedabove.

1.3.11 Installation

The installation of the air valves shall be done with isolatingsluice valve. The job covers supplyofthevalvesattheworksiteincludingalltaxesandduties,costofpacking,loading, transportation, unloading,stacking andinstallation atthespecified locationwith costofall jointing materials such as nuts and bolts, EPDM rubber gaskets etc. Thejob covers field hydraulic testing of the valves after installation for the specified test pressure for the respective pipeline section.

1.4 AntiVacuumValve:

1.4.1 Scope:

The Anti vacuum valve of 380 mm will be installed to prevent the formation of vacuum in large diameter (having of 1000 mm. and above) water mains to prevent line collapse under such conditionsof flowas mayresult, forexample, fromtoorapid aclosureof an upstream head gate or shut down valve, a downstream burst or ordinary emptying or recharging of a pipeline.

1.4.2 **Designfeatures:**

Designoftheanti-vacuum valveshall automatically allowinductionoflargevolumes ofair to prevent vacuum formation; and also provide an automatic means of ventilating a line when itisbeingemptiedofwaterandofexhaustingairwhen itisbeingrecharged.

It should be suitable to react automatically, sensitively, and positively even afterlong periodsofinactivity,tochangesofpressurewithinapipe,andwhenever necessary,permit air to flow in at a sufficiently high velocity, and at low enough induction pressure, to safeguardthelineagainstcollapse.

Cowled InletType of the anti -vacuum valve should havean annular cowl shrouding the orifice, providing protection to the orifice and the seating.It shouldbe suitable for air to flow through the ports provided around the periphery of the body assembly. Such application is confined to situations where no damage is likely to occur surrounding structures from sudden intakesofair.

1.4.3 **Operation**:

About Operation, the valve element should be inthe form of the disk which is sensitively balanced by a counterpoising mechanism. The disk guide pin should be attached to a crosshead, to which is fitted at either end a cranked lever that should rock about an intermediatepivotpinandshouldbeapplicabletocarryanadjustablecounterweight onits outer arm. The parts should so arranged that by adjusting the position of the counterweights,thevalvemustbebalancedatanydesiredpointsonitsworkingtravel.

Thus, when swinging freely the valve may be balanced at a partially opened position in which case, ifitisclosed byhand,itself-opens tothe predetermined point of equilibrium, andvice-versa.Alsoattachedtothecrossheadshouldbeanoildashpotwhichshouldgive free opening, in a downward direction, but offer resistance to closing, in an upward direction,andavoidallpossibilityofoscillationofthesuspended.

Inaction,therefore, thevalve should not remainateither extremity of itstravel unless itis actedуponbysomeexternalforce.Duringnormaloperation,thediskshouldbeheldshutby thewater pressure inthe pipe.Ifthe pressure onthe underside ofthediskfalls belowthat oftheatmosphere,thevalveshouldimmediatelyopentoadmitairandbreakvacuum.With verysmallvacuum, say 1inchof mercuryorabout Y.i psibelow atmosphere, shouldopen fully and offer awide passage for freeflow of air.Onthe cessation of air inflow,thevalve must return to a position of slightly open, which is sufficient for the escape of air during refilling of the line. When the risingwatermakes contact with the underside of the disk, closureiscompleted:onlyaverysmallwaterpressureshouldberequiredtoclosethevalve, consequently, the quantity ofwater overflowingthrough theorifice duringfinal closure will be negligible.

1.4.4 Manufacturer'sTestcertificate

The manufacture shall provide atest certificate confirmingthat alltheAntivacuum valves have beentested inaccordance with the relevant standards and performance of the test resultsobserved.

1.4.5 Thirdpartyinspection

The inspection and testing of the sample Anti vacuum valves shall be carried out by the employer and or inspecting agency appointed by the employer, in the manufacture's workshopbeforeapplicationofanypaint.Thevalvesshallbedispatchedonlyafterissueof the test certificate by the inspecting agency for satisfactory performance of the tested valves. The inspection charges for such tests shall be firstpaid by the contractor to the inspectingagency,which shall bereimbursedonproductionofthedocumentary evidence for the payment made.

1.4.6 Marking

Eachvalve shall be permanentlymarked with a plate securely fixed to the body with the informationasspecifiedunderrelevantstandards.

The design,construction material,manufacture,inspection,performance andtestingshall complywithallapplicable IndianStandards andCodes.Nothinginthespecification willbe construedtorelievethesupplierofthisresponsibility.

1.4.7 Acceptablemakesforthevalves

Acceptable makesfor theAntivacuum valves shallbeaspertheapprovedvendor list.All the valves shall have the same make. Contractorshould not place order with any other manufacturer forthe above said itemtill hasbeenapproved inwriting byemployer for the makes listedabove.

1.4.8 Installation

Thejob covers supply of the Anti vacuum valves at the work site including all taxes and duties, cost of packing, loading,transportation, unloading,stacking and installation atthe specified location with cost of alljointing materials such as nutsand bolts, EPDM rubber gaskets etc. The job covers field hydraulic testing of the valves after installation for the specifiedtestpressurefortherespective pipelinesection.

1.4.9 PAINTINGSPECIFICATIONFORVALVES:

Final coating on internal and external surface of the Valve shall be carried out after satisfactory testing,priorto dispatch.

Before inspection: Each valve shall be cleaned and surface shall be preparedby Sand blastingtoSA2%Grade-Nearwhiteblastcleaning,andsuitablyprotectedbyapplyingone coat of two component high build polyamide cured re-coatable zinc phosphateepoxy primer.

After inspection :Onecoat oftwo component high build polyamide crude re-coatable epoxy coating shall beapplied to achieve DFT 150micron,followed byone coat of two component aliphatic polyurethane finish to achieve DFT80 micron.

1.5 Non-returnvalves

GENERAL

Each pumpwill be provided with one NonReturnValve initsdelivery pipe.The non-return valves shall be all flanges type single door type / multi door type, (recoil or equivalent)wellproventype,freeactingquickopening,givingrapidnon-slam closure etc.and with lowhead losscharacteristics confirming to IS5312.The valves shallbe provided withby passes valves. The flanges shallbe confirming to IS 1538-1976/BS4504.Multidoor NRV will also be accepted.

1.5.1 MATERIALSOF CONSTRUCTION

Body,cover,door,hinges	C.I.210GRFG-200/caststeel Stainless steel.
Hinge, pines, door pins Suspensionpins	
Disc facing	LeadedinBronzeIS318GRLTB2
Seatinginbody	LeadedinBronzeIS318GRLTB2
Bearingbushes,Bodyrings, Door faces	LeadedinBronzeIS318GRLTB2
Boltsandnuts	StainlessSteel/CarbonSteel

1.5.2 TESTING

Thevalves shall besubjected toseat and bodytest inaccordance with IS5312 atthe manufacturer's works vide table below. These tests shall be carried out at manufacturer's works in presence of Engineer or his representative, before delivery. Test Certificates shall be furnishedin triplicate.

Valverating	SeatTestPressure	BodyTestPressure
PN -0.6	6.0Kg/cm.sq.	9.0Kg/cm.sq
PN-1.0	10.0Kgfcm.sq..	15.0Kgfcm.sq.
PN-1.6	16.0Kgfcm.sq.	24.0Kgfcm.sq.

AlsoinsteadofNonReturnValve,DualPlateCheckValveDesigncanbeconsidered

2.O PUMPCONTROLVALVE

2.1 SPECIFICATIONOFPUMPCONTROLVALVES

The PumpControl Valve shall open fully or shut off inresponsetoelectric signals. Itshall isolatethe pumpfrom the system during pumpstarting and stopping, to preventpipeline surgesduringPumpON/OFF.

Valve Should bewithRapid-action pistonfor FastOpening/Closing actiontofacilitate stable and accurate control.

ValveShouldhaveHighKvfactore.g.4"valveshouldhaveKVvalueof475 m3/hr,

ValveshouldhaveLowheadlossathighflowrates,

Valve should bestrong, lightweight andcorrosion proofsurfaces,which resist cavitation damage, thus increasingservice life and reducing operation & maintenance cost.
Valve should have Linearflow,Lowturbulence to minimize cavitation, and allow highflow velocities withlow noise and vibration.
Valveshouldhave"Softclosure"featuretopreventwaterhammer.
Multi-Valve modular configurationFull redundancy enabled. Individualvalves can be possible to separately removedfor maintenance or replacement which reduces downtime and maintenance costs & allows maintenance work to be done withouthalting water flow.

2.2 MATERIALOFCONSTRUCTION:
ValveBody, :ReinforcedfiberglassnylonorPolypropylene

Pistons,Bushing,FrontandRearCups: Reinforcedfiber glassnylonor Polypropylene

Mainseal:NBR,VITON or EPDM rubber,

0-rlngs:NBRorEPDM rubber

Inlets,outlets:Stainless Steel/Reinforced Fiberglass nylon

Clamps, bolts : Stainless steel

Multi-Valvemanifolds:SpheroidironwithPolyesterorEpoxy coating

/StainlessSteel.

PressureRating:PN16

InspectionandTestingofallequipmentwill bedone aspertheapprovedQualityAssurancePlan from the CE, Megalift.

Manufacture,supplyandinstallationofMS ExpansionjointsandCoverbox

3.1 M.SExpansionjoints

3.1.1 Requirement

Expansion joints are necessary on the MS pipeline laid above ground to accommodate expansionand contractionof theMS line due to temperaturevariations,so that the expansion or contraction is not cumulative over several lengths. These joints permit linear movementof thepiperelative to thepacking providedin the joint.Fabricated steelBellow-type expansion joints, as per the EJMA standards, shall be provided and installed at the locations shown on longitudinal section ofthe pipeline.
Normally, on plain ground, the centre to centre distance of the expansion joints shall not be morethan300m.Whenthelengthofabovegroundpipelineislessthan300mbutmore than 100m,oneexpansionjointatthecentreshallbeprovided.Thepipelineshallbe anchoredfirmlywithconcreteanchorblocksbetweentwoexpansionjoints,sothatthe

expansionor contractionbetween two anchorblocks is accommodatedby the expansion jointprovidedbetweentheblocks.Supports/saddlesshallbeplacedoneachsideofthe expansion joint at about one meter distance from the centre of the joint to avoid unequal deflection of the pipe on either side of the joint.

The item covers providing and packing, transportation to work site and fixing wherever required on thepipeline withhydraulic testing along with the pipeline section.

3.1.2 **Acceptable makes**

Acceptable makes for the Bellow-type expansion joints shall be as per the approved vendor list.All the expansion jointsshallhave the samemake. Contractorshouldnot place order withanyothermanufacturerfortheabovesaiditem tillhasbeenrecommendedin writing by employer for the makes listed above.

3.1.3 **MATERIALOFCONSTRUCTION**

BELLOWSMATERIAL	SA240GR.304
CENTRESPOOL/WELDENDS	IS2062GR.B
INTERNALSLEEVE	SA240GR.304
LIMITRODS/NUTS&CHECKNUTS	IS1367
FLANGES	IS2062(ASPERIS1538IIS6392)

3.1.4 **MScoverforexpansionjoints**

3.1.5 **Requirement**

CircularMScovers as shown on drawingshall befabricated and fixed onthe expansion joint forprotecting the jointfrompossible damages. Theitem covers the cost of plates and material required, nut bolts, all taxes and duties, providing and applying two coats of epoxy paint in addition to one primer coat, transportationand fixing charges etc complete

3.1.6 Manufacture,supply.andinstallationofMSdismantlingjoint

Bellow type Dismantlingjoint shall be provided for each online sluice valves, butterfly valve and washout valve to facilitateremoval of the valve for repairs wheneverrequired.

The joints shall be fabricated as per EJMA standard .The item covers cost of Bellow type Dismantlingjoint,including all taxes and duties and cost of coating, packing, transportation, cost ofjointing including required material such as nut bolts, rubber packing, labour cost etc complete with hydraulic testing to required pressure.

3.1.7 **MaterialofConstruction**

BELLOWSMATERIAL	SA240GR.304
CENTRESPOOL/WELDENDS	IS2062GR.B
INTERNALSLEEVE	SA240GR.304
LIMITRODS/NUTS&CHECKNUTS	IS1367
FLANGES	IS2062(ASPERIS1538IIS6392),BSEN1092-2

3.1.8 Acceptablemakes

Acceptablemakesforthe Bellow-type Dismantlingjointsshall beas perthe approved vendor list.All the dismantlingjoints shall havethe same make. Contractor should not place order with any other manufacturer for the above said item till has been recommended in writing by employer for the makes listed above.

3.1.9 Supplyandfixingofrollerbearings

3.1.10 Requirement

Steel roller bearings shall be provided and fixed on the bearing plates fixed on concrete pedestals for above ground pipeline,asshown on drawing. The bearing boxes shall befirmly fixed tothe bearing plate. Number of bearings and rollers,size of rollers etc shall depend on the pressure andthrust onthe pipelineand shall beas directed bythe Engineer-in-Chargein charge.

3.2 METALIC/RUBBEREXPANSIONJOINTS/DISMENTALINGJOINTS

Metalic /Rubber expansion joints shall be provided between the discharge head outlet and valve indelivery lineeach pumpfor easyassemblinganddismantling ofthe pipework.The metallic/rubber expansionjoint shall with standthe internaltest pressureandvacuum as specified inSchedule- design shall ensure that-

1. When assembled and under dynamic load the rigid bolts together withstand pull,equaltotwicethedutyheadandnotorqueorpullisextendingonthe discharge head mounting fasteners.
2. During assembling ordismantling,thesliding flange can slideadequately to enable to detach discharge head and pipingfrom eachother.
3. Thesealringthatjointshallbedesignedtowithstandtestpressurementioned in Schedule'B'withoutanyleakage.

3.2.1 DESIGNANDCONSTRUCTION

Designof the expansionjoints shall berestrainedtype with minimum three (3)tie rods.

BODY

Expansionbellowshallbemanufacturedfromnaturalorsyntheticrubber,withintegral flanges at both ends. Split retaining rings of adequate design shall be supplied for severally holdingthe expansion jointwith connecting pipe flanges.

CARCASS

Fabrics of high strength synthetic fibers shall be used insuitable number of pipesto holdthe shapeofthe belowattheworkingcondition.Allfabric pipeshall beimpregnated with rubber or syntheticcomponentstopermit flexibilitybefore them.

Coppercoated steelwireorsolid endless ringsembedded inthecarcass shall becoated with suitable material to protect the carcass from outside sewage and fluid corrosion.

Protectivehypaloncoatings shallbeappliedattheexterior.

3.2.2 CONTROLRODASSEMBLY

Eachexpansionjointshallbesuppliedwithcontrolrodassemblytopreventexcessive elongationor contractionof thebelow.Controlrod assemblywill consistoflong bolts, nuts

and lock nuts,spherical washer connecting plates (guest plates) for fixingthe assembly with matingflanges.

Control Rod assembly shall allow transverse and rotation movements under limiting axial conditions of the Expansion Joints.

Designofcontrol rodassembly shalltake careofthemaximumaxialthrust acrossthe Bellow, calculated on the bases of maximum fluid internal pressure and internal diameterof the each.

Expansionjointsshallbeprovidedwithflangesdrilledtosuitthe Pumpsdeliveryflange.

3.2.3 INSPECTION ANDTESTING

Testsatshopshallincludebutnotbelimitedtothefollowing

a. Materialtestasperspecificationrequirement.
b. Vacuumtest.
c. Hydro-test

3.2.4 HYDRAULICPRESSURETEST ANDLEAKAGE TEST

Allexpansionbellowsshallbesubjected tointernalhydrostaticpressuretestofequivalentto 1.5timestheshutoffhead ofpumpsand thefollowingcondition.

1. Freepositionofthebellowforfive(5)minutes.
2. Withpermitted (design) elongation and lateral deflection for Two (2) minutes and
3. Withdesigncontractionandlateraldeflectionfortwo(2)minutes.

Afterthehydrotestis over, thebellowshallbedimensionallyinspectedtocheck deformation, if any. During thetest,thecontrolassemblyshallbe suitablyadjustedtoobtainthetest condition of the Bellow.

At testsshallbecarriedoutinpresenceoftheEngineerorhisrepresentative.

3.2.5 CLEANING,PROTECTIONANDPAINTING

Before installation, all expansion joints shall be properly cleaned, as necessary.All exposed finished metalsurfaces shall begreased to prevent dust.

3.2.6 DISMANTLINGJOINT

ItemDesign, Manufacture, Supply & Erection of Dismantling Joints of various diameter including hoisting lowering in position fixing in true plumb & level etc. including tie rods hardware gaskets & other necessary material for making jointsincluding all taxes, central state & local conveyance to site, loading, unloadingsafe storage till erection etc. complete.

General:Theitemproviding &fixingin position dismantling jointof variousdia. on the pipes.The design workman ship shall beto the specificationsof Engineer &shall comply with one or more ofthe standards, regulations &codes issued by Bureau of Indianstandard /B.S.

Itemto Include:

The Unit includes:

- ManufacturingofDismantlingjoints,providinggasket,tierods,nut,bolts&studs.
- Quality control
- Conveyancetosite.
- Storagetillerection
- Erectionwithalljointingmaterialandlabour

- Successfulcommissioning.
- Alltaxes central, state and localandany other incidental expenses.

Design to be approvedbefore manufacturing:

BeforemanufacturingthecontractorshallsubmittotheEngineer-in-charge,thedetailed drawingwithrelevantIS.Thecontractorshallnotmanufacturejointswithnotwrittenapproval of Engineer-in-charge to the design.

Materialofconstruction&Designdata:

i) NameofFluid RawRiver Water

ii) WorkingPressure 10Kgfcm.sq.

iii) MaterialofConstruction

Inner shell f- MS as perIS 2062Gr. B. Outer

Sheet f- MSasperIS2062Gr.B.

Pressureflange f- MS as per IS 2062 Gr. B.

Nuts bolts tie bar f-CS IS 1367 Gr. B.(Galvanized) studs

Gasket f-Rubber

'0'Ring f-Neoprene{50shorehardness)

iv) Governingstandard

Flanges f- IR1318

Fabricationf- IS3589

v) Testing f-TestPressure16Kgfcm.sq.

TestCertificatef- HydraulicTestCertificate&

Material TestCertificate

Before the jointsareactuallyfixed,theyshallbecleaned,greased&it shouldseenthatall the parts are perfectly inworking conditions.

3.2.7 Dismantlingjointsshallbe suitable forflangebolting individual to flangesofBFV &NRV.

Flangemade segments&weldedshallbe stressrelived afterwelding.

Flange&machinedsurfacesshallbeprotectedfromcorrosionduringshipmentand Subsequentstoragebycastingrustpan,preventativeorequivalentwhichiseasily removablewithpetroleum.

3.3 SURGEPROTECTIONDEVICES

3.3.1 General

DoingSurgeanalysisanddesigningsystemtocontrolanticipatedWaterhammerby installation of 'Spring operated Zero Velocity Valves' and 'Air Cushion Valves' etc. shall be responsibilityof theContractor.

TheWaterhammercontrolsystemshouldbesuchthat:

i. Thereisnosignificantheadloss
ii. Positivepressureshallnotexceed140%ofthemaximumWorkingpressureof the Pipeline and
iii. Fallin pressureduring forwardflowshallnotbebelow Atmospheric pressure.

The agency engaged for doing Surge analysis and supply of Water hammer control devices should have sufficient experience of doing similar tothe proposedjob and should guarantee control of Waterhammer pressures within above parameters.

The design shall be got approved from "Indian Institute of Science, Bangalore" / IIT/NIT or Institute as approvedbytheEngineer-in-Charge.Thedesignchargesshallbeat thecost of the contractor.

Thespecificationsforabovespecifiedhammercontroldevicesshallbeasspecifiedbelow:

3.3.2 BLADDERVESSEL(WaterHammerControlDevice)

Supply,Erection,Testing&CommissioningofSurgeprotectionsystem(BladderVessel) required followingfeatures.

1. Largeinletsizetowaterchamberasperwaterhammeranalysis.
2. Minimumvessel thicknessis6mminclusiveof2mmcorrosion allowance.
3. Waterdoesnotcomeincontactwithvessel.
4. Fullsizefloatingbladderrein forcedwithhigh strengthnyloncoatedwith food grade imperviousbutyl rubber forlong life.
5. Drainarrangementtocheck prechargedair pressure.
6. Easyavailabilityofspares.
7. The vesselis subject to testpressure for10minutes at 1.5timemaximum pressure.
8. Vesselshouldbeepoxycoatedinternally&externally
9. Bend, NRV, Butterfly Valve, Bypass lines,Air valve, are fitted as perthe design.
10. The piping between rising mainand bladder vessel hasto becarried out as percontract.
11. Requiredfoundationforthebladdervessel.
12. ThevesselshouldbechargedwithairpressureasperRequirement.
13. TheBladder vessel shall be connected to rising main within 5*D WhereD= Diameter of rising main

Any other Bladder Vessel Design can be considered alongwith necessary recommended equipment as per approved Surge Analysis Report by "Indian Institute of Science, Bangalore" / IIT/NIT or Institute as approvedby the Engineer-in-Charge

3.3.3 **CONSTRUCTION**

Bladder vessel consists of Air Chamber and Water chamber. Both are separated byfloating imperviousbladder.The Airchamberispre chargedviaairinlet valve.Thebottom flange can be connected to pipe line via throttling orifice and control valve.

3.3.4 **ZeroVelocityValve**

The valve has an outer fabricated casing (’Main Body’) in which a Central Rod’ is held by struts. A ’Stationary CentralDome’ creates an annular streamlinedpassage for smooth flow of water. Closing Disc is mounted on "CentralRod’. Disc is held in closed positionby a number of ’Stainless Steel Springs’ (of AISI 304).Two’Anti Rotation Guide’ are provided on the edge of ’central disk’ with minimum resistance to flow. ’Anti Rotation Guide’ is lined with StainlessSteel Strip(of AISI304)and’GuideFork’ withbrass liners. ’Bypass’ witha’Valve’

connectsupstreamand downstreamsides of Zero VelocityValve. A'Man Hole' is provided on'outlet' cone ofmain body, formaintenanceandreplacement of springs (if required) without removing thevalvefrom line. Astainless steelsleeve(ofAISI304)isfittedon 'Central Shaft' and moves in brass bush fitted in 'Disc' for free movement. The 'Outer Shell',

'Dome'and'Disc'are fabricatedout ofM.S. plates(ofIS 2062.). The valve willbe paintedin Black Tar Enamel Paint from inside and outside.

MATERIALOFCONSTRUCTION:

51. No.	Description	Material
1	EntryBarrelandCone	MS-15-2062
2	ExitBarrelandCone	MS-15-2062
3	CentralLapRing	MS-15-2062
4	GuideDome	MS-15-2062
5	CentralDisk(WithSpringGuides)	MS-15-2062
6	CentralShaft(S.S.Lined)	MS-ST42
7	Entry ConeSupportRibs	MS-15-2062
8	ExitConeSupportRibs	MS-15-2062
9	Springs	SS-AISI-304
10	AntiRotationGuide(withSSStriponPlate&Brasson fork)	MS+SS304+ BRASS
11	Stiffener	MS-ST-42
12	HandHoles	MS-15-2062
13	SupportBush	MS-ST-4 2
14	BushforDisc(WithBrassInnerBush)	MS+BRASS
15	SupportBush	MS-ST-42
16	Bypass WithValve	1.5.-1239

3.3.5 **AirCushionValve**

Thevalveconsistsofa'MainBody'andTopHousing'.Onthesideofmainbody,two'Air Inlet Valves' loaded with a light spring are fitted. The 'Inlet' is protected by a cover. The 'Top Housing'hasanopening forairescape.Aspringloaded'Poppet'withabrasssealand Neoprene 'Sealing Ring' covers the top of the opening. The spring pressure on the valve is adjustablebyascrew(S.S.asper AISI-304).The'Housing'hasataperedoutlet,theopening of which is adjustableby a taperedplug and Screw (S.S. asper AISI-304).

Theoutletis protectedby acoveronits lowersideacageholding aball floatis fitted.'Main Body', 'Top Flange', are fabricated from M.S. (as per 1.5. 2062/1.5. 1239).The 'Top Housing' is made fromhigh gradecastiron. Main body, floatball and airinlet flangearehydraulically pressure tested. Stems of valves are in stainless steel (as per AISI-304), and work in 'Brass Bushes'.Sealingrings are of goodqualityrubberand seats are ofbrass.

The'Valve'willbepaintedin"BlackTarEnamelPaint' frominsideandoutside'.

3.3.6 **MaterialofConstruction**:

51. No.	Description	Material
1	AdjustableScrew	StainlessSteel
2	Spring (OutLet)	SpringSteel
3	PoppetSpindle	StainlessSteel
4	PoppetValveDisc	C.I.
5	Seal(OutLet)	NeopreneRubber
6	Seat(OutLet)	Brass
7	Cage	C.I.orM.S.
8	BallFloatWood	(RubberCoated)
9	TaperedOutlet	C.I.
10	TaperedPlug	Brass
11	Screw	StainlessSteel
12	OutletCover	C.IorM.S.
13	Seat ForBall	Brass
14	TopHousing	C.I.
15	MainBody	M.S.(Fabricated)
16	AirInletBody	M.S.(Fabricated)
17	Seat(Inlet)	Brass
18	Stem	StainlessSteel
19	Spring(Inlet)	SpringSteel
20	InletCover	M.S.(Fabricated)
21	InletDisc	C.I/M.S.
22	Seal(Inlet)	NeopreneRubber
23	MountingFlange	M.S.

3.4 FLOWMEASUREMENTDEVICES:

3.4.1 Scope:

ElectromagneticFlow Meter of appropriatesize shallbe installed at the end of themanifold to measure the quantity of water dischargedintothe Distribution Chamber.

3.4.2 ElectromagneticFullBoreTypeFlow Meter

Full bore electromagnetic flow meter shall consist of flow sensor (i.e. flow tube),flow transmitter and flow indicator and integrator and any other item required to complete the system. To avoid the effects of disturbancesin the velocityprofile, a straightand uninterrupted run,upstreamaswellasdownstreamfromthelocationoftheflow meter shallbeprovided,asrequiredbytheflowmetermanufacturerandinlinewiththe applicablestandards.Contractorshallfinalizetheexactlocationofflowmeterin consultation with Representative of Employer.

Flow measurement shall not be affected by physical properties of water viz., temperature, pressure turbidity etc., within given limits. Contractor shall provide compensating Electronic circuits,ifrequired.Fiow metershallbe installedasperOEMguideline&verifyaccuracy after installation by OEM.

A lockable enclosure shall be provided for theflow transmittercum computing unit,if required.

Flow metersshallbe suitableforthewaterturbidityatsiteduring variousseasons.Flow tubeshallberuggedin constructionand shallbe suitableforcontinuousoperation.Flow tubeshallhavewaterproofconstructionandshallbesuitableforinstallationon underground /above ground pipe lines.

The flow computerandtransmittershall bea single unit suitable forpanel mounting. Itshall accept inputsfrom flow tube, process the signals and shall provide an outputproportional to the flowrate. Thedistancebetween transmitterand flow tubeshallbe maximum250 mtrs. Taperpiecesrequiredforinstallationof flowmetershallnotexceedanangleof8"in order to avoid disturbance inflow profile.

a) General:

(i)	Accuracy of flow measurement during FAT	±0.5%of measuredvalue
(ii)	Overallaccuracyofflow measurement loop.	±1.0%ofmeasuredflow

b) Flowtube

(i)	Application:	Thewaterpumpingmains
(ii)	Type:	In line fullboreelectromagnetic
(iii)	Sizeofflowtube:	AsapprovedbytheEmployer.
(iv)	Processconnection:	Flanges as perBS4504
(v)	WeatherProtectionClass :	IP68asper IS13947
(vi)	Surgeprotectiondevices(SPD) betweenflowtubeandflowtransmitter:	Requiredforprotection fromlightningsurges
(vii)	MaterialofConstruction:	
	Electrodes :	SS316,selfcleaningpipe
	CoilHousing:	SS316,fullyweldedconstruction. /S.Sflow tubewith carbon steel coil housing
	Flanges:	Carbonsteel
	Groundingring:	SS316
(viii)	Flowtubelining:	ETFE/Neoprene/PTFE.

c) FlowTransmitterUnit

(i)	Type:	Microprocessorbasedwith facility to configure the ranges.
(ii)	Typeofdisplay:	4 digit backlit LCD/ LCD, for flow rate in m3/hr.8digit backlit LCD/LCDfortotalized flowin ML
(iii)	Unitsofdisplay:	Flow rate-m'/hr Totalized flow- ML
(iv)	Input:	Fromflow tube
(v)	Output:	4-20mADC(isolated) proportionalto flow rate

(vi) PowerSupply: 230VAC

(vii) ZeroandSpanAdjustment: Required

(viii) WeatherProtectionClass: IP68asperIS13947

(ix) Battery backupfortotalized flow

Type	Online
Capacity	2.5 mVA
BackupTime	8 hours.

(xi)Facilityforonlinediagnosis: Required

3.4.3 Calibration:

TheElectromagneticflowmetershallbe wetcalibratedforthefullflowrangespecifiedas per BS EN 29104 (Methods of evaluation of electromagnetic flow meters). The calibration method shall be either gravimetric method as per ISO 4185 (Measurement of fluid flow in closedconduits-weighingmethod)orvolumetricmethodasperISO8316(Calibrationby

Volumetric Method). TheContractorshallproduceaccreditationcertificatesfor the test facility and calibration certificate for the flow meter for the review by representative of the Employer.The Contractor shall also demonstrate complete wet calibration onthetest bed in the flowmeterlaboratory. The flowmetershallbe acceptableif the accuracyand repeatability is equal to or better than those specified.

3.4.4 FlowIndicatorandIntegrator

Flow indicator and integrators shall be modular in design. It shall consist of two separate dedicateddisplays for flowrate indication and total flowindication.It shallaccept4-20rnA DC isolated input. The flow integration shall be carried out in the Programmable Logic Controller(PLC). Theflowindicatorcumflowintegratorshallprovide4-20rnA retransmissionoutputproportional to flowrate.

51. No.	Details	Description
1	Type	Microprocessorbased
2	Mounting	FrontfaciaofControlPanel
3	Display	Digital,sevensegment backlitLCD/LEDdisplay
4	DigitHeight	14mmorHigher
5	No.of Digitsfor Flow indicator Flowintegrator	 4Digits 6Digits
6	Input	4-20rnADC(Isolated)fromflowtransmitterthrough analoguesignalmultiplier(ReferNote2)
7	Zeroandspan adjustment	Required
8	ManualResetFacility	Required(shallbepasswordprotected)

51. No.	Details	Description
	forflowintegrator	
9	Engineeringunits: -Flowrateindicator -Flowintegrator	 Cum/hr ML
10	Batterybackupfor integrator	Required
11	Retransmittedoutput	4-20rnAproportionaltoflowrate
12	Alarm outputs	1NO+1NCforhighandlowalarms(adjustable)
13	Communicationport	RS-485(WithModbusprotocol)forinterfacingwithPLC
14	WeatherProtection	ClassIP-52ofIS13947PartI
15	Accuracy	±0.25%ofspan orbetter.

Notes:

1. Digitalflowindicatorandflowintegratorshallbeacombinedunit.
2. Facilityshall be availableinthe analog signal multipliers and inthe flow indicator and integrator forproviding excitation voltagefor the flow transmitterincase of 2-wire flow transmitters.

3.4.5 AcceptablemakesforElectromagneticFlowmeters

Acceptable makesfor the ElectromagneticFlow meters shall beas per the approved vendor list. All the Electromagnetic Flow meters shall have the same make. Contractor should not place orderwithany othermanufacturerfortheabovesaiditem tillithas been recommended inwriting by employer for the makes listed above.

3.4.6 Installation

Theinstallationof theElectromagneticFlow metersshallbe doneat thelocationsdecided by theEngineer-in-Charge.The jobcoverssupplyof theElectromagnetic Flow metersat work site with cost of all the required material and all types of taxes and duties, cost of packing, loading,transportation,unloading, stacking and installation at the specified location with cost of alljointing materials such as nuts and bolts, EPDM rubber gaskets etc.The job alsocoversfieldhydraulictestingoftheElectromagnetic Flow metersafterinstallationfor the specified test pressure for the respective pipeline section.

3.5 PIPE,VALVES,FITTINGSOFAUXILLARYSYSTEM

3.5.1 CODE&STANDARDS

The design, manufacture, shops testing, erection testingand commissioning ofpipingandvalvesshallconformtothelatestrevisionsofapplicableIndian standards.

3.5.2 SCOPE

Theequipment&materialtobe suppliedforeachPumping stationunderthis section shall include but not be limited to the following.

Pipes, bends elbows, tees, branches laterals, crosses, reducing unions, couplings, cap, expansion joints, flanges, blank flanges, saddles, shoes, sampling connections etc. necessary for making a reliable pipingsystem.

Gaskets, ringjoint,bracing rings,jointingmaterial etc.as required.

Instrument tapping connection, stub and thermo wells.

Supply and machining workof flanges,pipe spools and matching pipes to conned flow measuringorifice nozzles etc., pressure accumulators as necessary.

Valvetostartstopandregulateflow.

Strainers

Anchorblock (for buried/ over ground piping), support brackets, clamps, supports etc. for the piping

Bolts, nuts, fastenersas required forinterconnectingpiping, valvesand fitting as wellas for terminalpoint.

Secondary steel for pipe supports and embedded steel. Also pipe supports and necessary embedmentrequiredtobeembeddedinconcreteforunder ground/above groundpipe.

Paintinganti-corrosivecoatings,etc.insideandoutsideofpipesasnecessary.

All embedded parts required for all tanks, water-retaining structures made of RCC including puddle pipes shall besupplied bythe contractor.

3.5.3 DESIGN,CONSTRUCTIONANDERECTION

Piping{General)

Materialofconstructionforpipescarryingvariousfluidsshallasbelow:

51. No	**Service**	**RecommendedMaterial**
1.	FilteredWater	CarbonSteel/GRP
2.	AcidicWater	RubberlinedSteel
3.	Acid(hydrochloric)	RubberlinedSteel
4.	Alkali(SodiumHydroxide)	
	a.Strong(5%to50%)	Stainless'Steel
	b.Dilute	Rubberlined steel/Stainlesssteel
5.	WasteeffluentfromOMPlant vessels &chemicalsolution tank's etc.	HDPE/RubberlinedSteel

3.5.4 Pipelinescarryingwater,chemicals,airetc.,shallbesizedonthefollowing velocities.

		Velocityinm/sec.		
	PumpSize	**Below50mm**	**50-l00mm**	**200mm&above**
a)	Pumpsuction	-	1.2-1.5	1.2-1.8
b)	Pumpdischarge	1.2-1.8	1.8-2.4	2.1-2.5
c)	Header		1.5-2.4	2.1-2.4

Pipe line under gravity flow shall berestricted to a flow velocity of $1m/sec$generally. Channels under gravity flow shall be sized for a flow velocityinthe range of 0.6 ml sec.(maximum).

Material&Dimensional"Standardsforpiping

All piping system shall be capable of withstanding the maximum pressure and temperature inthe corresponding line.

The steel pipes (welded type)for the servicesof water/clarified - water/Filtered water shall conform to the following standard or codes.

1. Pipesupto150NB
   a) IS:1239Part-1 (Heavygrade-Black)
   b) ASTM-A53GradeBWelded),such80upto2inchnominalsize
2. Pipes200NBandabove
   a) IS:3589-Grade410
   b) ASTM-A53GradeB(welded)-Sch.40

If pipes are manufactured from steel plates, the plates shall conform to IS: 2062, B grade. The thickness shall be as per the pressures to be handled but should not be less than 8 mm.

Pipestobeusedfortherubber-linedconstructionshallconformtheaboveclause 3.02.02 and Inside surface shall be completely de beaded and made suitable for lining.

various fittings to be used in the piping shall conform to the IS/BS/ANSI Standards and In conformity with the parent pipe standard.

3.5.5 DesignofPipingSystems

Forwater, air andother services where steel pipesare used,joints ofthis size range shall be screwed/flangedtype;

All unlined steel pipes 65 NBand above (other than .CIpipesandair service pipes) shall bejointedby butt welding.

All rubber lined pipesshall haveflanged joints.Miter bends shall not be used· on RL piping. Only forged fittings shall be used.

Steel pipeflanges shall begenerally sliponor raisedface type.Welded neckflanges shall be used when flange follows immediately after a butt-welding or where it is required with respect to service conditions. When weld neck or socket weld flanges are used, their bore must be made the same as that of the pipe being welded to Socketweldedor threadedflangesmaybeused, withtheappropriatepiping system for connection of pipe to the flanged equipment

AllthepipingflangesandcounterflangesshallconformtoANSIB16.5Cl.150.

For easy handling &removalof equipments, valves etc. and for maintenance purpose, break up flanges for 65 'NB and above sizes and suitable type of compression flexible coupling for flanged joints of 50 NB and below size shall be provided. The overgrown piping,wherever routed inside building, shall have a clear head room of minimum2.1meter fromoperating floor.

Buried piping shallbe generallyinstalled so that the top of pipe is 1.0meterbelow the ground level unless otherwise specifically mentioned.

Complete supporting system for the pipe line shall be designed, fabricated and suppliedbytheBidder.Insidethebuilding,theoverheadportionofthepipeline

may be supported from the building structures. No support shall betaken from the brick wall. Outdoor, pipes other than buried pipesshall run on steel trestles.Crossing of the road shall be on a pipe bridge with a clear height to at least 6.1 metersovertheroadsurface.Allthesteelstructuresforthepipebridge,andthe

supporting posts / trestles along with all necessary hangers clamps, connecting steel,fixing bolts, nuts etc., shall besuppliedand erectedbythe Bidder.

Miter bendswill not beaccepted for steel pipesof 250 NBand below. For sizes 300 and above, the miter bends shall conform to BS: 534.

For rubber lined pipe, lining should be applied in two (2) layers, giving a total thickness not less than 3 mm.

3.5.6 Paintingandapplicationproceduresshallbeasfollows:

a) Surface to be painted shall be thoroughly cleaned of loose mill scale, rust etc, by wirebrushing.

b) For over ground exposed steel pipes, two coats of red oxide primer (zinc chromate). primer shall be applied on the cleaned surface. There after minimumtwo(2) coats ofsyntheticenamelpaint ofapprovedcolourshall be applied on the same to total dry film thickness of not less than 200 microns.

c) The protective coatingof buried pipe shall consist of coal tar primer2coast· and 2wraps of coaltar enamel andglass fiber inner wrap followed byglass fibberor coal tarimpregnatedkraft paper outerwrap.Min. thicknessfor each layer of application shall beas per IS:10221,andthe totalthickness of the completed coating shall not be less than 3.2 mm.

3.5.7 VALVESANDSTRAINERS

Valveswillbeused tostart/stop&controlflow.

All valves shall besuitable for service conditions i.e.flow temperatureand pressure under which they are required.

ValvesinClarifiedFilteredwater application

Either Butterflytype or sluice/ gate valves shall be usedfor isolation purposes.

Sluice/gatevalveshallconform toIS: 780 & IS: 2906 ofrating PN 1.0 (min). Stem, body,- seat ringandwedge facingringshall· beofstainless steelconstruction. Other partsshallbeasper IS:780.Flangesshall bedesigned asperANSI B16.5Cl.150.to meet with the pipingflanges. Valves shall beof outside screw and risingstem type.

Sluice/Gate valves shall be provided with thefollowing accessoriesinaddition tothe standard items.

a) Handwheel

b) ManualGear reduction unitoperator forvalves200 NBandabove.

c) Bypassvalvesforvalvesofsizes350NBandabove.

d) Drainingarrangementwhereverrequired.

e) Arrowindicatingflowdirection

f) Positionindicator

Sluice/GateValvesshallbeprovidedwithbackseatingbushtofacilitategland renewal during full open condition.

Butterfly valves shall be of double flangedor lugged wafer type of low leakage rate confirming toAWWA-C-504class 150orBS: 5155 Class 150.

Thevariouscomponentsofbutterflyvalvesshallbeofthefollowing:

i)	Body	:	CastIron-ASTMA48Cl.40;BS:1452Gr.220SG Iron-BS:2789
Iii)	Disc	: : :	CastSteel-ASTMA216GR.WCB;85:1504Eq.Gr. CastIron-ASTMA48Cl.40:BS1452,Gr.220SGIron-8S 2789. CastSteel-ASTMA216Gr.WCB: 8S:1504Eq.Gr.
iii)	Shaft	:	ASTMA296Gr.CF8M/AISI316:AISI420:BS970Gr. 316;BS970Gr.420
iv)	Seat rings	:	Nitrilerubber, EPDM(Ethylenepropylenerubber), Hypalon

Butterflyvalves shall befitted w1th sleeve type bearmgsuch as PTEF.Valves of 350 NB and above shall be provided with one or two thrust bearings to hold the disc securely in the of valve seat withouthydraulic or external axial shaftloads. Sleeve andotherbearingsfittedinto thevalvesbody shallbe ofselflubricatedmaterials that donot haveany affect onthefluid handledandother components ofthe valves.

All the butterfly valves shall be provided with Hand wheel or level as per the requirements. For larger sizes i.e. 150 NB and above hand wheel shall be provided. For level/wrench operated valves, means shall be provided for positively holdingthe disc in not lessthan three intermediate positions. Manually operated valves shall be providedwithreductiongearunit forvalvesofsize200NBand above.Valve provided with motorized pneumatic actuator shall be with a hand wheel for manual operation. All the valves shall be equipped with adjustable mechanical stop-limiting devices to prevent over travel of the valve disc inthe pen and closed positions. The valve operators (Hand wheel Gear reduction unit motor actuator etc. shall be designed as per relevant International Standard.

Allthebutterflyvalvesshallbeprovidedwithanindicatortoshowthepositionof the disc. Flanges shall conform to ANSI B 16.5 Cl. Conforming to the following technicalspecifications.

a) BallValves

i) DesignStandard BS:5351Class150

ii) Type:Welded/Flangedends; Fullbore;Shlit Body &Seat supported construction

A.MaterialofConstruction

Body	CarbonSteel/CastIron
Ball	StainlesssteelANSI420
Seatring	PTFE
Stem	StainlesssteelAISI420
Seats	Nitrilerubber;PTFE.

iv) Valvesshallbedesignedtobedirectlyoperablebyawrench/Handlever.

v) Suitablestopsbeprovidedforboththefullyopen&closecondition.

vi) All the valves shall be provided with an indicator for showing the position of thespindle.

b) GlobeValve

i) DesignStandard IS:778Class-1

ii) Type:Straight,risingstem,withoutsidescrew

iii) Materialofconstruction

1. Body,Bonnet,stuffing Box&:LeadedTin Bronzeconformingseatrings/Disc IS:318Gr.
2. Stem :StainlessSteel,AISI-316
3. Disc :15:318Gr.2/AISI-316

i) Backseatshallbeprovidedonthestemoronthedisc.

B. Renewablediscassemblyshallconsistofdisc holder,disc,discguide,Check nut and disc retaining nut with washer.

C. Discofglobevalvemaybeprovidedwithrenewablerubberseatingring.

iii) Handy wheels shallbe marked with the word:'OPEN'or 'SHUT'with arrow to indicate direction of opening or closing.

Thevalvesshallconformtothefollowingrequirements:

i)	DesignStandard	:	IS780/IS:2906ratingPN1.0orEquipment
ii)	Type	:	Double Flanged or waferbody,outsidescrewand rising stem type
iii)	Material Construction Body	: :	 Cast Iron:15:210Gr.FG.260
	Stem	:	StainlessSteelAISI420
	Disc	:	CastIron 15:210Gr.FG260

Thevalvesshallconformtothefollowingspecifications.

i)	Design	:	IS:5312,BS:1868,BS:5153orEqvt.
ii)	Type	:	SwingcheckTypeandFlangedends.
iii)	Materialof Construction(Fornoncorrosiveapplication)		
a)	Body&CoverHingedisk/door	:	CastironIS:210Gr.FG260/orCast IronBS:1452Gr.220orEqvt.
b)	HingePinandDoor/Disc.Pin		CaststeelASTMA216Gr.WCB
c)	Discfacing ring		Stainlesssteel
d)	BodySeatedring		Stainlesssteel
e)	BearingBushes		LeadedTinBronze:IS:318Gr.2
f)	Bolts		CarbonSteel

Flangesshallconformto ANSIB 16.5 Cl.150tomatch withthepiping flangesas specified elsewhere.

Bodyshallbepermanentlymarkedwithan"arrow"Indicatingthedirectionof motion of the fluid for all the check valves.

Checkvalvesforclarified/filteredwatermaybeofferedinGunmetalconstruction &withthreadedendsforsizes50NBandbelowconformingto15:778or Equipment.

3.5.8 **Strainers**

a. BasketStrainers

b. Basketstrainersofsimplesdesignshallhavethefollowingmaterialsof construction of raw/ clarified/ filtered water.

Body:Fabricatedmildsteel:IS:226(Testedquality)Wireshallbestainlesssteel {AISI:31618BWG30mesh suitablereinforced.Reinforcementmaterial shall alsobeofstainless steelconstruction.

Drain plug/Nuts: Gunmetal;

c. Insideof basket bodyshall beprotectedwith onecoat or redleadprimer and minimum three coats of chlorinatedrubber paints to a Total thickness of 200 microns.

d. SuitableVentanddrainvalvesshallbeprovidedforthestrainers.

e. Screen (strainer) flow areshallbealeastfourtimes pipesectional area.Flow area inanyportionofBasketstrainer assemblyshallnotbelessthanthepipe crosssectional area.

f. Pressuredropincleanconditionshallnotbemorethan1.0MWC.

g. Basket Strainer shall be provided with lifting lugs and suitable mounting arrangement.

h. ForOMwaterservice.bodyshallberubberlinedtominimum4.5mmthickness (softrubberofshore Hardness85±5"A).

3.5.9 Y-TypeStrainer

a) Y-Type strainer for water application shall be constructed of following materials:

Body CastIron15:210Gr:FG260

Strainers:Wires, of stainless steel AISI - 316. 18BWG 30 mesh suitably reinforced. Reinforcement material shall also be of stainless steel construction.

DrainPlug/Nuts:Gunmetal(threadedconstruction).

b) Y-Typestrainersshallalsoconformto Cl.4.-9.01{b),{d),(e),end (t).

c) BodyoftheY-typestrainersforalkali,anddematerializedwatershallbeof CastIron {IS: 210. Gr. FG 260) andlined with soft or hard rubber to a thickness of.3 mm.

D) For acid services, apart form the rubber lined body material, the screen material,shall be polypropylene or HOPEwire cloth of suitable mesh and thickness.

3.5.10 TESTFORPIPING,VALVES&FITTINGS

A) Piping&Fittings

i) Pipeshallbehydraulicallytestedasperrelevantstandards

ii) Pipe whichare.to beofinternalbeadremovedqualityandsubjectedto pressuretestafter basedremovalbutbeforerubbinglining.

iii) Allrubberliningistobesubjectedtothefollowingtestasper IS:4682Part-1

a) Adhesiontestb)BleedingTestc)Thicknessoflining d)Shoreharnesse) Sparktest5KV/mmoflining f)Ageingtestonthesamplesofrubbersheets shallbeoneasperASTM-D471,part37beforelining g)visualinspection.

Valves/Gages/Strainers

Allthevalvesshallbehydraulicallytestedforthebodyandtestleaktestas per relevant standard. For rubber lined valves, body shallbe subject to hydro test before rubber lining.

Backseatleakagetestshallbedonewhereverapplicable.

SeatAir leakagetestakg/cm2shallbecarriedoutwherever applicableasper relevantstandards.

iv) Elastomers wherever coated or linedfor thevalves shall betested for the corrosionresistanceagainstthemediumforwhichthoseareselectedasper relevant Standard and the test certificates shall be furnished for the Owner's approval.

v) RubberliningonvalvesGatesStrainersshallbecheckedinaccordancewith IS:4682Part-1includingalltestsasindicatedaboveforpiping&fittings.

vi) Strainer shall be hydraulically tested for its strength. The pressure drop across the strainer assembly shall be verified at design flow for clean condition for eachtype and size. Ifalready conducted for each size! type, testcertificatesmaybeproducedofOwner'sreviewandapproval.

3.5.11 TESTATSITE

a) All piping,valves, Gates, resin traps, strainers and other fittings after erection at site shallbetestedtohydraulictestpressureoftwotimestheoperatingpressureor1.5times themaximumallowablepressurewhicheverishigherforaperiodofonehour.

b) All valves (Manual/ Automatic) shall be operated throughout 100% of the travel manually and as well as from control panel and these should function without any troublewhatsoever.

N.B:- All the above specifications and material of construction are for guidelines. However the EPC contractor can propose for any new or combination type for approval by the CE, Megalift which should satisfy the relevant IS code or international code mentioned in the above Guidelines.

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SECTION-VII

POWERSYSTEMCONNECTIVITY

IMPORTANTINSTUCTIONTOBIDDERS

- **This Section comprises of two parts:**
  - **A. Technical Specification on construction of over head lines (Sub-transmission, HT & LT) and Construction Practices for MSDSS and DSS.**
  - **B. Technical Specifications for supply of equipments & materials & respective Guaranteed Technical Particulars (GTP).**
- **Above shall be read in conjunction with Technical Specification Volume-II, SectionII A "survey & Investigation, Planning, Design and Drawing" as they are integral parts of Technical Specification.**
- **Bidders are advised to follow Bureau of Indian standards, REC construction standards, approved manufacture specifications & other relevant manuals and construction standards that complies with relevant Regulations of CEA/CERC/ OERC, for those items not provided specifically in this document, but required for EPC mode completion of Sub-Stations and associated Sub-Transmission, HT & LTlines.**
- **SLD for system networking, drawings & physical scopes where ever mentioned in the Bid document give indicative scope of work. Drawings are complementary to specifications and shall be referred to for better understanding as well as for estimation of quantities for arising at lump sum bid price on EPC mode. System connectivity & related equipments are on EPC mode. The successful biddershall be liable to abide by the specific requirements of DoWR at detailing stage with no financial liability to Owner.**
- **Bidders shall comply with the submittal list & duly fill up the required formats in complete shape including GTPs. For Bid purpose, only GTPs of important system elements like Power Transformers 33/6.9 KV (rating 630 KVA & 1.6 MVA), Distribution transformers (rating 100 KVA & 315 KVA), 33 KV Vacuum Circuit breakers, Conductors (AAAC) shall be submitted along with Technical Bid.**
- **Bidders are advised to ensure that all documents/ drawings are legible copies & drawings should be of size not less than A3.**
- **Non compliance with any of listed submittals or incomplete submittals shall be treated as "Non-responsive" Bid.**

[Conventions:The following conventions are used throughoutthisdocument;

a) Theword"shall"donateamandatoryrequirement.

b) Italicsareusedtoindicatetitlesofactsorpublication.]

A. CONSTRUCTION OF 33KVSUB-TRANSMISSION AND 6.6KV,LTSUB-SYSTEM

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6	GENERALPARTICULARSOFSYSTEM	
7	OWNERSSTUDY	
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	FORMATS:	
	ESC-1**(**DETAILSOF33KVFEEDERSEMANATINGFROMEHVGRID SUB-STATIONS)	
	ESC–2(DETAILSOFPROPOSEDPRIMARY33/6.6KV(MSDSS)AND 33/0.433 KV SUBSTATIONS AND HT FEEDERS (6.6 KV) EMINATINGFROMTHESESUBSTATIONS)	
	ESC–3**[**AGUMENTATIONOFCONDUCTORSIZEOFEXISTING33KV FEEDERS (PROPOSED UNDER THE SCHEME)]	
	ESC–4(DEVIATION SCHEDULE)	
9	CHAPTER–1SPECIFICATIONFORCONSTRUCTIONOFOVERHEADLINE A. (Sub-Transmission&HT). B. LT.	
10	CHAPTER–2 CONSTRUCTIONPRACTICEFOR33/6.6KVSUB-STATION (MSDSS).	
11	CHAPTER–3 SPECIFICATIONSFORDSS(TRANSFORMERCAPACITYUP TO&BELOW250KVA)ONDOUBLEPOLE STRUCTURE.	

1.0BroadScope: Scopeincludesbutisnotlimitedto;

Planning,Design,Testing,Supply,Erection&Commissioningof:

a. **Main Step-Down Distribution Sub-Station (MSDSS) [33/6.6 kV in relation to the projected load, voltage regulation & shall meet the basic requirements indicated in the attachedsingle Line Diagram (SLD)]**
b. **Lay-out of above outdoorswitchyard.**
c. **33 kV Sub-Transmission networking/ System Connectivity with identified EHT Grid Sub-Stations and/or identified DISCOMs network topology as shown in attached SLD.**
d. **HTLine(6.6kV)andLToverheadlines.**
e. **Distribution sub-stations DSS (6.6/0.433 kV, 33/0.433 kV) as per the requirements, including conductor/cable and supporting structures.**
f. **Metering,Protection&controlfor33kV,6.6kV&LVsystems.**
g. **Earthingsystem&earthmatdesign**

2.0Project Information:-

- 'Project Synopsis' [enclosed with volume-1] provides details of the project with their Identification Number (ID).
- Each project and/or pool of projects needs physical connectivity with thedistributionnetworksofconcernedareadistributionlicensee,toeffectpowersupply in terms of the provisions contained under*'ODISHA ELECTRICITY REGULATORY COMMISSION DISTRIBUTION (CONDITIONS OF SUPPLY) CODE, 2004'*.
- Odisha Power Sector is characterized by (i) four area Distribution Licensees, namely CESU, NESCO, WESCO & SOUTHCO (ii) State Transmission Utility, OPTCL and (iii) GRIDCO, the Intra State Trader, the sole bulk supplier of power to DISCOMs in Odisha.
- To meet the additional projected load on account of Mega Lift Projects, physical assessment of System augmentations at EHT level has been worked out & funds placed with OPTCL for execution. Augmentation covers up-rating of Power Transformers, installation of 3rd Transformer with associated 132kV bays and 33 kV feeder bays for the projects. Thus EHT back up for power supply to Mega- Lift Project rests with OPTCL (Transmission Utility).
- The project conceives connectivity at voltage level at 33 kV. Thus connectivity maybe a direct interfacewithTransmissionUtility'sGridSub-stationsorinter-connection with DISCOM's 33 kV network to be decided as per techno-economic analysis. Project, where dedicated Grid connectivity would not be feasible or not cost effective, solution like connectivity with local distribution 33 KV systems, may be considered, subject to technical feasibility. General practices adopted by concerned area distribution licensee (DISCOM) will be taken in to consideration so that infrastructure developed is compatible to their system.
- Intervening 33kV dedicated new lines linking nearest/identified Grid Sub-station & Point of supply of the beneficiaries [here 33/6.6 kV Main Distribution Sub-Station (MSDSS) and/ or DSS (33/.433 KV) to feed MLIPs] and other 33kV new lines, thatmay be required for integrating beneficiary's installation with DISCOM's existingand/ or ongoing (schemes like CAPEX Program/ ODSSP etc.) infrastructures, will be part of the bidder's scope.
- 33 KV new feeder bay, if any required at DISCOM's 33/11 KV existing and/ or ongoing schemes for power supply to the project including augmentation (up rating of conductors) / rehabilitations (replacement of missing/damaged structures,

anymissingaccessoriesetc.)ofexistingsub-transmissionsystemshallbeassignedto DISCOM..

- 33kV infrastructure, so developed, will be handed over to area distribution Licensee for Operation & maintenance, with effect from *"date of commencement of supply"*. Modalities for handing over for O&M shall be decided by DoWR.
- Downstream electrical composite unit including 33/6.6 kV Main Step down Distribution Sub-Station (MSDSS) , Distribution S/S (6.6/.433 kV) and/ or(33/0.433 kV), apparatus (indoor, outdoor), 6.6 kV & LV lines, electrical motors, and underground cables,erected and wired by or on behalf of beneficiary, shall be termed as *"consumer installation".* Planning, design, testing, supply, erection & commissioning of all related *"Consumer Installation"* shall be part of the bidder's scope including operation & maintenance of the installation for a specified period as detailed in the bid document. .
- DISCLAIMER: This Document includes statements, which reflect variousassumptions.EachBiddershouldconductitsownestimationandanalysisandshoul d checktheaccuracy,reliabilityandcompletenessoftheinformationinthisDocument and obtain independent advice from appropriate sources in their own interest. DoWR will have no liability whatsoever to any Bidder or any other person under the law or contract, the principle of restitution or unjust enrichment or otherwise forany loss, expense or damage whatsoever which may arise from or be incurred or suffered in connection with anything contained in this Documents and mater deemed to form part of this document.

  Though adequate care has been take while issuing the Bid document, the Bidder should satisfy itself that documents are complete in all respects. **Intimation for any discrepancy shall be given to this DoWR immediately.**

3.0ScopeofProposal:-

Scope of proposal shall be on the basis of single bidder's responsibility, completely on **EPC mode**, covering supply, erection, testing & commissioning of all equipments and new OH (33 KV & 11 KV) line as specified under the accompanying Technical Specifications/ SLD including other services. It would include the followings;

- Planning&developmentofsuitablesystemconnectivity: -Networkplanningshallbe through consultation process with DISCOMs and STU (OPTCL). Owner's indicative network enclosed in the Bid document is based on interaction/ consent with concerned DISCOMs & STU (OPTCL). Any modification to SLD needs to pass through similarprocessandapproval.Networkplanningshallbedulysupportedby

appropriatecomputeraidednetworkanalysisthroughsoftwarepackage,preferably with Mi-Power package (being used by OPTCL). System impact study (LFA) by the EPC contactor shall be submitted to OPTCL for their review.

EPC developer shall provide Block diagramfor Systemconnectivitybothfor33KV & 6.6 KV based an SLD (as agreed in the Joint meeting of OPTCL/GRIDCO/DISCOMs & PMU (Mega Lift).

- Preliminary route survey, finalization of route alignment, detailed survey, structure (tower/pole) spotting, geo-technical investigation, optimization of structurelocation and check survey of Line, substation and preparation of SLD/BOQ;
- Design, selection and installation of foundation for structures, poles for single/double circuit over head line.
- The design, testing, supply and erecting of33kV, HT (11 KV linesto be charged at6.6 KV) andassociatedLT lines with single/double circuit support structures [lowbased tower structure/M.S rail pole/ GI RS Joist/ H poles/PSC poles (for lines other than 33 KV line)], associated cross arms, nuts, bolts & washers, D-shackles, support stays and accessories like danger plates, anti-climbing devices, structure identification plate and earthing devices;
- Supply ofsupports, conductors, insulators, insulator hardware, earth wire, joints, clamps for conductors, earth wire clamps and accessories including stringing;
- Design, manufacture, supply, erecting and stringing of special structures/towers including design and constructionof foundations forcrossings like Railways,Rivers, power lines etc;
- Theslackspanconnectionsofconductorsfromterminalstructurestothesub-station gantry structure at Transmission and/or Distribution licensees interface (i.e. point of supply).
- Planning, design, testing, supply, erection & commissioning of MSDSS (33/6.6 kV), Distribution sub-stations (6.6 /0.433 kV and/or 33/0.433 kV) and all related *"Consumer Installation"* and operation & maintenance of the installation for a specified period as detailed in the bid document.
- Providing Engineering drawing, data including calculation sheets (both hard and soft copies in XL form), operational manual, etc for Owner's approval.
- Relevant drawings pertaining to safety aspect (General Lay-out with important elevations&sectionalviewsofMSDSS/DSSincludingSLD,Earthingdetails,OHLines including important crossings, shall be approved by statutory Authority, prior tofield executions.

- Gettingtherelevantdrawingsforthesubstationsandlinesapprovedbefore execution & installation inspected after completion of work by Electrical Inspector.
- O&Mofsubstation/installationforspecifiedperiodasdetailedinBiddocument.
- Supplyoftestinginstruments&maintenancekitforcarryingouttestingand measurement at MSDSS & DSS for O&M purposes.
- Supplyofcontingencyreservestocksforsystemelements,Transformer,Transformer oil, CBs, Insulators, Supports/ conductor, conductor hardware, Cables for O&M.

4.0 SYSTEMCONDITIONS(DesignParameters):

The equipments/lines to be installed for altitude up to 1000 m above MSL shall becompatible to the system characteristics:

i) SystemParametersforHVSystemshallbeasflows:

Parameter	33kV	6.6kV
RatedSystemFrequency(HZ)	50	50
NominalSystemVoltage(kV)	33	6.6
MaximumSystemVoltage(kV)	36	7.2
ThreePhasesymmetricalshortcircuit rating for switch gear (KA)	25	25
Durationofshortcircuitfaultcurrent (Second)	3	
Dynamicshortcircuitcurrentrating(KA_P)	62.5	62.5 (Rated making current=1.8*√2*rated short circuit breaking current)
InsulationLevel:		
1.2/50µsImpulsewithstand(kV_{peak})	170	60
Powerfrequencyoneminute withstandindrycondition(kV_{rms})	70	20
Designambienttemperature(^0C)	50	
WindPressure	AsperIS802(Part.I/ Sec.I)	
Systemearthing	Solidlyearthed	Solidlyearthed

ii) SystemparametersforLTsystemshallbeasfollows:

Nominalsystemvoltage (V)	415
Highestsystemvoltage (V)	433
Voltagevariation (%)	± 10%
Frequencyvariation(%)	+3to-5%
MaximumSystemfaultlevel (KA)	50(for1sec)
Systemearthing	Solidlygrounded

5.0 SYSTEMCONNECTIVITY:

- System networking shouldbe planned & developedsuitably, that shall be capable of providing reliable, economic and efficient power supply in terms of the provisions contained under ***CEA (Technical Standards for connectivity to Grid) Regulations 2007, CEA (Technical standard for construction of plant and lines) Regulations, 2010, CEA (Measures relating to safety and Electric Supply) Regulations, 2010, OdishaGridCodeand"DistributionSystemPlanningAndSecurity Standards,Operating standards –1999" or its latest amendments, if any****issued by OERC, **ODSSP** Technical specifications, Document andtheir relevant drawings, **CBIP** Manuals, **IEEE/IEC/IS**.*
- Independent 33 kV feeder from nearby EHT Grid Substation shall be provided for loads of5 MVA and above.Service area foreach MSDSS (33/6.6kV sub-station) shall be identified by pooling a set of nearby Project and such sub-distribution station can be fed by independent 33kV feeder from nearby EHT Grid Sub-stations in an integrated manner, with an overall objective of quality, reliability in supply & reducing 33 kV inventory. Such schemes should be based on Techno-economic study/ analysis.
- Schemes, where dedicated Grid connectivity would not be feasible or not cost effective, solution like connectivity with local distribution 33 KV systems, may be considered, subject to technical feasibility by concerned area distributor (DISCOM).
- For isolated Schemes (that are out of above supply zone of MSDSS) may be fed by spur lines to be extended from existing/ ongoing (CAPEX Program/ ODSSP) 33 kV infrastructure of distribution licensee, subject to permissible ***KVA-KM Loading.***
- 6.6 kV sub-distribution networks shall either over head or by cable & preferably in ring configuration.
- 6.6KVoverheadlineshallbe11kVdesignedline.
- Comprehensive Sub-Transmission Planning & 6.6 kV distributions networking along with methodology, assumptions, ***load flow study*** and analysis thereof need to be submitted to OPTCL & for approval by DoWR**.**
- Earthing design (Earth mate) with relevant studies for MSDSS/DSS need to be submitted for approval.

6.0GeneralparticularsofSystem:

Substation Philosophy:

- MSDSS:33KVsidewillbeAIS(outdoor)&indoorswitchgearpanelsforboth33& 6.6KV systems.

- Vacuum type circuit breakers shall be used for voltage level of 33 KV and below[i.e.Outdoor type with its GI Supporting structure & indoor control panel for 33 KV& indoor type for voltage 6.6 KV].
- It will have at least two power transformers of adequate capacity to meet the projectedloadandoperateat80%oftheirratedcapacity.Stationsupply (LVsystem) will be from a station transformer connected to 33 KV systems.
  - CapacitiesofPowerTransformersshallbeselectedasperthefollowingguidelines:
    - MD of the project shall be calculated as per the guidelines given in clause 9.1.2ofSection-V-B,Vol-II.
    - Diversity factor of 1.0 shall be used on summation of MDs of Project to be fed from MSDSS& efficiency of transformer shall be as per the data from the manufacture (GTP data sheet).
    - There shall be at least two transformers that shall be able to operate in parallel operation&beselectedfromstandardratingsof630KVA,1MVA,1.6MVA, 3.15MVA&5MVA.
    - Loadingoftransformershallnotexceed80%ofratedcapacity.
- DSS (33/.433 KV): 33 KV side will be AIS & indoor switchgear panels for both 33 KV & LT systems. It will have at least two distribution transformers of adequate capacity to meet the projected load and shall sustain the starting impact of largest LV motor. The 33/.433 KV distribution transformers shall normally have standard ratingof100,160,200,315,400,500,630,1000,1250,1600,2000or2500KVA depending on requirement and shall be mandatory BIS certification (minimum of Energy efficiency level 2) complying to IS 1180(Part-1):2014.
- DSS (6.6/.433 KV): Location of DSS is preferred to be within 6.0 KM radius with stipulation to satisfy permissible KVA-KM for AAAC 100^{2}mm.6.6 KV side will be AIS & indoor switchgear panels for both 6.6 KV & LT systems. It will have at least two distribution transformers of adequate capacity to meet the projected load and reserve capacity to sustain the starting impact of largest LV motor. Distribution transformersshallnormallyhavestandardratingof100,160,200,250,315,400, 500, 630, 1000, 1250, 1600 KVA depending on requirement and shall be mandatory BIS certification (minimum of Energy efficiency level 2) complying to IS 1180 (Part-1):2014.
- In case of contingency failure in or any transformers load interrupted shall not exceed 20% of the total demand on the substation. This shall be applicable to MSDSS/DSS. There would be at least one station transformer to meet the auxiliary load of MSDSS (33/6.6 KV).
- Formation level for Substation shall be at minimum 1.0 m above HFL. Adequate provisionsinlayoutshallbemadeforprotectionofmaincontrolroomagainst

flooding & shall be located at floor higher than that of main Pump- motor floor. DSS shall be either a ground AIS or on raised concrete platform, close to pumping station & well writhen permissible KVA-KM for conductor used for voltage grade of 33 KV/6.6 KV/LV system. DSS shall be easily approachable in all the seasons.

- Bay lay out& structural part for MSDSS/DSSshall be in lines with ODSSPstructural model and control room should be in lines with existing arrangements of Mega Lift Projects & approved by PMU.
- Solar roof top shall be installed for both MSDSS and Pump-site to meet the emergency load/street lights with change over mechanism to main supply in case of battery are not charged.

LinePhilosophy:

- 33 KV Lines may be single circuit and/or double circuit based on site requirements & as per the present practices adopted by respective DISCOM. Connectivity shall be from the identified EHT Substation and/or from identified 33 KV DISCOM network as per the attached SLD.
- Lines shall be designed/constructed with due consideration the area wind pressure zone & as per the general practices adopted by concerned area distributionlicensee(DISCOM)sothatinfrastructuredevelopediscompatibleto their system.
- 33 KV lines will be Low based tower structure / GI RS Joist as per the practices adopted under DISCOM (under ODSSP).
- 11KV out going lines (to be charged at 6.6 KV) will bewith 10 mtr (300 Kg type) PSC poles for pin points up to 100 Deviation, 10 mtr PSC Pole with guywire for more than100but up to 600 deviationand DP structure using GI RS Joist for deviation of more than 600 up to 900.
- 33 KV trunk lines with be with 148 sq mm or 232 sq mm (AAAC) and 11 kV lines with 100 sq mm AAAC. Sizing of conductors will be based on findings of LFA.
- Relevant drawings shall be submitted to respective DISCOM for their views & vetting by Electrical Inspector.

7.0OwnersStudy:

The Owner has developed an indicative system networking (enclosed) based on cited objectives & in consultation with State Transmission Utility (OPTCL)/GRIDCO & Concerned area DISCOM.Developer may like to submit at bid stage, any other, networking schemewith duly supported system studies ***(Load flow analysis)***, that ensures improvement on savings in technical loss & maintain permissible VR [Owner's Comfort zone for 33 kV < (-)7%]. Physical projections, if any, mentioned under Owner's studies are indicative only.

7.1 over view of Sub transmission and Distribution Planning: Methodology, theplanning criteria and guide lines that are used in planning and design of integrated systemconnectivity has been out lined in brief but not limited to;

A. Planningstandard&criteria:

1) *Planning standard & criteria as specified in OERC Distribution Planning Standard & security Standard.*

2) *Over all approach to system planning is based on risk based deterministic approach: under which all the load cannot be supplied with a network element out of service (hence N-1 criteria are not met) but with due regard to acceptable degree of adequacy and security.*

3) *Riskbasednetworkplanningaimstostrikeaneconomicbalancebetween;*

   - *Costofprovidingadditionalnetworkcapacitytoremoveanyconstraintand*
   - *Potentialcost andother impacts that maybeassociatedwithlow probability events*

4) *Augmentation criteria that would cover network augmentation and non-network alternatives to augmentation which take account to minimizes distribution losses & maintain voltage at permissible limit.*

B. Sub-StationPlanningCriteria:

5) *Primary 33 KV sub-station (Less than 10 MVA) shall comply with Para 4.3.2.3 of DISTRIBUTIONSYSTEMPLANNINGANDSECURITYSTANDARDS,*
   OPERATING STANDARDS, issued by OERC; The layout shall generally conform to relevant Construction Standards of Rural Electrification Corporation Ltd / any other improved standards and provisions in Indian Electricity Rules, 1956 subject to the requirements mentioned in sub paragraph (a) below.

   a. *Thelayoutadoptedshallincludethefollowing:*

- *GroupcircuitBreakercontrolofTransformers.*
- *Independentcontrolof11KVFeeders.*
- *Single Bus.*

6) *Above stipulations shall be applicable to all transformers having capacity less than 1000 KVA. However, in lineswith the provisions contained U/S 35(3)(i) (b) of CEA(Measures relating to safety and Electric Supply) Regulations.2010, a circuit breaker shall be provided on primary side ofeverytransformer having capacity 1000 KVA and above installed in or after the year 2000.*
7) *Loading in any current carrying component of the Distribution System (e.g. Conductors, Joints, Transformer, Switchgear, Cables, other apparatus etc.) shall not exceed 80% of the respective thermal limit.[U/S 4.4 of Security Standards issued by OERC]*
8) *There shall be 33 KV incoming breaker (at Connection Point)having a minimum of over current and earth fault protection with or without directional featuresso that faultoccurredattheirendwillnotbereflectedtowardsgridsub-stationend.(U/S9.8 of Odisha Grid Code)*

9) *Primary Distribution (MSDSS) sub-station shall normally have two or more transformers ([U/S 48 (6) of CEA (Technical Standard for Construction of Plant & Lines) Regulations, 2010].*Model of banked transformer zone substation configuration has been adopted, where in multiple transformers are used but not segregated for system disturbances. For contingency loss of a transformer customer supply is interrupted prior to restoration. Considering to above stipulation & acceptable degree of adequacy & security, in DSS (that

Feedsmainpumpingmotors)shallhaveatleasttwodistributiontransformers.

10) *While sizing of transformers in MSDSS/ DSS, due consideration with regard to adequacy & security have been taken in lines with OERC "Distribution system planning & security standard."Annual energy at risk" shall not exceed "N-1" station output capability rating of the substation. Capability of a zone substation with one transformer out of service is referred to as its (N-1) rating. & "N" being the capacity of substation with all transformers in service.*Load interrupted shall be limited tonot generally exceed 50 percentile of the total demand on the sub-station with rider thatdeveloperwillultimately bringdownto 20%inspanofthreeyears.Thereisalso 50% chance that actual demand during off season will be lower than projected demand in any one year. More over probability of a major transformer outage occurring over the duration of year is a low event (about 1% per transformer).
11) *Preferred rating of power transformers shall be 1, 1.6, 3.15, 5, 6.3, 8, 10, 16 and 20 MVA. [U/S 54 (3) of CEA (Technical Standard for Construction of Plant & Lines) Regulations, 2010]*
12) *ATransformerwithoff-circuit tapchanger shallhavetaps rangingfrom(+)2.5% to(-)10% each on high voltage winding.[U/S 54(9) of CEA (Technical Standard for Construction of Plant & Lines) Regulations, 2010]*
13) *On load tap changing (OLTC) device tap ranging from (+) 5% to (-) 15% in step of2.5% shall be provided with Transformers of 3.15 MVA and higher rating [U/S 54(10) of CEA (Technical Standard for Construction of Plant & Lines) Regulations, 2010].*
14) *Normally vacuum type circuit breakers shall be used for voltage level of 33 KV and below [U/S 59(1) of CEA (Technical Standard for Construction of Plant & Lines) Regulations, 2010].*
15) *Distribution Transformer can be oil filled or dry type depending on requirement [U/S 54(10) of CEA (Technical Standard for Construction of Plant & Lines) Regulations, 2010]*
16) *Distribution transformers shall normally have standard rating as specified U/S 75 (7) of CEA (Technical Standard for Construction of Plant & Lines) Regulations, 2010.*

7.2. Reference Drawings: Drawings relating to Main Step-down Sub-Station (MSDSS) and Distribution Sub-Station (DSS) showing indicating scope of work are enclosed. Drawings are complimentary to the specifications and will be referred to for better understanding as well as for bidding purpose.

8.0SUBMITTALS:

I. **Methodology:** A brief write up on methodology, design & planning criteria on development of integrated system networking, Sub-Stations including O&M practices to be followed for *"User installation"*.

II. ***Single line diagrams for system connectivity (SLD):****Showing 33 KV lines from points of connection with Transmission utility interface point (EHT sub-station), MSDSS (33/6.6 KV substation), DSS (33/.43 KV and/ or 6.6/.43KV), HT lines (11 KV to be charged at 6.6 KV) and location of project (with ID number). Projected distance of lines should be clearly mentioned in SLD.*

[*SLD is mandatory requirement under proviso 4.16 of Odisha Grid Code;* the Bidder must submit either SLD of their own planning study or statement to the effect that they may like to follow Owner's indicative model.]

III. **SLDofMSDSS[CoveringHT(6.6KV&LT)].**
This submittal is optional. Owner's Conceptual SLD has been given in this document for reference of the Bidder.

IV. **SLDofDSS[33/.43KVand/or6.6/.433 KV].**
This submittal is optional. Owner's Conceptual SLD has been given in this document for reference of the Bidder.

V. **Detailsof33KVfeedersemanatingfromEHVsub-station-(FormatESC-1):**This submittal is applicable to those who would like to propose alternate connectivity configuration other than owner's indicative model. *VR & system loss may be calculated by long hand method as per REC standard and/ or submit the Load flow study in support of their proposed SLD.*

VI. **Details of Proposed Primary 33/6.6 KV (MSDSS) and 33/0.433 KV Substations and HT Feeders (6.6 KV) emanating from these Substations - (Format ESC-2):**
Thissubmittalisoptional&maybesubmittedatdetailedengineeringstage.

VII. **Detailsofaugmentationofexisting33KVFeeders-(FormatESC-3):**
Thissubmittalisoptional&itistobesubmittedatdetailedengineeringstage.

VIII. **Deviationschedules-(FormatESC-4):**

- Statement on deviations, if any, from the Bid technical stipulations/ specifications along with reasons & supporting documents, shall be submitted.
- For supply of materials/ equipments- GTPs for major items likePower Transformer (rating 630 KVA & 1.6 MVA), Distribution transformers (315 KVA & 100 KVA), AAAC & 33 KV VCB shall be submitted along with Bid offer. Othersshall be submitted at detailed engineering stage.

IX. **Detailsofspares&maintenancekitforO&M:**

Bidder shall submit a list of spares for major system elements i.e. Conductors, insulators & hard wares, LAs, HT & LT Power cables, Cable jointing kits, Ststion transformer, Transformer oil etc. for the contingency events (forced outage and/or planned outages) and Testing instruments and Maintenance kits & other tools & plants. Above list shall be over & above the mandatory spare items that are supplied along with the equipments by manufactures.
Reserve stock for maintenance shall be limited to 10% of respective population (considering Project as whole) for each of above cited critical system elements.
The schedule of testing instruments & maintenance kit given here are generally meant for carrying out testing and measurement at primary (MSDSS) & distribution substations (DSS) for O&M purposes. These kits shall be of reputed make; type tested and shall be subjectedto acceptance as per approved specification of DoWR.

Itemoftestingkit	Unit	MSDSS/DSS
100KVtransformeroilbreakdownvoltagetestset	Nos	1per MSDSS
Insulationresistancetester(Megger);Voltagerange (1 - 5 KV DC)	Nos	1per MSDSS
Oilsamplebottle	Nos	4per MSDSS
LCDClamponmeter	Nos	1per MSDSS
Line tester	Nos	1per MSDSS
Digitalearthtester	Nos	1(for Cluster)
Dischargerodasperstandardforcarryingoutthe switchyardmaintenance work	Nos	6per MSDSS
Relaytoolskit	Sets	1(for Cluster)

In addition to above,list of other tool & and Plants (T&P's) like set of "D" and" Ring " spanners,socketwrenchwithsocket,insulatedcuttingpliers,nosepliers,monkeypliers,

Pipe wrench, Sly wrench, insulated screw drivers of different sizes, L-N keys set, hammerswith handle etc as per requirements forO&M shall be given in the offer list.

****

ESC-1

DETAILSOF33KVFEEDERSEMANATINGFROMEHV GRID SUB-STATIONS:

NameofGridSub-StationandVoltageLevel(220or132KV:----------

Sl.No	Nameof33KV Feeder	33KVLine Section						%Voltage regulation at pf 0.8	SystemLoss
		LineSection	Name of Originating substation	Name of Terminating station	Type&sizeof condr.	Lengthof section	Max. Projected demandon section		
						(Km)	(KVA)	(%)	(LU)
1	*2*	*3*	*4*	*5*	*6*	7	8	9	10
1	FEEDER-1	A-B	A	B					
		B-D	B	D					
		D-G	D	G					
		Sub-Total(FEEDER-1)							
2	FEEDER-2								
		Sub-Total(FEEDER-2)							
		GrandTotal(AllFEEDERS)							

1. Voltage regulation may be calculated by Long hand method using KVA-Km method or through Load flow analysis (LFA).
2. Regulation constant for conductor shall be as per the data given in REC construction Manual.
3. Diversity factor (DF) shall be based on pattern of consumption as proposedin Bid document.All the Pumps under the each scheme, are supposed to run continuously during working season. Owner recommends DF of 1.37 for VR calculation (For WESCO Zone).
4. Owner'scomfortzoneforVRis(-)7%forsub-transmissionlines.
5. Peak Loss (Watt) can be calculated based on KVA^2Km method as per REC manual.

(This submittal is applicable to those who would like to propose alternate system connectivity configuration as per their own planning study and/or Load flow study- Ref: Para 6.0 of this Chapter)

ESC-2

DETAILSOFPROPOSEDPRIMARY33/6.6KV(MSDSS)AND33/0.43KVSUBSTATIONSAND PROPOSED FEEDERS (6.6 KV, LT) FROM THESESUBSTATIONS:

No	Sl.No ofSubstation	PowerTransformer capacity (NoxKVA)withrespectto Projected load			TotalanticipatedMaxprojected Demand including aux.	6.6KV Feeders					
		Voltageratio (KV)	(No xMVA)	Totalcapacity(MVA)		FeederNo.	FeedingtoScheme ID	ProjectedLengthof the feeder (Km)	Condr.type& size	Projecteddemand on feeder (MVA)	Voltageregulation (%)
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*		*9*	*10*	*11*
	MSDSS-1	33/6.6				1					
						2					
	MSDSS-2					1					
						2					

- Voltage regulation may be calculated by Long hand method using KVA-Km methodor through Load flow analysis (LFA).
- Regulation constant for conductor shall be as per the data given in REC construction Manual.
- Itisrecommendedtouseunitydiversityfactor(DF)forradialfeeder.
- SizingofTRFsshallbeinlineswithBiddocument.
- Owner'scomfortzoneforVRis(-)7%forHTline.

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ESC-3

AGUMENTATION OF CONDUCTOR SIZE OF EXISTING 33KV FEEDERS (PROPOSED UNDER THE PROJECT)

(Applicable to the Project that need connectivity with DISCOM network topology.)

Sl. No	Name of new line/section		Source Substation	Connecting Substation	Conductorsize		Length (Km)	Remarks
	From (Location)	To (Location)			Existing	Proposed		
1	2	3	3	4	5	6	7	8
SubTotal								

(Note:Thisinformationisoptional -Ref:Para6.0ofthischapter.Itistobesubmittedat detailed engineering stage

****

ESC-4

DeviationSchedule:(sectionVII)

A. Constructionof33KVsub-Transmission&6.6KV,LTSub-System

Sl. No.	ReferencetoBid document: (Parano&Page)	Subject matter	Deviationproposedby the Bidder	Remarks

B. TechnicalSpecificationonSupplyOfMaterials-GTPs

[Note:Relevantsupportingdocuments(ProvisionsofActs,Regulations, Standards&any other technical publications) in support of the proposals shall be enclosed.]

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CHAPTER-1

SPECIFICATIONFORCONSTRUCTIONOFOVERHEADLINE

A. (Sub-Transmission&HT):

1.0 STANDARDS:

Except where modified by this specification, the sub-transmission and distribution line, associated equipments shall be designed, manufacture, tested and erected in accordance withthe*RECConstructionsstandards* withlatestversionofthefollowing standards and associated specifications and practices adopted by DISCOMs under ODSSP;

IEC/ISO	***Indianstandard***	***Subject***
IEC:826 *IEC:652*	*IS:802Part1/1 (1995)* *Part1/1(1977)* *Part1/2 (1992)* *Parts2and3(1978)*	*UseofstructuralsteelinOverHeadTransmission Line Tower- Code of Practice*
	IS:5613Parts1and2 (1985) *Part3 (1989)*	*CodeofPracticeforDesignInstallationand Maintenance of Over Head Power lines*
	IS:4091(1979)	*CodeofPracticeforDesignandConstructionof Foundations for Transmission Line Towers and Poles*
IEC:1089	*IS:398*	*Roundwireconcentriclayoverheadelectrical conductor*
	IS:1498	*ClassificationandIdentificationofsoilforgeneral Engineeringpurposes*
	IS:1888	*MethodofLoadtestin soil*
	IS:1892	*CodeofPracticeforsub-surfaceinvestigationof foundation*
IEC:1089	*IS:2141*	*Galvanizedsteelwire*
	IS:9708	*StockBridgeVibrationDamper*
ISO:1460	*IS:2629*	*Hotdeepgalvanizingofsteeland iron*
	IS:2121	*Conductorandearthwireaccessories*
ISO:9000		*QualityManagementsystems*
ISO:8501-1		*Shotblasting*
	IS:6005	*Phosphatingofironand steel*
	IS:2633	*Testongalvanizedsteel*
	IS:4043	*Codeofpractice-earthing*

2.0 SURVEY AND MARKING:As detailed under Volume-II, section-II (Survey, Investigation, Design and Drawing).

3.0 Supports(PolesandTowers):

3.1 General:

The supports will be poles or narrow based lattice towers with fully galvanized structure as per the site requirements. Type of supports shall be as per the prevailing practices adoptedby respective DISCOM.

- LBS/GI RS joist will be used for 33kV line as per the requirement.For 11 KV lines, poles will be PSC and GI RS Joist as required, provided PSC poles shall not be used at cut points and as end poles. Supports shall be designed based on wind pressure of concerned zone andgeneral practices adopted by concerned area Distribution licensee (DISCOM) and comply with Line Philosophy guide linesspecified at para 6.0 above .
- Polesshallconfirmtothespecificationasdetailedintheschedule.
- PSC poles/ GI RS Joist preferred in plain area. For angle of deviation of more than 10^0-60^0 Double poles structure and four poles (FP) for 60^0- 90^0 deviation, shall be used.
- For locations involving long spans or higher clearances on account of crossing of power line orcommunicationlinesorarailwayline,specialdesignedpoles/latticetower/cablesmaybe used. Relevant drawings & data shall be furnished to the appropriate authorities and obtain statutory clearance.
- The heightofthepoleabovethe ground level, lengthofthe polebelow groundand working load shall be decided taking into consideration wind zone, terrain, topography, and the statutory clearances required to be maintained and shall confirm to the relevant IS
- The average span length for 100 sq mm Conductor shall be 80 to 100 Mtrs & for 148 sq mm & 232 sqmm condrshallbe50-55Mtrs.Spanlengthshallbe,wherepossible,no longerthan 64% of normal span & depend on site conditions.
- One cut point in every 1km in rural area. But however, this can vey as per the site requirement.
- Provisional quantities/numbers of different types of tower structures/Joist poles/PSC poles shall be estimated and indicated in the BOQ Schedule. However final quantities for workshallbeasdeterminedbythesuccessfulbidder,oncompletionofthedetailsurvey,

preparation of route profile drawing and designing of the different types of tower structures/Joist poles/PSC poles as elaborated in the specification.

3.2 OptimizationofPoleLocation:

3.2.1 PoleSpotting

To optimize the line length, the contractor shall spot the poles in such a way so that the line is as close as possible to the straight line drawn between the start & end point of the line.

3.2.2 Crossings

a) Road Crossings: - Road crossing will be with DP structure with 13 mtr long GI Joist pole. Where the clearance will not be sufficient, it will be with PC or PC+6 mtr lattice GI tower. At all road crossings, double tension HW fittings should be used. There should absolutely no joints in the conductors in all roads, power line and all other major crossing.The crossing angle shall be near possible to 90^0 but in any case shall not be less than 60^0. The ground clearance from the road surfaces under maximum sag condition shall be not less than 7.1 Mtrs over roads. In National High way the minimum height of guarding at the maximum sagging point should be less than 8.5 Mtrs.

b) Railway Crossings: - The railway crossing overhead or underground shall be carried out in the manner as approved & prescribed by the railway authorities from time to time. The crossing shall normally be at right angle to the railway track. In case crossing is required tobe done through underground cable, costof the cable including laying andother accessories shall be in the scope of the contractor. During detailed engineering, the contractor shall submit his proposed arrangement for each railway crossing to the owner. The approval for crossing railway track shall be obtained by the owner from the Railway Authority.

c) Power Line Crossings: -Where the line is to cross over another line of the same voltage or lower voltage, provisions to prevent the possibility of their coming into contact with each shall be made in accordance with the *Indian Electricity Rules/ CEA Safety Regulations, 2010*. At all the crossing described above the contractor shall use protective guarding as per *REC Construction Standard A-1* to fulfill statutory requirements.

d) River Crossings: - For crossing crossings over major rivers, the clearance to be provided as per stipulations of Navigation authority. For non-navigable rivers the clearance shall be measured over highest flood level. The crossing angle shall be as near as possible to 90^0 but in any case shall not be less than 60^0.

Forrivercrossingof33KV&11KV line,

- For span length from 100mtr- 450 mtr shall be with PC+6 Tower & 11mtr H pole DP as anchoring with ACSR,

- For span length more than 450 mtr shall be with UR+6 Tower & 11mtr H pole DP as anchoring with ACRS.
- For span length from 70mtr to 100mtr, it shall be with 14mtr H pole DP & 11mtr H pole DP as anchoring.

For longer spans special crossing structures shall be required & the developer shall propose an appropriate solution for each situation as it arises (developer may adopt the standard designs of OPTCL for structure used for 132 KV/ 200 KV Lines). In such cases, the developer shall carry out sub-soil investigation, to ascertain soil parameters in locations where higher tower will be required to get adequate ground clearance.

Nomidspanjointsshallbeallowedinthecrossingspan.

3.2.3 Line Clearances: - Clearance from ground, buildings, trees and telephone lines shall be provided in conformity with the *Indian Electricity Rules, 1956/ CEA Safety Regulations, 2010* as amended up to date. The vendor shall select the height of the poles in order to achieve the prescribed electrical clearances.

Situation	***MinClearance(Mtrs)***	
	33Kv	***6.6Kv***
Overopencountry	*5.2*	*4.6*
OverRoad	*7.10*	*7.10*
AlongRoad	*5.8*	*5.2*
OverTelecom.Line	*2.44*	*2.44*
Overrailways	*14.10*	*14.10*
Over11KvorLVline	*2.44*	*2.44*

3.2.4 Support Structure Design and fabrication for over head lines: - The support structure shall comply with technical specification for line support structures and cross arms. IS: 5613(Part1/sect1) :(1985) shall be taken into consideration for wind pressure to be applied to conductors, insulators and support structures.

3.2.5 ***Factorofsafety:-***

- *Formetalsupports:2.0*
- *Formechanicallyprocessedconcretesupports:2.5*
- *Forstaywires,guardwiresorbearerwiresshallbe2.5basedonultimate tensile strength of the wire*
- *Forconductor,shallbe2.0basedontheirultimatetensilestrength.*

3.2.6 ExcavatingPitsforerectionofPoles:

Polepitshouldbeofsize600x900x1500mm orcircularwith600mm dia andbasepaddingof 200mmthickwith1:3:6cementconcretebedonebeforeerectionofpole.Theearthingcoil

should also be grounded 800mm below ground level in a separate pit & filling the pit with soil. The earthing coil is jointed with the earth wire provided in the base of the PCC pole and metallic fittings should be earthed with the embedded wire in the PCC pole at the top. In case of RS Joist Pole/H Pole, the earthing coil is bolted with the same. PCC pole should be in vertical position & the pit is filled with 1:3:6 cement concrete mixture for size 450x600x1500mm and rest filled with boulders. The poles should be erected with maximum span of 100 meters.

3.2.7 EarthingofPoles:

InSub-Transmissionline&HTlines,eachpoleshallbe earthedwithcoiltype earthingasper *RECConstructionStandardJ-1.*

AllDP & FP structure& thepolesonbothsidesofrailway,Telecommunication,road,drain& river crossing shall be earthed by pipe earthing as per REC Construction Standard J-2.

3.2.8 ProvidingofGuys/StrutPolestoSupport:

The arrangement for guys shall be as per *REC Construction Standard* for PSC Poles. Strut poles/ flying guys wherever required shall be installed on various pole locations as per *REC Construction Standard.* In case of 5 feet centre DP, six stays should be provided on the DP.The location of pit for embedding the anchor plate and stay rod shall carefully be determined either in true alignment.

The pit 0.4x0.6x1.6 Mtr. shall be excavated and anchor plate with stay rod shall be suitably aligned in such a manner that the stay wire when binded with anchor rod & stay clamp at pole, the same should make an angle of 30 degree to 45 degree from the pole in thetightened position. Cementconcretemix 1:3:6 shall be poured (about 0.3 cmt) in the pit, well packed with ramming adequately & cured properly. The stay clamp shall be located near and below the DC Cross arm to counter balance the tensile load of the line conductor. Stay wire shall be bound at both ends i.e. at theboxand the stay rod. Flyguy/storm guy, as per the site conditions should be used after getting approval from DoWR. The stay set consisting of Anchor Rod, Anchor plate, turn buckle bow, thimble should be used at the tension locations.

3.2.9 Fixingof'V'Cross-Arm,Topclamps,DCChannelsetc.OnPoles:

- The fitting such as V cross arm, top clamps, D.C. channel etc. should be fixed onpoles as per *REC standard*. The fabrication of above fittings should also be got done as per the standard indicated in the schedule.
- Thegeneralspecificationofsteelsectionsisgivenbelow:

Cross arm should be made out of M.S. Angle of size 75x75x6mm. The weight of oneV cross arm isapproximately 25.70Kg/Cross Arm.Topclampshould bemadeofM.S. Angle of size 75x75x6mm. The weight of clamp should be approximate 4.08 Kg/Top clamp. D.C.crossarm5'centreshouldbemadeoutoftheM.S.channelofsize100x50x6.0 mm. The weight of one DC cross arm comes out 62.3 Kg D.C. and length 3245 mm. Other special fittings if required may be got fabricated as per the drawings approved by DoWR.

Theclampsforholdingsthefittingsshouldbefabricatedoutof M.S.flat65x8mm size.

All nuts & bolts used shall be of M.S. with combination of plain and spring washer and machine made.

3.2.10 FixationofInsulatorsandHardwarefittings:

Insulator shall be handled carefully in all stages of loading and the individually checked for cracks, damages, loss of glaze etc. before assembling and erection of at site.

a) The 33KV & 11KV galvanized steel pins made by process of forging suitable for 33KV pin/11KV pin insulators having maximum failing load of 10 K.N & 5 KN respectively withsmall steel head as per *IS2486 (ii)/1974* shall be used.The dimensionof pin shall conformto ref L-306N fig *69IS-2486 (ii)/1974*. The pin shall be provided with nut (hot dip galvanized)one plain washer and one spring washer (electro galvanized).

b) The disc insulators should be fitted with respective voltage grade hardware for tensioning theconductor.Hardwareshouldbefixedinthediscinsulatorsasperthestandardpractice and in the correct positionto bear the tensionof conductor.The strain hardwarefitting of aluminium alloy suitable for Dog Conductor (100 mm^2) should be used conforming to *IS-2486(Part-II)1989.*

c) InsulatorStrings:

Sl. No.	**Particulars**	**Single suspension string**	**Double suspension string**	**Single tension string**	**Double tension string**
	(No.ofstandardDisc)	(Nos)	(Nos)	(Nos)	(Nos)
1	33KV	1x3	2x3	1x4	2x4
	11KV	1x2	2x2	1x3	2x3
2	SizeofDisc	Mm			
	33KV,11KV	255x145	255x145	280x170	280x170

3.2.11 FinalSchedule

The final schedule including Bill of quantity indicating location of poles specifically marking locations of failure containment pole/structure, line sectionalizes, line tapping points; angle of deviation at various tension pole locations, all type of crossings and other details shall be submitted for the approval of the owner. After approval, the contractor shall submit sixmore sets of the approved documents along with one set in reproducible form to purchaser for record purpose.

3.3 Conductor:

In normal practice ACSR / AAA conductors of 100 Sq mm will be used in 11 KV lines and that of 148 Sq mm (AAAC) & 232 sq. mm AAAC (Trunk line) will be used in 33 KV lines, as per the Line philosophy given at Para 6.0.

3.3.1 Stringingofconductor:

Conductor should be laid out from a rotating wheel supported on jacks for easy unwinding of the conductor snatch blocks shall be used for stringing the conductor and shall have groves of a shape and size to allow early flow of conductor and ensure damage free operation. Come along clamps should be used to grip the conductor at the time of stringing.

3.3.2 Saggingofconductor:

All conductors sagging shall be preferred in accordance with the sag and tension tables. After the conductors have beenpulled tothe required sag,intermediatespans shall be checkedto determine the correct sag. The conductor shall be installed on insulators secured to it by meansof6 SWGaluminumbindingwire.Thejumpersatthetensionlocationsshouldalso be bound by 6 SWG aluminum binding wire. Before fixing the conductor on insulator and strain hardware, aluminum tape should be wrapped on the conductor.

3.4 Guarding:

Guarding cross arm is to be fitted on the pole as per the drawing for guarding the line with 6 SWG GI wire as guard wire and 8 SWG GI wire for lacing. Guarding cross arm made of 75x75x6 mm angle 8 feet long should be clamped at 300mm below the bottom arm of 'V' cross arm.

3.5 Anti-climbingdevice:

Barbed wire weighing 35 Kg per pole should be wrapped at a height of 3000 mm above ground level stretching in900mm length. Bothends ofbarbed should be clamped suitably toavoidComing down from its location.

3.6 Danger board: Danger Board for 33KV or 11KV voltage and danger mark conforming to *IS: 2551-1963* should be fixed on each location.

3.7 PoleNumberingSystem:

Each feeder support structure shall be uniquely identified along the route. Identification number to be painted on PSC and steel pole using stencils at a distance of 1.6 m from the ground, as per the approved scheme.

4.0 Project License: The eligible Contractor has to obtain project license from the competent authority *(ELBO)* in respect of the mentioned works prior to commencement of the works.All the expenses towards the project license and inspection thereof have to be borne by the contractor.

5.0 FINAL CHECKING, TESTING AND COMMISSIONING: After completion of the work, final checking of the line shall be carried out by the contractor to ensure that all foundation works, pole erection and stringing have been done strictly accordingly to the specification and as approved by DoWR. All the works shall be thoroughly inspected in order to ensure that:

i. Sufficientbackfilledearthcoverseachfoundationpitandisadequatelycompacted.
ii. All poles are used strictly according to final approved drawing and are free of any defect or damage whatsoever.
iii. Stringingofconductorshasbeendoneasperdesiredclearances.
iv. Allconductoraccessoriesareproperlyinstalled.
v. All other requirements for completion of works such as fixing of danger plates, anti climbing devices etc have been fulfilled.
vi. The insulation of the line as a whole is tested by the contractor through provision of his own equipments, labour, etc to the satisfaction of DoWR.
vii. Allpolesareproperlygrounded.
viii. Thelineistestedsatisfactorilyforcommissioningpurpose.

B. LT(OverheadLines):

1. **SCOPE**: Planning, supply, installation, testing and commissioning of 415 Volt over-head low tension line on 140 Kg. 8 meter long PCC Pole and necessary iron fitting etc. complete. All relevant supports fittings and fixtures, conductors shall conform to their respective *IS specifications and REC standard.* The physical layout of the work has to be got approved by DoWR before start of work.
2. **POLE:**The overhead LT line shall be supported on 140 Kg. 8 meter long PCC pole as specified in the schedule of item conforming to ISS. Normally one sixth of the pole length shall be buried in the ground. The supports shall suitable be spaced depending on the number and size of the conductors,roadcrossingsetc.ingeneral,thespacingofsupportsshallbeapproximately50-60 meters depending upon road crossing, telephone crossing etc, and in no case theinter-distance between two consecutive support shall exceed 65 meters *as per rule 85 of the Indian Electricity Rules, 1956.* For erection of pole, a pit size of 600x900x1500 mm should be done and base padding of 200 mm thick should provided and back filling of pole pit with boulders. Suitable timeofatleastsevendaysshallbeallowedforsettingthebaseconcretewithpropercuringetc. Then the pole shall be laid in the center of the pit and shall attain vertical position & pit shall then be refilled with excavated soil and well consolidated.
3. **CROSSARMS AND BRACKETS:** TheLT crossarm shallbe made up ofM.S. Angleas follows: i)LT 3 Pin Cross Arm: 50x50x6 mm size 4.5 Kg/meter, 680 mm long ii) LT 4 Pin Cross Arm: 50x50x6 mm size 4.5 Kg/meter, 980 mm long The minimum clearance between holes for U clamps shall be 300mm. Aminimumspaceof40mm along the length ofthe bracket shall bekept spare from top hole and bottom hole of the bracket the length of cross arm and bracket shall be suitable for spacing of conductors, earth wire and guarding in accordance with the minimum spacing specified in relevant ISS and in accordance to *Indian Electricity Rules.* The width of the bracket shall be not less than 50 Cms.
4. **INSULATORS**:L.T. Porcelain shackle insulators of size 90x75mm conforming to IS: 1445-1977 shall be provided and fixed in 'U' clamps for holding the conductors. LT shackle hardware galvanizing shall conform to *ISL 2633-1964* for 4 dip tests. For holding neutral conductor Aluminium bobbin insulators of size 60x50mm size with nuts bolts shall be provided.
5. **CONDUCTORS:**AAAC 7/3.15mm (55 sq mm)/7/2.5 mm (34 sq mm) & 7/2.00 mm (22 mm sq. mm) may be used for phase conductors based on technical requirement. The conductors shall be laid out in such a manner that there is no damage to the conductors in any form. While stringing overhead conductors, there should not be any kinking. Reels of conductor should be handled carefully, so that there is no cutting, nicking or fraying of the conductor strands. 'D' loops shall be provided on each conductor on both sides of each LT pole and all jumpers of LT line.
6. **CLAMPS:**BackclampsandstayclampsforLTlineshouldbemadeupof50x6mmMS flats.
7. **GUARDING:** Suitable guarding shall be providedas per provisionof Rules88of *Indian Electricity Rules.* Thespacing between the outermost conductorand the guard wires shallnot be lessthan 30 Cm. both vertically and horizontally.The guard wire shall be GI and shall in no case be less than 8 SWG in size and shall have a breaking strength of not less than 635 Kg.
8. EARTHINGOFPCCPOLE:Every*thirdpoleshouldbesuitablyearthedasperRECStandards.*

CHAPTER-2

CONSTRUCTIONPRACTICEFOR33/6.6KVSUB-STATION(MSDSS)

1.0 GeneralConsideration:-

a) The Sub-Station shall be designed and constructed complying with requirements ofthe Project, applicable Indian Standards (IS), as well as other rules and Regulations as per the latest amendments. The design and construction of Sub-Station including civil works shall be such that they perform their intended functions.In case of conflict, morestringentprovisionsshallprevail.ThecivilscopegenerallycoversConstructionof Control room-cum-Switch gear room along with foundations. cable trenches along with covers, marshalling box/control cubicle foundations, switchyard dressing and leveling, site clearance, soil investigation, roads, drains, fencing/ compound wall, gravel filling and, transformer foundations, firewalls, PH facilities. .

b) The Sub-Station shall be outdoor type. The bus bars may be of either rigid type or flexible strain type depending upon the choice of the designer conserving the overall suitability and economy of the substation to be installed.

c) TheSub-Stationshouldhavetheprovisionfordataacquisitionsystemformonitoring.

d) *Each Sub-Station shall normally have two or more power transformers.* Each Sub-Station will have incoming feeders preferable from two different sources.

e) *All Sub-Stations shall have independent circuit breaker control of 33 KV incoming feeders and all the incoming feeders feeding the Sub-Stations shall have independent circuit breaker at source end.*

f) The 415 V AC Station load would be met from a 33KV/.433 KV Auxiliary TRF of appropriate capacity.StationTransformermay be conventionaloiltype(3starratedbyBEE)ordry type (capacity less than 200 KVA).

g) DC system comprising of adequate capacity of 110 V DC battery and its chargers shall be provided for protection and monitoring system of the various panels, circuit breakers, isolators, lightings etc. of the entire switchyard system. DC power supply from maintenance free rechargeable seal lead acid batteries i.e. VRLA battery would be preferred.

Thesystemparametersof110VDCsystemsshallbeas follows:

Nominalsystemvoltage (V)	110
Highestsystemvoltage (V)	121
Voltagevariation (V)	99-121
Ambienttemperature(^{0}C)	50
Systemearthing	Unearthed
Maximumsystemfaultlevel(KA)	25(1sec)

Theampere-hourcapacityofDCstoragebatteryshallbebasedonthethreehour supply. The battery duty cycle:

Load	Duration	Typeof Loads
Continuousload	3hours	Relays, IEDs, HMIs, CB spring charging, isolator interlockloads & other miscellaneous permanentlyconnectedloads, etc.
Emergencyload	1hour	Emergencylightingloads

h) Any other items, not specifically mentioned here but required for commissioning of substation shall be deemed to be included in the scope.

i) Prior to commencement of supply/ works all relevant drawings, designs must be got approved by respective Statutory authorities/ Agencies and DoWR.

1.1 **Selection of site**:- The main points to bear in mind while selecting site for MSDS shall be as follows:-

a) Selectionshallbemadeaftertakingintoconsiderationthecapacityandlocationofthe feeding Grid Sub-Station, the projected load, the existing network configuration, etc. and the economic, and environment consideration.

b) Asneartotheloadcentreas feasible.

c) Farawayfromobstructiontopermiteasyandsafeapproachofhighvoltageoverhead line transmission line.

d) Easily accessible to the road to facilitate transport of plant & equipments in all the seasons.

e) FormationlevelshallBe1maboveHFL.

f) The land shall be reasonably leveled and shall not have any open drain/ nallah or road crossing it.

g) The developer shall carry out detailed survey and Geo- technical Investigation of the area as per the specification given elsewhere in this document for finalization of the layout approved*SingleLine Diagram,* locationof33kV and 6.6kV bays,controlroom, incoming and outgoing 33 kV lines.

2.0 Lay out of Sub-station:- It may follow the standard lay out for 33/11kV Sub-Station, as standardized by REC/ CAPEX programme of DISCOMS. 33kV switch yard shall be out-dooring type with indoor 6.6 kV switch gear. SLD is shown at Exhibit- ELEC/5-2014 is only for reference purpose only.

3.0 Control room Building:-

i. Control room shall preferably be located to oversee the entire switch yard from control room. The minimum floor area requirement shall be 10 x 8 sq. m. The size which may vary at the time of detailed engineering to suit the actual site requirements. The layout and orientation of the control room shall be finalized as per the detailed engineering based on individual project and line corridor & future requirements.

ii. The different rooms required for Control room would; Main Control room, JE'sroom, Battery room, Store room and WC/Bath/WB.

iii. An open space of minimum 1 meter shall be provided on periphery of the rows of the Panel board and equipments in order to allow easy operator movements and accessaswellformaintenance.Workingclearancesshouldcomplywithprovisions of ***CEA (Measures relating to safety and Electric Supply) Regulations, 2010***.

iv. Contractor shall comply with all applicable statutory *Acts, Rules & relevant Regulations,* while developing the Control Room.

4.0 Installation:- The physical layoutofentire sub-stationwith positions ofequipment, busbar, structures and outgoing feeders shall be marked at site and drawings have to be got approved by Electrical Inspector &concerned competent officer of DoWR before start of works.

5.0 Structural:

i. Switchyard structure to support buses, electrical equipments and terminals of line conductorsshallbemadeoffabricatedsteelstructure,150x150GIRSjoistPole&GI Channels & angles as per the ODSSP drawings of suitable cross section for 33/6.6 KV (MSDSS) and 33/0.433 KV & 6.6/0.433 KV DSS. Steel structure shall normally be hot dip galvanized or painted.

ii. AllPolemountedstations(forstationsupply)shallbeasper*RECstandard.*

iii. Minimum strength of structural foundation concrete shall be M20 confirming to *IS: 456* as per drawing.

iv. Blindingconcretebelowfoundations,cable trenches,shallbePCCofminimumgrade M-7.5.

X. **Erectionofstructure&Equipments:**

XI. Supports shall not be guyed but may be suitably concreted. For erection of bus bar structure supports, normally one sixth of the support shall be buried in ground. A pit of size 0.6 Mtr. x 0.9 Mtr. of required 1.5 Mtr. depths shall be excavated. A layer of 20 cm thick of 1:3:6 cement concrete poured for base pad concreting of post is to be done by 1:3:6 ratio cement concrete ofsize0.45 M x0.60 M x1.5 M. Suitable time shall be allowedforsetting the cement concrete before removal of holding ropes. Proper curing of cement concreteby means of wet gunny bag for at least seven days shall be done. All precautions shall be taken to avoid any chance of injury or damage to labors working at site.

XII. After the columns/supporting structures are erected respective equipments of 33/6.6 KV is to be erected carefully by suitable crane. The breaker and isolators are to be erected as 3 phase unit basis. Control relay panels are to be mounted inside the control room in the same order as in the switchyard. After the earth mat design is finalized, the earth mats with 50x6 mm GI flat are to be put for each equipment. Then flats are to beinterconnected with each other. The bus bars are to be strung after all the columns and beamsarefitted.Controlandpowercablesshouldbelaidinconsultationwith Engineer-in-Charge for safe and easy maintenance. All the equipments of each 33 bays are to be connected by suitable jumpers and clamps.

XIII. **Muffing**: A layer of 1:3:6 mix cement concrete 45 cm x 45 cm on all sides of the pole up to a height of 45 cm and tapered on top shall be coasted and adequately cured for seven days. One finishing coat of cement paste shall be applied on outer surfaces of the muffing.

XIV. **GI Iron Fittings:** All channels used shall not be less than 100x50x 6 mm. All angle used shall not be less than 50 x 50 x 6 mm corresponding to *ISI 6565*. MS flats used shall be of sections as directed by Engineer-in-Charge. All nut-bolts used shall be GI with a combination of plain and spring washer.

XV. **Painting of Pole:** - All steel poles, brackets, cross arms and all steel fittings shall be first painted with two coat of red oxide paint. The portion of the pole to be buried inside the ground shall be painted with two coats of bitumen tar. After erection of pole, the external

surface of pole and all steel items shall be painted with two coatsof aluminium paint in an approved manner.

6.0Transformers: The transformers and fittings and accessories shall comply with the Owner's technical specification and relevant IS. *The preferred rating standards for 33/6.6 KV transformers shall be 0.630, 1.0, 1.6, 3.15, 5.0 MVA and shall be three- phase, outdoortype.*

7.0 Protection:

7.1 *All 33 kV lines at Connection Points shall be provided with breakers having a minimum of over current and earth fault protection with or without directional featuresso that fault occurred at their end will not be reflected towards grid sub-station end.*

7.2 The life expectancy of power transformer is much dependant on right type of protection provided with a transformer. *One 33 kV breaker should be provided for group control when there are two transformers of capacity less than 1000 KVA each. A circuit breaker shall be provided on primary side of every transformer having capacity 1000 KVA and aboveinstalled in compliance with CEA(Measures relating to safety and Electric Supply) Regulations, 2010.*

7.3 In addition to basic protections, *transformers shall have O/C (three elements) & E/F numerical relays. For TRF of 5 MVA & above capacity, differential or REF relays may be provided.InadditionalltransformersMVAandaboveshallbeprovidedwith gas-operated relays, temperature protection and winding temperature protection and oil temperature protection. Guidelines mentioned in protection manuals of Central Bureau of Irrigation & Power (CBI & P) may be kept in view. The contractor shall provide protection schemes in lines with proviso 9.8 of Odisha Grid Code,* for approval by DoWR.

7.4 The Intelligence Electronic Device (IEDs) shall provide numerical electrical protection of feeders/ equipments. Eachnumerical protection scheme shall have a serial interface on the front for communication on open protocol like MODBUS or IEC: 60870-5-10 for remote communication, data transfer etc.

7.5 Necessary auxiliary relays, timers, trip relays, etc. required for interlocking, alarm, logging, etc. and completeness of the scheme shall be provided.

8.0 Disconnectors(Isolators)andearthswitches(applicableforAIS):

Disconnectors shall be of outdoor horizontal central break/ double break/ vertical break/withoutearthswitchasperIEC62271-102.Typeofdisconnectorshallbeasperlayout

requirement. 33 KV system disconnectors shall be manual operated type. Disconnectors/ earthswitchesshallbeprovidedwithpad-lockingarrangementtopreventoperationincase of emergency.

The earth switches shall be capable of discharging trapped charges associated with lines. Earth switches shall be locally operated. Mechanical and electrical safety interlocking shall be provided to prevent closing of disconnector when main earth switch is closed and vice-versa.

9.0 Bus Bar Conductor: Conductor used should be able to take the short circuit current corresponding to the fault level as notified in technical specification. Minimum Aluminum conductor steel reinforced of size 100/232 Sq.mm conforming to *IS: 398-1961* as specifiedin the schedule of item and directed by Engineer-in-Charge shall be used for 3 phase 3 wire 33 KV over head bus bars based on site fault level.Tension should then be adjusted until correct sag is obtained in spacing near the pulling end. Stringing chart should be used for proper stretching of conductor. The sag shall then be checked either by sighting method or by stopwatch reflected method. The conductor shall be installed on insulators secured to it by means of 6 SWG aluminium binding wire and aluminum tape on it maintaining proper tension and sag.

10. CableandEarthing:

a. Cables: The cables shall be supplied, inspected, laid tested and commissioned in accordance with drawings,specifications relevantstandard specifications and cable manufacturer's instructions. The MV cable shall be PVC insulated PVC sheathed alluminium conductor armoured cable of 1100 volts grade & FRLS type. The sizingof the power cable shall be based on current rating & fault level; however rating factorscorrespondingtotemperature andgroupingofcableshallbeconsidered.All cable shall be inspected upon receipt at site and checked for any damage during transit by the Engineer-in-Charge before it lay down to trenches, walls etc.

b. LayingofCables: Cablelyingingeneralshallfollow;

a) Switchyardarea:-Inconcretecabletroughs(cabletrenchhavingcabletrays)

b) Control room: - On cable racks consisting of slotted type and ladder type cable trays. Cable trays shall have standard width of 150 mm, 300 mm and 600 mm and standardlengthsof2.5meters.Minimumthicknessofmildsteelsheetsusedfor

fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be minimum 3 mm.

c) Buildings: Conduits directly buried cables shall be used wherever necessary with the approval of DoWR.

Minimum vertical separation between layers of cable tray shall not be less than300 mm.

Cables shall be laid by skilled and experienced workman using adequate rollers to minimize stretching of the cable. Great care shall be exercised in laying cables to avoid forming kinks. The relative position of cables shall be first marked to avoidthe cables crossing each other. At all points of changes in direction in horizontal as well as in and vertical planes, the cables shall be bent smooth with a radius of bend not less than 12 times the diameter of the cables. For laying cables under-ground a trench of at least 750 mm deep of required width shall be excavated for entire lengthofcableroute.Thetrenchshallbebrickmasonry made.Abedoffinesandof 100mm thickness shall be dressed and well dressed. The cable shall be laid on the bed of sand with full precautions to avoid any kinking, twisting and damage ofcable.Finesandshallbespreadoverthecableandshallbeflushedwithtopsurface RCC Slab are to be placed at suitable size to cover cable trenches. For cables to run along the wall proper and accurate verticality shall be maintained. Before fixing the cables on walls vertical plumbed arcing shall first be made. Parallel cables shall be spaced at least 50 mm apart maintaining their relative position over the entire length. Saddles for gripping the cables shall be spaced not more than 1 meter apart in order to avoid undue stress on the cables due to its own weight.

Suitable routed cable trenches shall be provided to accommodate power and control cables from marshalling box in the yard to the respective panels in the control room building. The cable entering the control room building will be laid in pipes with suitable sealing at wall opening to prevententry of water and rodents in to the building through cable trench opening.

b. **Earthing:**

To meet the requirements, an earthed system comprising of an earthing mat buried at suitable depth below ground and supplemented with ground rods at suitable points is provided in the substations. The impedance to ground should be as low as possible but it should not exceed 1.0 (one) ohm.

i. All the non-current carrying metal parts of electrical installation shall be earthed properly. All metal conduits trucking, cable sheaths, switch gear, distribution fuse boards, light fittings and all other parts made of metal shall be banded together and connected by means of specified earthing conductors to an efficient earthing system. All earthing shall be inconformity with the *Indian Electricity Rules/ CEA* ***(****Measures relating tosafety and Electric Supply) Regulations, 2010* and in accordance to *IS: 3043-1987/ IEEE80*. The Step and touch potentials shall be within safe limit.Design of earth mate shall be duly supported by computer based soft ware study.

ii. All equipments, structures etc. shall be connected to the grounding mat as per IE Rules/ CEA Safety Regulations, 2010, code of practices for earthingand IEEE80 at two separate and distinct locations.

iii. A grounding mat shall be provided at minimum depth of 600mm in the Substation/switchyard to provide low impedance path for lightning surges/ system fault current to earth.

iv. The earthing conductor size shall be designed for life expentancy of minimum (forty) 40 years and system fault time of 1.0 Sec. whichever is higher. Minimum rate of corrosion of steel used for earthing conductor shall be considered as 0.12 mm per year for designing its size.

v. Allearthing conductors shall be of GI plate, GI pipe or earthing coil of specified size and shall be protected against mechanical injury or corrosion.

vi. Underno circumstances the cross sectional area of earthing conductorshall be less than half of the largest current carrying conductor subject to an upperlimitof80Sqmm.Ifthe areaofthelargestcurrentcarryingconductor orbusbarexceeds160Sqmm.thentwoormoreearthingconductorshallbe usedinparalleIto provideatleasthalfonecrosssectionalareaofthelargest current carrying conductor.

vii. **Connections to Earth**: All sub-station equipment shall be earthed on a grid system.The gridaround the substation connecting earthing stations shall be of bare GI conductor of size not less than 7/3.15mm.

- The transformer neutral shall be directly connected to two pipe electrodes in treaded earthpits, which intern and shall be connected to station earth grid. All the electrodes shall be buried in cement pit

with cast iron cover hinged to cast iron frame to have an access to the joints.

- Earthing terminal of each lighting arrester and lighting down conductorsshallbedirectlyconnectedtorodelectrodewhichinturn shall be connected to station earthing grid.
- All other sub-station equipment shall be earthed with separate and independent GI strip of required section or bare GI conductor of size 6 SWG connected to grid. The earthing conductors inside the buildings shall be properly supported with clamps and brass screws. GI strips outside the building shall be laid at-least 450 mm below the finished ground level.
- Overlappinginstripsatjointswhererequiredshallbeminimum75 mm. The joints shall be reverted with rivets and brazed in approved manner. Sheathed lugs of adequate capacity and size shall be used for all termination of connection. Lugs shall be fitted to the equipment body to be earthed after the metal is cleaned of paintand other oily substance and properly tinned.

11. LightningProtection:

i. Lightening protection system installation shall be in strict accordance with latest edition of *Indian Electricity Rules, Indian Standards and Code of practice and Regulations*existing in the locality where the system is installed.

ii. Direct stroke lightening protection (DSL) shall be provided in the switch yard by electrodes mounted in the Joist pole structure.

iii. 25 mm dia 1000 mm long MS solid rod electrode shall be provided with each lighting mast.

iv. Lighting protection system down conductors shall not be connected to conductors of earthing grid above ground level. Also no intermediate earthing connection shall be made to lighting arrestor, transformer earthing leads, which shall be directly connected to rod electrode.

v. Connection between each down conductor and rod electrode shall be made via joints located approximately 1500 mm from ground level. The joints shall be directly connected to earthing system.

vi. Downconductorsshallbecleatedatthestructureat1000mminterval.

12.0 Fire Protection: Firefighting equipment of adequate capacity shall be provided in the sub-station to deal with fires likely to be encountered.The layout of the Sub-Station itself shall be such that the fire shall not spread from one to other equipment and areas as far as possible. Fire hydrant, carbon dioxide (Co_2) type fire extinguisher or dry chemical powertype fire extinguisher conforming to latest IS shall be provided as per site requirement. All fire fighting equipments shall conveniently be located and conspicuously marked.

A fire wall shall be erected between the transformers if the free distance between the variouspiecesofequipmentislessthan10 m,to protecteachonefrom theeffectsoffireon another.

Fire walls shall also be erected between the power transformers if the free distance is less than ten meters. Fire walls shall extend at least two metres on each side of the power transformers and at least one metre above the conservator tank or safety vent. These dimensions might be reduced in special cases where there is lack of space.

13.0 Switchyardlighting:50 luxonmainequipmentatfirstlevel(equipmentconnectionlevel),20 lux on balance switchyard & road etc. Details shall be supplied by Engr-In- Charge.

14.0 Chain Link Fencing, Gate etc: The outdoor switchyard shall compound wall or be enclosed by GI wire mesh chain link fencing over masonry works (0.78 meter height of brick work and 1.22 meter of chain link). The fencing shall be supported by adequate angle iron frame work of minimum size 50 x 50 x 6 mm and shall have iron bracings of the angle iron frames. Framework of gates of the switchyard shall be made up of M.S. flat and M.S. bars. Thedesign of Compound wall for MSDSS and/or fencing arrangement for switch yard shall be as per the approved drawing by the Engineer-in-Charge. Switch yard area shall be filled with 150/100 mm thick gravels to restrict the growth of grass in the outdoor switchyard. Before laying the gravel fill, top layer of the soil shall be treated for anti-weed considering type of weeds found in the vicinity. It should be covered with granite metal jelly 15 to 20 mm sizefor purpose of effectively discouraging the growth of grass and weeds and to prevent the spreading of dust. All the areas adjacent to oil filled equipments such as breakers, transformers etc should be surfaced for additional purpose of absorbing leaking oil.

CHAPTER-3

SPECIFICATIONFORDSS,(TRANSFORMERCAPACITYUPTO&BELOW250KVA)ONDOUBLEPOLE STRUCTURE

1. SCOPE:

Design, planning, supply, installation, testing for commissioning of double pole structure (D.P.Structure) for pole mounting transformer Sub-station with all allied equipments etc. complete. The Sub-station plan shall be got approved by the competent authority of DoWR prior to erection work.

2. SUPPORTS:

The D.P. structure will be either withGI RS Joist supports orhave two numbers 140 Kg. 8 meter long PCCPole for250 KVASub-station as specified inthe scheduleof items. Normally onesixthof the pole shall be buried in the ground. The support shall be placed at a distance of 2400 mm. For erection of pole, a pit digging of size 600x900x1500 mm should be done and base padding of 200 mm thick should be provided and concreting with 0.3 Cmt per pole with 1:3:6 cement concrete mixture for size 450x600x1500 mm.

Suitable time for at least seven days shall be allowed for setting the base concrete with proper curing etc. the pole shall than be laid in the center of the pit and tied with ropes of adequate strength of four side of the pole by means of suitable clamps fixed at right angles to each other. Loose ends of two sides of ropes forming straight line shall be tied firmly with deep driven iron pigs located equidistant from the center of the pole pit. One of the remaining two ends of remainingropesshallbeconnectedtoturferandtheendofoppositeropeshallbekeptlooseand ready to be tied with deep driven iron pigs shall be manned by skilled worker to control the unwanted deflection of pole while pulling it by turfer. The pole shall then be pulled by turfer and correctly aligned to its truly vertical position and then set in 1:3:6 cement concrete poured up to ground level. Suitable time shall be allowed for setting the cement concrete before removing the ropes. Proper curing of cement concrete for at least seven days shall be done. All precautions shall be taken to avoid any chance of injury or damage to labour and technicians working at site.

3. FITTINGS:

6.6 KV"V" cross arms shall be made up of MS Channel 65x65x6 mm size having phase to phase clearanceof 1070 mm.6.6KV top clamps shall bemade up of MS angle 65x65x6 mm size 405 mm long. DC cross arms, single pole cut point DC, transformer mounting DC, AB Switch mounting DC, DO and LA mounting channel shall be made up of MS Channel 100x50x6 mm size of required length.

Backclampsandstayclampsshallbemadeupof65x8mmsize.

MS Nut and Bolts conforming to IS: 1363-1902 shall be used of 5/8" (16mm) for fitting works and for earthing arrangements GI nut-bolts must be used.

4. ABSwitch:

AB switches and DO Fuses should be supplied with base steel structure, terminal bi-metallic connectors/ PG clamps / earth connector.They should be checked for proper alignment and free & smooth operation. The insulators should be cleaned before commissioning. The linkage of contacts should be checked for free and adequate grip. The AB switch should be checked for fully OPEN/CLOSED positions. Contact between two movable points should be checked and recorded. The contacts should be adequately lubricated before commissioning. Connection of terminal connectors shall be checked for proper tightness. Operating handle should be separately grounded. Equipments should be supplied with detail technical specifications enclosed. The associated mounting / connection accessories items shall not be considered for measurement under any head of Price Schedule even if they happen to be appearing in Price Schedule.

5. LIGHTENINGARRESTOR:

The 6.6 KV lightening arrestor shall be valve type arrestor consisting of an outer ceramic body containing9 Set of resistance (Valves) and spark gaps in series. The resistance shall be made of special silicon carbide ceramic, which offer high resistance to power frequency voltages and low resistance to surge voltages. Arrestor should be installed as close as possible, to the HT line. The arrestor should be solidlyearthed. The lightening arrestor shall bemountedon 100x50x6mm MS Channel fixed approximately 1500mm below the 6.6KV tapping point.

6. D.O.FUSEUNIT:

The 6.6 KV drop out fuse unit shall havecurrentcarrying capacityof200 Amps having 2 Nos 11KV post insulators fitted on bakelite base with fuse barrel as per BSS-1314. The DO fuse should begot checked and test certificate from CPRI Bangalore/Bhopal as per IS: 5792-1970 should be obtained and produced.

7. TRANSFORMERS:

The 6.6/0.4KV step-down distribution transformer shall be supplied and installed as per the specifications mentioned in the Transformer Section.

8. DISTRIBUTIONBOX:

The distribution box suitable for 250 KVA transformers with isolator on incoming side and SPMCCB on outgoing side will be used. All sheet steel work shall undergo a process of digressing, picklinginacid,coldrinsing,phosphating,possivatingandthensprayedwithahighcorrosive

resistant primer and then backed in oven. The finishing treatment shall be by application of two coats of synthetic enamel gray paint in an approved manner.

9. DANGERCAUTIONBOARDS:

The danger of caution boards shall have to be displayed on pole, Transformer and LT distribution panel. The danger signboards should conform to *IS: 2551-1963.*

10. ANTI-CLIMBINGDEVICE:

Anti-climbing device consisting of barbed wire extending to a minimum length of 900mm shall be provided on poles. Both ends of the barbed wire shall be secured to poles by means of suitable iron clamps as per the direction of Engineer-In-Charge.

11. PAINTINGOFDPSTRUCTURES:

All metallic parts exceptttransformer andLT distribution boxofD.P.structure andPCCPole shall be painted in an approved manner.

12. EARTHINGOFSUB-STATION:

Three numbers pipe earthing with 2.5 meter long GI Pipe 40mm dia used connecting pipe earthing with 4mm GI wire with LA transformer neutral, transformer body, DO earthing, Channel earthing. Pole pit is filled with soil.

****

B.INSPECTION/ TESTING AND SUPPLY OF MATERIALS/SYSTEMELEMENTS FOR SYSTEM CONNECTIVITY (33kVSUB-TRANSMISSIONAND6.6 KV, LT SUB-SYSTEM)

SECTIONVII–B

INSPECTION/ TESTING AND SUPPLY OF
MATERIALS/SYSTEMELEMENTSFORSYSTEMCONNECTIVITY
(33kVSUB-TRANSMISSIONAND6.6KV,LTSUB-SYSTEM)

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SPECIALNOTE:

1. If any part, whole orspecific aspectof equipments is not being covered under the above list, the Bidder shall specifically bring out such aspect with their views/ suggestions, otherwise, the successful bidder shall be liable to abide by specific requirement of DoWR at detailing stage with no financial liability to DoWR.
2. Technical specifications for any other system elements/equipments for 33 KV & 11 KV OH line (to be charged at 6.6 KV) *and Substations,* not covered in this bid document, therelevant specifications adopted by OPTCL for execution of Govt. Of Odisha sponsored scheme "Odisha Distribution System Strengthening Project (ODSSP)" may be followed subject to approval from DoWR.
3. The material/equipments offered shall be procured from short listed approved vendors (specified in Tech. Document) and shall have been successfully Type tested during last five years on the date of signing of Agreement with EPC Developer. ***The materials/ equipments that do not meet the defined specification of the bid documents shall not be accepted.***
4. In case of any discrepancy observed in specifications, the bidder shall specifically bring out suchaspectswiththeirviews.Otherwise,thesuccessfulbiddershallbeliableto abidebythe specific requirements of DoWR at detailing stage with no financial liability to Owner.
5. DoWRshall always have the authority, either on an application made by EPC Contractor or suo motto, to review, revoke, revise, modify, amend, alter or otherwise change any specification, if DoWR considers it to be appropriate.

CHAPTER–1
PSCPOLESFOR11KVLINE/LTLINE

1.0 General:

PSC poles shall be of solid rectangular type with an overall length of 9.0 M & 11.0 M /300 Kg Poles suitable for use in 11 KV overhead power lines and 8.0 M long/140 kgs for LT lines.

2.0 ApplicableStandards:

Exceptwhenthey conflictwith specific requirementsin this Specification,thePSC polesshall comply with the relevant provisions made in the following Indian Standards or the latest versions thereof.

a) IS: 1678, Specification for pre-stressed concrete poles for overhead power, traction and telecommunication lines.

b) IS: 2905, Method of test for concrete poles for overhead power and telecommunication lines.

c) IS:7321,CodeofPracticeforselection,handlinganderectionofconcretepolesfor overhead power and telecommunication lines.

3.0 TERMINOLOGY:

Forthepurposeofthisspecification,followingdefinitionsshallapply:

(i) **AveragePermanentLoad**

Thatfractionoftheworkingload,whichmay beconsideredoflongdurationoveraperiodof one year.

(ii) **LoadFactor**

Theratioofultimatetransverseloadtothetransverseloadatfirstcrack.

(iii) **Transverse**

The direction of the line bisecting the angle contained by the conductor at the pole. In thecase of a straight run, this will be normal to the run of the line.

(iv) **TransverseLoadatFirstCrack**

For design, the transverse load at first crack shall be taken as not less than the value of the working load.

(v) **WorkingLoad**

The maximum load in the transverse direction,that iseverlikely tooccur, including the wind pressure on the pole. This load is assumed to act at a point 600mm below the top with the butt end of the pole planted to the required depth as intended in the design.

(vi) **UltimateFailure**

The condition existing when the pole ceases to sustain a load increment owing to either crushing of concrete, or snapping of the prestressing tendon or permanent stretching of the steel in any part of the pole.

(vii) **UltimateTransverseLoad**

The load at which failure occurs, when it is applied at a point 600 mm below the top and perpendicular to the axis of the pole along the transverse direction with the butt end of the pole planted to the required depth as intended in the design.

4.0 APPLICATION

A. 9.0Mand11.0M Poles

These poles shall be used at tangent locations for 11KV in different wind pressure zones in accordance with REC Construction Standards referred to in the following table:

PoleLinedescriptionReferencetolengthRECConstn.Standards

9.0M11KVlineswithoutearthwireL.T.A-4,B-5lines,andhorizontalformation. 11.0M
11KV lines with earthwire L.T. A-5, B-6 lines, and vertical formation.

The adoptable spans shall be as per REC Construction Standards A-8 (for 11 KV Lines). These poles shall be used for double pole structures of distribution transformer centers as per REC Construction Standards F-1 to F-4 and for special locations in 11 KV and L.T. Lines, such as road crossings etc. In case, rail poles/RCC poles are considered necessary for road crossingor for any other purpose, the same shall be in the scope of contractor and he shall quote for the same as specified in Bid Price Schedule (BPS).

(i) These poles shall be used at tangent locations of 11/0.4 KV lines using conductor formation and clearances as per REC Construction Standard M-3. These poles shall be designed for the working load of 200 Kg. (suitable for wind pressure of 100 Kg/mt.2). The maximum permissible spans shall be as per REC Construction Standard M-2.

(ii) These poles shall be used for double pole structures of distribution transformer centresas per REC Construction Standards F-1 to F-4 and for special locations in LT lines, such asroad crossings etc.

B. 8M/140kgPole: ThesepolesshallbeusedforLTlinesinwindpressurezonesof50kg /m^2,75kg./m^2,and100kg./m^2inaccordancewithRECconstructionstandards

5.0 MATERIAL

(i) **Cement**

Thecementusedinthemanufactureofprestressedconcretepolesshallbeordinary orrapid hardening Portland cement conforming to IS: 269 - 1976 (Specification for ordinary and low heat Portland cement) or IS : 8041 E-1978 (Specification for rapid hardening Portland cement).

(ii) **Aggregates**

Aggregates used for the manufacture of prestressed concrete poles shall confirm to IS: 383 (Specificationforcoarseandfineaggregatesfromnaturalsourcesforconcrete).Thenominal maximum size of aggregates shall in no case exceed 12 mm.

(iii) **Water**

Water should be free from chlorides, sulphates, other salts and organic matter. Potable water will be generally suitable.

(iv) **Admixture**

Admixture should not contain Calcium Chloride or other chlorides and salts which are likely to promote corrosion of pre-stressing steel. The admixture shall conform to IS 9103.

(v) **Pre-StressingSteel**

The pre-stressing steel wires including those used as untensioned wires (See Annex. I II and III), should conform to IS: 1785 (Part-I) (Specification for plain hard-drawn steel wire for pre-stressed concrete, Part-I cold drawn stress relieved wire), IS: 1785 (Part-II) (Specification for plain hard-drawn steel wire) or IS: 6003 (Specification for indented wire for pre-stressed concrete). The type designs given in the annexure are for plain wires of 4 mm diameter with

a guaranteed ultimate strength of 175 kg/mm2 and for plain wires of 5 mm diameter with a guaranteed ultimatestrength of160 kg/mm2. All pre-stressing steelshall be freefrom splits, harmfulscratches,surfaceflaws,rough,agedandimperfectedgesandotherdefectslikelyto impair its use in prestressed concrete.

ReinforcementforRCCpoles

All reinforcing bars shall conform to IS 432 (Part I) or IS 432 (Part-II) or IS 1786 as the case may be. All reinforcement shall be free from loose scale, rust and coats of paint, oil, grease, clay or other material that may have deteriorating effect on the bond between the reinforcement and the concrete.

(vi) **Concrete Mix**

The concrete mix shall be designed to the requirements laid down for controlled concrete (also called design mix concrete) in IS : 1343 62- 1980 (Code of practice for pre-stressed concrete) and IS : 456 - 1978 (Code of practice for plain and reinforced concrete), subject to the following special conditions:

a) Minimumworkscubestrengthat28daysshouldbeatleast420Kg/cm2.

b) Theconcretestrengthattransfershouldbeatleast210 Kg/cm2.

c) Themixshouldcontainatleast380Kg.ofcementpercubicmeterof concrete.

d) The mix should containas low water content as isconsistent with adequateworkability. If it becomes necessary to add water to increase the workability, the cement content also should be raised in such way that the original value of water cement ratio is maintained.

6.0 DESIGNREQUIREMENTS

Thepolesshallbedesignedforthefollowingrequirements:

a) The poles shall be planted directly in the ground with a planting depth as per IS : 1678. Wherever, planting depth is required to be increased beyond the specified limits or alternative arrangements are required to be made, on account of ground conditionse.g. water logging etc., the sameshall be in the scopeofthe contractor at no extra cost to owner. The contractor shall furnish necessary design calculations/details of alternative arrangements in this regard.

b) The working loadon the poles should correspond tothosethat are likelytocomeon the pole during their service life. Designs given in the annexure are for 200 kgapplied at 0.6M from top.

c) The factor of safety for all poles above 9.0 Mts. shall not be less than 2.0. For 7.5 M and 8.0 M poles, the factor of safety shall not be less than 2.5.

d) Theaveragepermanentloadshallbe40%oftheworkingload.

e) TheF.O.S.againstfirstloadshallbe1.0.

f) Ataveragepermanentload,permissibletensilestressinconcreteshallbe30kg/cm2.

g) At the design value of first crack load, the modulus of rupture shall not exceed 53.0 kg/cm2 for M-40.

h) The ultimate moment capacity in the longitudinal direction should be atleast onefourth of that in the transverse direction.

i) The maximumcompressive stress in concrete at the time of transfer of pre-stressshould not exceed 0.8 times the cube strength.

j) Theconcretestrengthattransfershallnotbelessthanhalf,the28daysstrength ensured in the design, i.e. 400 x 0.5 = 200kg/cm2.

For model check calculations on the design of poles, referred to in the annexure, a reference may be made to the REC "Manual on Manufacturing of solid PCC poles, Part-I - Design Aspects"

6.1 **DimensionsandReinforcements**

The cross-sectional dimensions and the details of pre-stressing wires should conform to the particulars given in the annexure. The provisions of holes for fixing cross-arms and other fixtures should conform to the REC standards referred to in clause 1.4 of this specification.

6.2 **Manufacture**

6.2.1 All pre-stressing wires and reinforcements shall be accurately fixed as shown in drawingsand maintained in position during manufacture. The untensioned reinforcement, asindicated in the drawings, should be held in position by the use of stirrups which should go round all the wires.

6.2.2 All wires shall be accurately stretched with uniform pre stress in each wire. Each wire or a group of wires shall be anchored positively during casing. Care should be taken to see that the anchorages do not yield before the concrete attains the necessary strength.

6.3 **Cover**

The cover of concrete measured from the outside of pre-stressing tendon shall be normally 20 mm.

6.4 **WeldingandLappingofSteel**

The high tensile steel wire shall be continuousover the entire length of the tendon. Welding shall not be allowed in any case. However, jointing or coupling may be permitted provided thestrength of the joint or coupling is not less than the strength of each individual wire.

6.5 **Compacting**

Concrete shall be compacted by spinning, vibrating, shocking or other suitable mechanical means. Hand compaction shall not be permitted.

6.6 **Curing**

The concrete shall be covered with a layer of sacking, canvass, hessian or similar absorbent material and kept constantly we up to the time when the strength of concrete is at least equaltotheminimumstrengthofconcreteattransferofprestress.Thereafter,thepolemay beremovedfrom themouldandwateredatintervalsto preventsurfacecrackingoftheunit; the interval should depend on the atmospheric humidity and temperature. The prestressing wires shall be detensioned only after the concrete has attained the specified strength at transfer (i.e. 200 or 210 kg/cm2, as applicable). The cubes cast for the purpose of determining the strength at transfer should be cured, as far as possible, under conditions similar to those under which the poles are cured. The transfer stage shall be determined based on the daily tests carried out on concrete cubes till the specified strength indicated above is reached. Thereafter the test on concrete shall be carried out as detailed in IS: 1343 (Code of practice for prestressed concrete). The manufacturer shall supply, when requiredby the owner or his representative, result of compressive test conducted in accordance with IS: 456 (Code of practice for plain and reinforced concrete) on concrete cubes made fromthe concrete used for the poles. If the owner so desired, the manufacturer shall supplycubes for test purposes and such cubes shall be tested in accordance with IS : 456 (Code of practice for plain and reinforced concrete). The detensioning shall be done by slowly releasingthewires,withoutimpartingshockorsuddenloadtothepoles.Therateof

detensioning may be controlled by any suitable means either mechanical (screw type) or hydraulic. The poles shall not be detensioned or released by cutting the prestressing wires using flames or bar croppers while the wires are still under tension.

6.7 **LiftingEye-HooksorHoles**

Separate eye-hooks or holes shall be provided for handling the transport, one each at a distanceof 0.15timestheoverall length, from eitherend of the pole. Eye-hooks,if provided, should be properly anchored and should be on the face that has the shorter dimension ofthe cross-section. Holes, if provided for lifting purposes, should be perpendicular to the broad face of the pole.

6.8 **HolesforCrossArms etc**

Sufficient number of holes shall be provided in the poles for attachment of cross arms and other equipments.

6.9 **Stacking&Transportation**

Stackingshouldbedoneinsuchamannerthatthebroadsideofthepoleisvertical.Eachtier in the stack should be supported on timber sleeper located as 0.15 times the overall length, measured from the end. The timber supported in the stack should be aligned in a vertical line. Poles should be transported with their broad faces placed vertically and in such a manner that shocks are avoided. Supports should be so arranged that they are located approximately at a distance equal to 0.15 times the overall length from the ends. The erection of the pole should be carried out in such a way that the erection loads are appliedso asto causemomentwithrespectto themajoraxis,i.e.theropeusedforhoistingthepole should be parallel to the broader face of the pole.

7.0 EARTHING:

7.1 Earthing shall be provided by having length of 8SWG GI wire embedded in concrete during manufactureand theendsof the wires left projectingfromthepole to alengthof 100mm at 250 mm from top and 150 mm below ground level.

7.2 Earthwireshallnotbeallowedtocomeincontractwiththeprestressingwires.

7.2.1 Tests

7.2.1.1 TransverseStrengthTest

7.2.1.1.1 Poles made from ordinary Portland cement shall be tested only on the completion of 28 days and poles made from rapid hardening cement only on the completion of 14 days, after the day of manufacture.

7.2.1.1.2 The poles may be tested in either horizontal or vertical position. If tested in horizontal position,provisionsshallbemadeto compensatefortheoverhangingweightofthepole,for this purpose, the overhanging portion of the pole may be supported on a movable trolley or similar device.

7.2.1.1.3 The pole shall be rigidly supported at the butt end for a distance equal to the agreed depth of planting

7.2.1.1.4 Load shall be applied at a point 600 mm from the top of the pole and shall be steadily and gradually increased to thedesign value ofthe transverse load at first crack. Thedeflection at thisloadshallbemeasured.Aprestressedconcretepoleshallbedeemednottohavepassed the test if cracks wider than 0.1 mm appear at a stage prior to the application of the design transverseloadatfirstcrackandtheobservedultimatetransverseloadislessthanthe

design ultimate transverse load. The load shall then be reduced to zero and increased gradually to aloadequaltothefirstcrackloadplus10%oftheminimum ultimatetransverse load, and held up for 2 minutes. This procedure shall be repeated until the load reaches the value of 80 per cent of the minimum ultimate transverse load and thereafter increased by 5 per cent of the minimum ultimate transverse load until failure occurs. Each time the load is applied, it shall be held for 2 minutes. The load applied to prestressed concrete pole at the point of failure shall be measured to the nearest five Kilograms. The pole shall be deemed not to have passed the test if the observed ultimate transverse load is less than the design ultimate transverse load.

7.2.1.1.5 **MeasurementofCover**

Aftercompletionofthetransversestrengthtest,thesamplepoleshallbetakenandchecked forcover.Thecoverofthepoleshallbemeasuredat3 points,onewithin1.8meterfromthe butt end of the pole, the second within 0.6 meters from the top and the third at an intermediate point and the mean value compared with the specified value. The mean value of the measured cover should not differ by more than (+) 1 mm from the specified cover.The individual values should not differ by more than (+) 3 mm from the specified value. If these requirements are not met, the workmanship with reference to aligning of the end plates and prestressing wires and assembly of moulds should be improved and inspection at pre-production stage tightened suitably.

8.0 SAMPLINGANDINSPECTION

8.1 Scaleof Sampling

8.1.1 Lot: In any batch, allpolesofthe same classand same dimensionsshall begrouped togetherto constitute a lot.

8.1.1.1 Sub-lot: If the number of poles in a lot exceeds 500, the lot shall be divided into a suitable number of sub lots such that the number of poles in any sub-lot shall not exceed 500. The acceptance or otherwise ofa sub-lot shall be determined on the basis of the performance of samples selected from it.

8.1.2 Thenumberofpolestobeselectedfromalotora sub-lotshalldependuponits size.

9.0NUMBEROFTESTS

9.1.1 All the poles as selected shall be tested for overall length, cross-section and uprightness. The tolerance shall be (+) 15 mm on overall length (+), 3 mm on cross sectional dimensions and 0.5 percentonuprightness.

9.1.2 The number of poles to be tested for transverse strength test.These poles may be selectedfrom those already tested.

9.2 CriteriaforConformity

9.2.1 Alotorsub-lotshallbeconsideredasconformingtothisspecificationiftheconditionsunder 9.2.2 and9.2.3aresatisfied.

9.2.2 The number of poles which does not satisfy the requirements of overall length, cross section and uprightness shall not exceed the corresponding number given in Col.3 of Table in 3.1.2.If the numberofsuch poles exceedsthecorresponding number,all poles inthelotorsub-lot shall be tested for these requirements and those not satisfying the requirements shall be rejected.

9.2.3 All the polestested for transversestrengthtestshall satisfy the requirements ofthetest. Ifone or more poles fail, twice the number of poles originally tested shall be selected from those already selectedandsubjectedto thetest.Ifthereisno failureamongthesepoles,thelotor the sub-lot shall be considered to have satisfied the requirements of this test.

10.0 MARKING

The pole shall be clearly and indelibly marked with the following particulars either during or after manufacture but before testing at a position so as to be easily read after erection in position.

a) Monthandyearofmanufacture

b) TransversestrengthofpoleinKg.

c) Maker'sserialNo.andmark.

11.0 DRAWINGS

11.1 The drawings submitted by the Contractor shall be approved /commented by the Owner as the case may be within thirty (30) days of receiptof drawings in Owner's design office. If the designs/drawings are commented by the Owner, the Contractor shall submit revised design/drawings duly incorporating all comments within fifteen (15) days of date of issue of comments.

11.2 Pole accessories drawings like name plate, danger plate, anti-climbing device etc. shall be prepared by the Contractor and submitted to the Owner in three copies along with one re-producible, for record. These drawings shall be prepared in A4 size only.

11.3 While submitting the drawings, the Contractor shall clearly indicate on each drawing Specification No., Name of the line, letter reference no. and date on which the submission are made. The same practice is also to be followed while submitting distribution copies.

11.4 The Contractor shall furnish the drawings in fifteen (15) copies to the Owner for necessary distribution within fifteen (15) days after the receipt of the approval from the Owner.

GUARANTEEDTECHNICALPARTICULARS OF9MTR,11MTRLONGPSCPOLES(FOR11KVLINES)& 8 MTR/140 Kg (FOR LT LINES)

[GTPbesubmittedforeachcategoryofHTandLTSupports]

Sl.No.	PARTICULARS	UNIT	BIDDER'S OFFER
1	2	3	4
1.	Nameofthe Manufacturer		
2.	Overall lengthofthePole		
3.	Depthof plantation.		
4.	MinimumUltimatetransverseLoad		
5.	WeightofthePoleinKgs.		
6.	Factorof safety		
7.	Workingloadappliedat300mmfromtop.		
8.	Volumeofthepoleincubicmeter.		
9.	Dimensionsof pole:		
a.)	Top Dimension.		
b.)	BottomDimension.		
10.	Actualconsumption/quantityofmaterialUsedin manufactureofeachPSC Pole		
i.)	Cement		
ii.)	Aggregate		
iii.)	Sand.		
iv.)	StoneChips.		
v.)	Steel		
	a) Diaof Wire.		
	b)No.Of Wire.		
	c)WeightofWire.		
vi.)	OtherM.SReinforcement		
	H.TWireRings		
	H.TWire Hooks		
	WeightofSteel.		
11.	Processadoptedforcompacting& curing.		
12.	EarthingarrangementineachPSCPole.		
a.)	LengthofG.IWire&SWG		
b.)	Weightof G.IWire.		
c.)	No.ofGalvanisedBolts,with2nuts&3Washers		
13.	MethodofPrestressing.		
14.	Concretemixandcubestrengthafter.		
i)	72Hours.		
ii)	28Days		
15.	Arethesesupportssuitableforuseatanglepoints wherestaysareneeded.		

****

CHAPTER-2
TechnicalSpecificationforRSJoist

1.Scope:

Thisspecificationcallsformanufacture,stagetesting,inspectionandtestingbefore dispatch, packing and delivery of following steel section to DoWR.

(i)150x150mm,@34.6Kg/m	**11Mtr,13Mtr,14Mtrlength**
(ii)175x85mm	**11MtrLength**
(iii)175x85mm	**9.3MtrLength**
(iv)Othersectionsasper site requirements(forOHlines & for Substations)	**Lengthaspersiterequirements**

The materials shall conform, in all respect, to the high standard of design and workmanship and shall be capable of performing duties specified herein. Materials offered shall be complete in all respect. Steel structure to be inducted should be galvanized with minimum zinc coating of 610 gms/Sq. Mtrs.

2 STANDARDS:

2.1 Materials shall conform to the latest applicable Indian standards. In case bidders offer Steel Section and supports conforming to any other international specifications which shall be equivalent or better than IS, the same is also acceptable.

Sl. No.	StandardNo	Title
1	IS:2062Grade-AQuality	SpecificationforR.S.Joists
2	IS:2062	Chemicalandphysicalcomposition of material
3	IS:1852	RollingandcuttingtolerancesforHotrolled steelproducts

2.2 ACCEPTANCE OF OTHER AUTHORITATIVE STANDARDS: In the paragraph2.1 above, relevant Indian standards specification has been mentioned. However, the material meeting any other authoritative international standards, which ensures equal or better quality than the standards, mentioned shall also be acceptable. Material for which Indian Standards are not available, the relevant British standards and IEC recommendations will be applicable. Please attach photocopy of all such standards according to which the materials have been offered.

3.0 LENGTH:Thematerialstobesuppliedshallbeinthefollowinglengths:-

R.S.Joists	9.3meters ,11meters,13meters, 14meters& different long(asper requirement)	Pleaseensurethatmaterialsuppliedin different lengths is as per specified quantitiesofthoselengthsonly.

Lengthandtoleranceasapplicableasper IS1852(-0mmto+100mm)

4.0 WEIGHTMENT: The weightment of Steel Section shall be witnessed by the consignee at the time of taking delivery. The weight recorded in the material receipt certificate issued by the consignees shall be final.

5.0 CHEMICALCOMPOSITIONANDMECHANICALPROPARTIES:

(ConfirmingtoIS:2062/84)

Sl. No.	Chemicalcomposition	FORFe410WAGRADE	
1	C	0.23%	Max
2	Mn	1.5%	Max
3	S	0.050%	Max
4	P	0.050%	Max
5	Sl	0.40%	Max
6	CE(carbonequivalent)	0.42%	Max

MECHANICALPROPERTIES:

1. Tensilestrength(min.)–42Kgf/mm2or410N/mm2
2. YieldstressMin.forthickness/diameter

<20mm	-26kgf/mm2OR 250N/mm2
20–40mm	-24kgf/mm2OR 240N/mm2
>40mm	-23kgf/mm2OR 230N/mm2

3. Elongation%(Min) 23%

Bendtest(Internaldia)<=25mm=2t,>25mm=3tAsperIS2062,E250-BR

6.0 TOLERANCE IN QUANTITY: Variation in ordered quantity for any destination and over-all ordered quantity shall be only to the extent of **± 2%.** Rolling and weight tolerances shall beas per latest version of IS: 1852 or to any equivalent International Standard. Any claim of quantity supplied in excess of above limits shall not be admitted.

7.0 MARKING: It is desirable that the Contractor should put his identification marks on the finished materials. The mark shall be in "legible English letters" given with marking dies of minimum 18 mm size.

8.0 INSEPTION& TEST CERTIFICATE: The materials to be supplied will be subject to inspection and approval by DoWR. The firm is required to offer the finished material for inspection well in advance to DoWR. The finished materials shall be delivered to consignees only after the same are inspected by DoWR. ThematerialsshallbetestedinISI approvedLaboratory ofthe tenderer having all facilities available for conducting all the tests as prescribed in relevantISS. The materials shall be tested either in their ISI approved Laboratory or in any Govt. approved laboratory. The tenderers are required to specifically indicate that:- (i) They hold valid ISI License against respective ISS. (ii) That the materials offered against this tender are bearing ISI certification marks. (ii) The tenderers are required to submit a copy of the validISI License clearly indicating size and range of roll-able product against respective ISS along withtheiroffer.Itistobenotedthatincaseanyofthetwoconditionsasmentionedabove i.e. (i) holding of valid ISI License and (ii) finished materials bearing ISI certification marks,are not fulfilled, the tender shall not be accepted / considered.

9.0 GUARANTEE PERIOD: - If during the course of 18 months subsequent to the date of receipt of consignment or 12 months from the date of commissioning, whichever is earlier, any of the goods are found to be defective in material or workmanship or develop defects during service, they will have to be replaced / repaired by the suppliers free of all charges.

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CHAPTER–3
TECHNICALSPECIFICATIONFORAAAC

1.0 SCOPE:

This specification covers details of all aluminium alloy stranded conductors for use on 33 kV, 11 kVandLToverheadlinesinMega-LiftProject.Allsizesofconductorshallbesuppliedwith ISI mark.

2.0 SERVICECONDITIONS:

Theconductortobesuppliedagainstthesespecificationsshallbesuitableforsatisfactory continuous operation under the following tropical conditions.

a) Maximumambienttemperature(DegreeC).....50
b) Maximumtemperatureinshade(DegreeC).....45
c) Minimumtemperatureofairinshade(Degree C)..... 3.5
d) RelativeHumidity(%)..... 10to100
e) MaximumAnnualRainfall(mm) 1450
f) MaximumWindPressure(kg/sq.m.) 150
g) Maximumaltitudeabovemeansealevel(meter).....1000
h) Isocerauniclevel(days/year) 50
i) Seismiclevel(Horizontalacceleration)..... 0.3g
j) Moderatelyhotandhumidtropicalclimateconductivetorustandfungusgrowth

3.0 CONDUCTORSIZES:

i) 7/2.00mm(22sq.mm)
ii) 7/2.5mm(34 sq.mm)
III)7/3.15mm(55sq.mm)
iv) 7/4.26mm(100 sq.mm)
v) 19/3.94mm(232 sq.mm)

4.0 APPLICABLESTANDARDS:

Unlessotherwisestipulatedinthisspecification,theconductorshallconformtothe following Indian Standards (amended up to date).

Sl.No.	INDIANSTANDARDS	TITLE
1	IS: 398(PartIV)/1994	SpecificationforaluminiumconductorsforOverhead transmissionpurpose.
2	IS:1778	Reelsanddrumsforbareconductors.
3	IS:1841	E.C.GradeAluminiumrodproducedbyrolling.
4	IS:5484	E.C.GradeAluminiumrodproducedbycontinuous castingandrolling.

5.0 PROPERTIESOFCONDUCTOR:

Thepropertiesofstrandedallaluminiumalloyconductorsofvarioussizesshallbeas detailed in the Table;

TABLE-1

Actual Area	Standing & wire dia.	Approx. overall dia.	Approx. mass	Calculated resistance at 20^0 C(max)	Approx. calculated Breaking load	Reactance per km	Current rating
1	2	3	4	5	6	7	8
Mmsq.	Mm	Mm	Kg/km	Ω/km	kN	Ω	Amp
22	7/2.00	6.00	60.16	1.5410	6.45	0.3556	115
100	7/4.26	12.78	272.86	0.3390	29.26	0.3394	325
232	19/3.94	19.70	636.67	0.1471	68.05	0.3146	520

6(a) PROPERTIESOFWIRES:

Thepropertiesofaluminiumalloywirestobeusedintheconstructionofthe Stranded conductors shall be as in Table-2

ALUMINIUM ALLOY WIRES USED IN THE CONSTRUCTION OF STRANDED ALUMINIUM ALLOY CONDUCTORS.

Diameter		Crosssectionalareaof normal dia.wire	Mass	Minimum breakingload after standing	Resistanceat 20^0C
Nom	Max.				
Mm	Mm	mm.sq	Kg/km	kN	Ω/km
2.00	2.02	3.142	8.482	0.92	10.653
3.94	3.98	12.190	32.92	3.58	2.746
4.26	4.30	14.250	38.48	4.18	2.345

6(b) TOLERANCEONNOMINALSIZES:

No negative tolerance shall be permitted on the nominal diameter aluminium wire used in themanufactureofAAAC.However,positivetoleranceinthisrespectshallbeasprovidedin IS: 398 (Part IV)/1994 (amended up to date).

7.0 FREEDOMFROMDEFECTS:

The wire shall be smooth and free from all imperfections such as spills, splits, slag inclusion; dia. marks scratches, fittings, blow holes, projections, looseness, overlapping of strands, chipping of aluminium layers etc. and all such other defects which may hamper the mechanical and electrical properties of the conductor. Special care should be taken to keep away dirt, grit etc. during stranding.

8.0 JOINTS.INWIRES:

8.1 Conductorscontainingsevenwires:-

Thereshallbenojointinanywireofastrandedconductorcontainingsevenwires,except those made in the base rod or wire before final drawing.

8.2 Conductorscontainingmorethansevenwires:-

In conductors containing more than seven wires, joints in individual wires are permitted in any layer except the outermost layer (in addition to those made in the brass rod or wire before final drawing) but no two such joints shall be less than 15 m apart in the complete stranded conductor, such joint shall be made by resistance or cold pressure butt welding. They are not required to fulfill the mechanical requirement of unjointed wires. Joints made

by resistance butt welding shall, subsequent to welding, be annealed over a distance of at least 200 mm on each side of the joint.

9. STRANDING:-

9.1 The wires used in the construction of a stranded conductor shall, before stranding satisfy all the relevant requirements of this standard.

9.2 Thelayratiooftheditferentlayersshallbewithinthelimitsgivenintheable-III. TABLE - III: LAY RATIOS FOR ALUMINIUM ALLOY STRANDED CONDUCTORS

No.ofwiresin conductors	LayRatioin			
	6-wirelayer		12-wire layer	
	Min.	Max.	Min.	Max.
7	10	14	-	-
19	10	16	10	14

9.3 Inallconstructions,thesuccessivelayersshallhaveoppositedirectionsoflay,theouter most layer being right handed. The wires in each layer shall be evenly and closely stranded

9.4 In aluminium alloy stranded conductors having multiple layers of wires, the lay ratio of any layer shall not be greater than the lay ratio of the layer immediately beneath it.

10. TESTS:

The samples of individual wires for the test shall normally be taken before stranding. The manufacture shall carry out test on samples taken out at least from 10 % of the aluminium wire spools. However, when desired by the purchaser, the test sample may be taken from the stranded wires. Thewires used for alloyconductors shall comply with the following tests as per IS: 398 (Part - IV) / 1994 (amended up to date):

i) Breakingloadtest
ii) Elongationtest
iii) Resistancetest

11. PACKINGANDMARKING:

Theconductorsshallbewoundinreelsordrumsconformingtothelatestversionsof IS: 1778 - 1961 (amended upto date), ' Specification for Reels and Drums for bare wire.

11.1 PACKING:

11.1.1 Thegrossmassofpackingforvariousconductorsshallnotexceedbymorethan 10% of the values given in the following table

ConductorSizeinsq mm.	GrossMassinKg.
22(7/2.00mm)	1100
100(7/4.26mm)	2000
232(19/3.94mm)	2400

11.1.2 Thenormallengthofvariousconductorsshallbeasgiveninthefollowingtable:

ConductorSizeinsq mm.	Normallengthinkm
22(7/2.00mm)	2.0
100(7/4.26mm)	2.0
232(19/3.94mm)	2.0

11.1.2.1 LENGTHSANDVARIATIONINLENGTHS:

The standard length of AAA Conductor shall be 2 (two) kms. Tolerance of +/- 5 %(plus or minus five percent) shall be permitted in this standard length. All the lengths outside these limits of tolerances shall be treated as random length.

Randomlengthshallnotbelessthan80%(eightypercent)ofthestandardlengthspecified as above and the total acceptable quantity of such random lengths shall be within 7% (sevenpercent)quantityoftheallottedquantitytoeachconsigneeoftherespectivesizeof the conductor.

11.2 MARKING:

Thefollowinginformationbemarkedoneachpackage:

Manufacturer'sname

b) Trademark,ifany

c) Drumoridentificationnumber

d) Sizeof conductor

e) Numberandlengthsofconductors f

) Gross mass of the package

g) Netmassof conductor

h) ISIcertificationmark.

12. INSPECTION:

All tests and inspection shall be made at the place of manufacturer unless otherwise especially agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities without charges, to satisfy him that the material is being furnished in accordance with this specification.

13. VERIFICATIONOFLENGTHOFCONDUCTOR:

i) The Company shall ascertain the length of AAA Conductor at supplier's works and at the receiving store centers by measuring the actual length by length measuring machine used forthe purpose. The supplier should ensure that length measuring machine is available for measurement of the length by inspecting officer of DoWR.

ii) Both ends of the AAA Conductor will be sealed by the supplier and seals will be contained in the drum and not exposed out of drum.

iii) The declared length will be measured between manufacturer's seals at both ends of AAA Conductor.

iv) The weight of AAA Conductor will also be checked for ensuring correct lay and length of the AAA Conductor.

v) For the verification of the length of the conductor, 10 %of total lot (in Drums) should be selected at the works. The physical verification of the length of the conductor should be carried out for maximum up to 5 (five) drums. If there are anymore drums left for verification, then weight of each verified drum should be carried out and average weight may be calculated.

Then the weight of each of all the remaining selected drums may be taken and if these weights are matching with the average weight, then that particular lot may be accepted otherwise rejected.

vi) Verification of length of conductor will also be carried out at each stores center for two drums out of each lot. If the average length is found correct or more, the lot will be accepted. If the average length is found to be less than the declared, the percentageofsuch short lengthwill be applied for reduction for the entire quantity supplied in the lot at respective stores for acceptance. vii) In case of dispute, joint inspection along with the representative of the supplier shall be carried out after giving 10 (ten) days notice to the supplier to remain present at stores center for the purpose. If the representative fails to attend on stipulated date for joint inspection, the decision of the consignee shall be final and binding.

14. REJECTION:

i) While measuring the length , the sample piece from each length shall be taken for carrying out the test as per IS: 398 (Part IV) / 1994 (amended up to date). All the values of each sample shouldnotexceedthevalueasperthe relevantIS.Incaseofdeviation,wholelotwillberejected at works.

ii) SpecificresistivityofAluminiumAlloywireusedshouldnotexceed0.0328ohmsq.mm./mat20 degree centigrade as prescribed in IS: 398 (Part IV)/1994 (amended up to date). If the results are at variance, whole lot shall be rejected.

15. BISCERTIFICATIONMARKS:

The AAA Conductor with BIS (ISI) marking only is required by the DoWR against this tender specificationandassuch,onlythosetenderers/supplierswho holdvalidBISlicenseforAAA Conductor need quote.

GUARANTEEDTECHNICALPARTICULARS(GTP)FORAAAC
[Size:22,100&232Sq.mm]

PART-A

1. Nameofthetenderer/ Contractor:

2. Nameofthe manufacturer:

PART-B

BIDDERTOCONFIRMFOLLOWINGIMPORTANTREQUIREMENTS.

Sl.No.	Particulars	Conformation
1	ConductorshallbemanufacturedasperIS-398part-IV/1994 or latestamendmentofit	
2	Woodendrumsshallbeasper IS-1778/1980withlatest amendments.	
3	Spacingbetweenouterlayeroftheconductorandinnersurface oflaggingshallbe75mm min.	
4	Standardlength2000Meters+/-5%.	
5	Drumsize9asperIS-1778/80withlatestamendment.	
6	ConductordrumshallcarryISIMark.	
7	Markingofdrumasperclause	
8	Conductorshallhave7Nosforwiresofsize100sq.mm&below and19Nofor232sq.mmsize.	
9	PropertiesofindividualwiresshallbeasunderS:	

The propertiesof strandedall aluminum alloyconductorsofvarious sizes shallbeas detailed in the Table-1

Actual Area	Standing & wire dia.	Approx. overall dia.	Approx. mass	Calculated resistance at 20^0 C(max)	Approx. calculated Breaking load	Reactance per km	Current rating
1	2	3	4	5	6	7	8
Mmsq.	Mm	Mm	Kg/km	Ω/km	kN	Ω	Amp
22	7/2.00	6.00	60.16	1.5410	6.45	0.3556	115
100	7/4.26	12.78	272.86	0.3390	29.26	0.3394	325
232	19/3.94	19.70	636.67	0.1471	68.05	0.3146	520

10 Lay ratio

LayratioforAAACofvarioussizesshallbeasdetailedinthe Table:

No.ofwires in conductors	LayRatioin			
	6-wirelayer		12-wire layer	
	Min.	Max.	Min.	Max.
7	10	14	-	-
19	10	16	10	14

PART-C

PackingspecificationofConductor:

Size of Conductor (Sq. mm)	Diameter of reel without lagging (mm)	Width of reel(mm)	Widthof lagging (mm)	Thickness oflagging (mm)	Gross wt. of conductor on reel (Kg)	Net wt. of conductor onreel(Kg)
22						
100						
232						

PART-D

Bidderhastomentiondeviationifany,quotingrelevantclausesofspecification.

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CHAPTER–4
TECHNICALSPECIFICATIONFORACSRCONDUCTORS

1.0 SCOPE:

Thisspecificationprovidesforthemanufacturing, testingandsupplyofACSR Conductors as per the following details:

2.0 STANDARDS:

TheConductorshallconformtothefollowingIndianStandardspecificationswhichshallmean latestrevisionswithamendments/changesadoptedandpublishedunlessspecificallystated otherwise in the specification.

1.	**IS:398(Part-II)1976/1990**	SpecificationforAluminumConductors.
2.	IS:2629-1985/1990	HotdipGalvanizingofIronandSteel
3.	IS:4826/1979	SpecificationforHotDippedGalvanizedcoatingson RoundSteel Wires.
4.	IS:209/1966/1992	ElectrolyticHighGradeZinc.
5.	IS:1778-1980	SpecificationforReelsandDrumsfor Bare Conductors
6.	IS:2633-1992	MethodofTestinguniformityofcoatingofZinc coatedArticles.

3. MATERIALANDWORKSMANSHIP

3.1 Material used in manufacture of the conductor shall be of the highest quality of its kinds obtainable and except where modified by the specification, shall comply in all respect with the standards laid down by Indian Standard Institution.

3.2 The Aluminum Wire (Strands) shall be hard drawn from electrolytic Aluminum rods having puritynotlessthan99.5%TestcertificatesofAluminumManufacturer,inrespectofimpurity contentofAluminumConductivityetc.shallhavetobefurnishedinorderto assess itquality.

3.3 TheSteelWire(Strands)shallbedrawnfromHighCarbonSteelWireRodsproducedbyeither theacidorthebasicopenhearthprocess,orbytheelectricFurnaceprocess.Thesteelwires shallbehotdipGalvanizedconformingtoIS:2629:1985andshallhaveweightofZinccoatingas per 15:4826/1979. The quality of zinc used for coating on steel wires strands shall be as per ZN98of1S:209:1966/1992i.e.ElectrolyticHighGradeZincof99.95%purity. Zinccoatingshallbereasonablysmooth,continuingofreasonableuniformthicknessandfreefrom alldefectsnotconsistentwithgoodcommercialpractice.Thesteelwireshallbeofsuchqualityand puritythatwhendrawntothesizeofwirespecifiedandcoatedwithzinc,thefinishedstrands and the individual wire shall be of uniform quality and have the same properties and characteristics as prescribed in the relevant Indian Standard.

3.4 AlltheAluminumaswellasSteelwirestrandsshallbereasonablysmooth,uniformandshallbefree fromalldefectssuchasdie-marks,scratches,abrasionsandkinksetc.afterdrawingand alsoafter stranding.

3.5 Thefinishedconductor shall have a smooth surface without any surface dent, abrasions, scuffsmarksandshallbefreefromdirtgritetc.Alsotheconductorshallbefreefromloosestrands.Theends oftheconductorshallbepropertysealedtoavoidunwindingofthestrands.

3.4Particular care has therefore, to be taken during the manufacture, handling packing and transportationof the conductor, to see that the surface is not dented, cut or damagedin anyway.

4.0 MODULUSOFELASTICITYANDCOEFFICIENTOFLINEAREXPANSION

Thevalueof thefindmodulusof elasticityand coefficient of linear expansion for ACSRconductors shallbeasbelow:

Sl.No.	Conductor	Find Modulus of ElasticityGN/m^2(Practical)	Co-efficientoflinear expansionper^{0}C.
1.	ACSRWeasel	79	$19.1x10^{-6}$
2.	ACSRRABBIT	79	$19.1x10^{-6}$
3.	ACSR RACCOON	79	$19.1x10^{-6}$
4.	ACSRDog	75	$19.8x10^{-6}$
5.	ACSRWolf	75	$17.8x10^{-6}$
6.	*ACSRPanther*	*80*	*$17.8x10^{-6}$*

5.0 JOINTS:

5.1 There shall be no joint of any kind in the steel core of the conductor. Joints in the Aluminum strands,ifanyshallbeasperIS398(part-II)1976/1990.Jointsshallbemadebycoldpressurebutt welding and shall withstand a stress of not less than the breaking strength of individual strand guaranteed.Acertificateto this effect shall be recorded by the supplier on each and every invoice / bill and Challan.

6.0 STRANDING:

The wires used in manufacture of standard conductor before stranding shall conform to all therelevantrequirementsofIS:398(Part-II)1976/1990.

7.0 TOLERANCES

(I)**ForACSR"RABBIT"Conductor**

a) Diameter of Aluminum and Steel Strands

	Standard	Max	Min
Aluminum	3.35mm	3.38 mm	3.32mm
Steel	3.35mm	3.42 mm	3.28mm

b) LayratioofConductor

	Max	Min
Aluminum6wirelayer	14	10

(ii) ForACSR"RACOON"Conductor

a) DiameterofAluminumandSteelStrands

	Standard	Max	Min
Aluminum	4.09mm	4.13mm	4.05mm
Steel	4.09mm	4.17mm	4.01mm

b) LayratioofConductor

	Max	Min
Aluminum6wirelayer	14	10

(iii) ForACSR"DOG"Conductor

a) DiameterofAluminumandSteelStrands

	Standard	Max	Min
Aluminum	4.72mm	4.77mm	4.67mm

Steel	1.57mm	1.60mm	1.54mm

b) LayratioofConductor

	Max	Min
Steel6wirelayer	28	13
Aluminum6wirelayer	14	10

(iv) ForACSR"WOLF"Conductor

a) DiameterofAluminumandSteelStrands

	Standard	Max	Min
Aluminum	2.59mm	2.62 mm	2.56mm
Steel	2.59mm	2.64 mm	2.54mm

b) LayratioofConductor

	Max	Min
Steel6wirelayer	28	13
Aluminum6wirelayer	14	10
18wire layer	16	10

(V)ForACSR"PANTHER"conductor

a) Sizeofconductor:30/7/3.00 mm
b) Standingandwirediameter:
   Aluminum 30/3.00mm
   Steel 7/3.00 mm
c) SectionalAreaofAluminum:21210mm^2
d) Approximatetotalmass;974kg/km
e) Calculateresistanceat20^{0}CMax:0.139ohm/KM
f) Calculatedbreakingloadofcompositeconductor(UTS)(Min);89.67KN
g) Lay ratio:-
   Steelcore:Max-28
   Min-13
   AluminumLayers
   12wirelayer(layerbelowoutsidelayer)Max-16
   Min-10
   18 Wire (outside Layer) Max-14
   Min -10
h) Modulusofelasticity:0.815x10^{6}Kg/CM^2(80GN/M^2)
i) Co-efficientofLinearexpansionofconductor:17.8x10^6/^{o}C
j) StandardareaofcrossSectioninsq.mmofconductor:261.50Sq.mm
k) Diameterofcompleteconductorinmm:21mm

8.0 PACKING&MARKING

1) Theconductorshallbesuppliedinnonreturnable,strong,woodendrumsprovidedwithlagging of adequate strength, constructed to protect the conductor against any damage and displacementduringtransit,storageandsubsequenthandlingandstringingoperationsinthe field.TheContractorshallberesponsibleforanylossordamageduringtransportationhandling and storage due to improper packing. The drums shall generally conform to IS: 1778-1980, except as otherwise specified hereinafter.

2) Thedrumsshallbesuitableforwheelmountingandforlettingofftheconductorundera minimum controlledtensionof the orderof 5 KN.
3) TheContractorshouldsubmittheirproposeddrumdrawingsalongwiththebid.
4) TheContractormayoffermorethanonelengthof theconductorinasingledrum.
5) Allwoodencomponentsshallbemanufacturedoutofseasonedsoftwoodfreefromdefects thatmaymateriallyweakenthecomponentpartsofthedrums.Preservativetreatmentshallbe applied to the entire drum with preservatives of a quality, which is not harmful to the conductor.
6) Theflangesshallbeoftwoplyconstructionwith64mmthicknesswitheachplyatrightangles to the adjacent ply and nailed together. The nails shall be driven from the inside face flange, punchedandthenclenchedontheouterface.Flangeboardsshallnotbelessthanthenominal thickness by more than 2mm. There shall not be less than 2 nails per board in each circle. Whereaslotiscutintheflangetoreceivetheinnerendoftheconductortheentranceshallbe in line with the periphery of the barrel.
7) Thewoodenbattensusedformakingthe barrelofthe conductorshallbeofsegmentaltype. Theseshallbenailedtothebarrelsupportswithatleasttwonails.Thebattensshallbeclosely buttedandshallprovidearoundbarrelwithsmoothexternalsurface.Theedgesofthebattens shallberoundedorchamferedtoavoiddamagetotheconductor.
8) Barrel studs shall be used for the construction of drums. The flanges shall be holed and the barrel supports slotted to receive them. The barrel studs shall be threaded over a length on eitherend,sufficienttoaccommodatewashers,spindle platesandnutsforfixingflanges atthe requiredspacing.
9) Normally,the nutsonthestudsshallstandprotrudedoftheflanges.Allthenailsusedonthe innersurfaceoftheflangesandthedrumbarrelshallbecountersunk.Theendsofbarrelshall generally be flushedwiththe topof the nuts.
10) The inner cheek of the flanges and drum barrel surface shall be painted with bitumen based paint.
11) Before reeling, card board or double corrugated or thick bituminized water-proof bamboo paper shall be secured to the drum barrel and inside of flanges of the drum by means of a suitablecommercialadhesivematerial.Thepapershouldbedriedbeforeuse.Mediumgrade Kraftpapershallbeusedinbetweenthelayersoftheconductor.Afterreelingtheconductor, the exposed surface of the outer layer of conductor shall be wrapped with water proof thick bituminized bamboo paper to preserve the conductor from dirt, grit and damage during transport and handling.
12) Aminimumspaceof75mmforconductorshallbeprovidedbetweentheinnersurfaceofthe external protective tagging and outer layer of the conductor. Outside the protective lagging, there shall be minimum of two binders consisting of hoop iron/ galvanized steel wire. Each protectivelaggingshallhavetworecessestoaccommodatethebinders.
13) Eachbattenshallbesecurelynailedacrossgrainsasfaraspossibletotheflange,edgeswithat least 2 nails per end. The length of the nails shall not be less than twice the thickness of the battens. The nails shall not protrude above the general surface and shall not have exposed sharp,edgesorallowthebattenstobereleasedduetocorrosion.
14) Thenutsonthebarrelstudsshallbetackweldedontheonesideinordertofullysecurethem. Onthe secondend,aspringwashershall be used.

15) Asteelcollar shall be usedtosecure all barrel studs.Thiscollar shall be locatedbetweenthe washersandthesteeldrumandsecuredtothecentralsteelplatebywelding.
16) Outside the protective lagging, there shall be minimum of two binders consisting of hoop iron/galvanizedsteelwire.Eachprotectivelaggingshallhavetworecessestoaccommodatethe binders.
17) Theconductorendsshallbeproperlysealedandsecuredwiththehelpof U-nailonthesideof oneoftheflangestoavoidlooseningofthe,conductorlayersduringtransitandhandling.
18) AsanalternativetowoodendrumContractormayalsosupplytheconductorsinnon-returnable paintedsteeldrums.Afterpreparationofsteelsurfaceaccordingto IS:9954,syntheticenamel paint shall be applied after application of one coat of primer. Wooden/Steel drum will be treated at par for evaluation purpose and accordingly the Contractor should quote in the package.

MARKING:

Eachdrumshallhavethefollowinginformation stenciledonitinindelibleinkalongwithotheressential data:

(a) Contract/Awardletternumber.
(b) Nameandaddressofconsignee.
(c) Manufacturer'snameandaddress.
(d) Drumandlotnumber
(e) Sizeandtypeofconductor
(f) Length ofconductorinmeters
(g) Arrowmarkingforunwinding
(h) Position oftheconductorends
(i) Numberofturnsintheoutermostlayers.
(j) Grossweightofdrumafterputtinglagging.
(k) Averageweightofthedrumwithoutlagging.
(n) Netweightoftheconductorinthedrum.
(o) Monthandyearofmanufactureofconductor

Theaboveshould beindicatedin thepackinglistalso.

9.0 CHECKINGOF CONDUCTORLENGTH

Sufficient facilities should exist at contractor's premises to measure the conductor length by the inspecting officers. For this purpose motorized system to facilitate quick measurement should be available at the works.

10.0 TOLERANCEOF QUANTITIES

Thetotalpermissiblevariationfortheentirequantityorderedshall subjecttolimitof±1% for order up to 500 km. and ±½% for orders above 500 km.

11.0 TESTING: The conductor shall be subjected to the following tests in accordance with IS: 398 (Part-II) 1976.

11.1 CheckfordiameterofindividualAluminumandSteelstrands.
11.2 CheckforlayratioofvariouslayersofAluminumandSteel
11.3 BreakingloadtestsonAluminumandgalvanizedSteelwires.
11.4 WrappingtestonAluminumandgalvanizedsteelwires.
11.5 ElectricalresistancetestonAluminumwiresonly.
11.6 Ductilitytestongalvanizedsteelwireonly.

11.7 GalvanizingtestongalvanizedSteelwiresonly.
(i) WeightofZinccoating.
(ii) UniformityofZinc
11.8 Checkingofconductor'ssurface,declaredlengthandweight.
11.9 VisualexaminationtestonconductordrumsasperIS:1778/1980.
11.10 Therejection&retestprocedureshallbefollowedasstipulatedinIS:398{Part-II)1976.

12. TESTINGANDTESTCERTIFICATE

Theconductorshallbesubjecttoalltestslaiddownintherelevant ISSatcontractor'swoksorat approvedtestlaboratoryatcontractor'scost.Certifiedcopiesoftestcertificateinrespectof tensile test of both Aluminum and Steel strand, electrolytic quality of Aluminum and galvanized coating test of Steel strand and all other tests as prescribed in the relevant ISS shall be furnished by contractor to owner.

13. CALIBRATIONOFTESTINGEQUIPMENTS:

ThetensiletestingmachineandKelvin'sBridgemachineetc.shallbegotcheckedfromthecompetent authorityforcalibration onceinayear. Calibration certificates,whendemanded by the Inspecting Officer,shallbeproducedforverificationpurposes.Incaseofdisputeregardingcalibration,the instrumentsshallbejointlyscaledandsenttoinstitutions,labordeputedforcalibrationatthe costofsupplier.TheresultofsuchcheckingshallbebindingonthesupplierSCHEDULEOFTECHNICALPARTICULARS FOR ACSR WEASEL

		Minimum Guaranteed Value	Proposed Value
A	Name of tenderer /contractor		
B.	TenderspecificationNo.		
C.	Name of manufacturer ofequipment.		
1.	Code name of conductor	Weasel	
2.	NominalAluminumArea(mm^2)	30	
3.	No. ofstrands (a) Aluminum	6	
	(b)Steel	1	
4.	Strand'sDiameter inmm		
	(a) Aluminum i)Standard	2.59	
	ii)Maximum	2.62	
	iii)Minimum	2.54	
	(b)Steel i)Standard	2.59	
	ii)Maximum	2.64	
	iii)Minimum	2.54	
5.	Toleranceon standarddiameterof		
	i)Aluminimum	±1%	
	ii)SteelWires	±2%	

6.	Approximateoverall diameter of completeconductor(mm)	7.77	
7.	Minimumbreakingloadofeachstrand in KN		
	a) Aluminium i)Beforestranding	0.89	
	ii)After Stranding	0.85	
	b)Steel i)BeforeStranding	6.92	
	ii)After stranding	6.57	
8.	Approximate calculatedbreakingload (KN)	11.12	
9.	Maximumresistance of conductor ofeach strandat20ºC(ohms/km)	5.490	
10	Calculatedresistance of conductorin ohms/km at 20ºC	0.9289	
11	Weight of Zinc coatinginrespect ofsteel core (GM/m^2)	230	
12	Approximatemass ofeachstrandin kgs/km		
	a) Aluminium	14.24	
	b)Steel	41.09	
13	Minimumguaranteedmass inkg/km		
	a) Aluminium	87	
	b) Steel	41	
	c) Total	128	
14	Lay ratio		
	Aluminium (i)Maximum	14	
	(ii)Minimum	10	

SCHEDULEOFTECHNICALPARTICULARS FOR ACSR RABBIT

		Minimum Guaranteed Value	Proposed Value
A	Name of tenderer /contractor		
B.	TenderspecificationNo.		
C.	Name of manufacturer ofequipment.		
1.	Code name of conductor	ACSRRabbit	
2.	NominalAluminumArea(mm^2)	50	
3.	No. ofstrands (a) Aluminum	6	
	(b)Steel	1	
4.	Strand'sDiameter inmm		
	(a) Aluminium i)Standard	3.35	

	ii)Maximum	3.38	
	iii)Minimum	3.32	
	(b)Steel i)Standard	3.35	
	ii)Maximum	3.42	
	iii)Minimum	3.28	
5.	Approximateoverall diameter of completeconductor(mm)	10.05	
6.	Minimumbreakingloadofeachstrand in KN		
	a) Aluminium i)Beforestranding	1.43	
	ii)After Stranding	1.36	
	b)Steel i)BeforeStranding	11.58	
	ii)After stranding	11.00	
7.	Approximate calculatedbreakingload (KN)	18.25	
8.	Maximum resistance of eachAluminum strandat20ºC(ohms/km)	3.265	
9.	Calculatedresistance of conductorin ohms/km at20ºC	0.5524	
10.	Weight of Zinc coatinginrespect ofsteel core (GM/m^2)	250	
11.	Approximatemass ofeachstrandin kgs/km		
	a) Aluminum	23.82	
	b)Steel	68.75	
12.	Minimumguaranteedmass inkg/km		
	a) Aluminum	145	
	b) Steel	69	
	c) Total	214	
13	Lay ratio		
	a)Steel Wire (i)Maximum	-	
	(ii)Minimum	-	
	b)Aluminium (i)Maximum	14	
	(ii)Minimum	10	

SCHEDULEOFTECHNICALPARTICULARS FOR ACSR RACCOON

		Minimum Guaranteed Value	Proposed Value
A	Name of tenderer /contractor		
B.	TenderspecificationNo.		
C.	Name of manufacturer ofequipment.		
1.	Code name of conductor	ACSRRaccoon	
2.	NominalAluminumArea(mm^2)	80	
3.	No. ofstrands (a) Aluminum	6	
	(b)Steel	1	
4.	Strand'sDiameter inmm		
	(a) Aluminium i)Standard	4.09	
	ii)Maximum	4.13	
	iii)Minimum	4.05	
	(b)Steel i)Standard	4.09	
	ii)Maximum	4.17	
	iii)Minimum	4.01	
5.	Approximateoverall diameter of completeconductor(mm)	12.27	
6.	Minimumbreakingloadofeachstrand in KN		
	a) Aluminum i)Beforestranding	2.00	
	ii)After Stranding	1.98	
	b)Steel i)BeforeStranding	17.27	
	ii)After stranding	16.41	
7.	Approximate calculatedbreakingload (KN)	26.91	
8.	Maximum resistance of eachAluminum strandat20ºC(ohms/km)	2.194	
9.	Calculatedresistance of conductorin ohms/km at 20ºC	0.3712	
10.	Weight of Zinc coatinginrespect ofsteel core (GM/m^2)	275	
11.	Approximatemass ofeachstrandin kg/km		
	a) Aluminum	35.51	
	b)Steel	102.48	
12.	Minimumguaranteedmass inkg/km		
	a) Aluminum	216	
	b) Steel	103	

	c) Total	319	
13	Lay ratio		
	a)Steel Wire (i)Maximum	-	
	(ii)Minimum	-	
	b)Aluminum (i)Maximum	14	
	(ii)Minimum	10	

SCHEDULEOFTECHNICALPARTICULARS FOR ACSRDOG

		Minimum Guaranteed Value	Proposed Value
A	Name of tenderer /contractor		
B.	TenderspecificationNo.		
C.	Name of manufacturer ofequipment.		
1.	Code name of conductor	ACSRDog	
2.	NominalAluminumArea(mm^2)	100	
3.	No. ofstrands (a) Aluminum	6	
	(b)Steel	7	
4.	Strand'sDiameter inmm		
	(a) Aluminium i)Standard	4.72	
	ii)Maximum	4.77	
	iii)Minimum	4.67	
	(b)Steel i)Standard	1.57	
	ii)Maximum	1.60	
	iii)Minimum	1.54	
5.	Toleranceon standarddiameterof		
	i)Aluminimum ofwire	±1%	
	ii)GalvanisedSteelWires	±2%	
6.	Approximateoverall diameter of completeconductor(mm)	14.15	
7.	Minimumbreakingloadofeachstrand in KN		
	a) Aluminum i)Beforestranding	2.78	
	ii)After Stranding	2.64	
	b)Steel i)BeforeStranding	2.70	
	ii)After stranding	2.57	
8.	Approximate calculatedbreakingload (KN)	32.41	

9.	Maximum resistance of eachAluminum strandat20ºC(ohms/km)	1.650	
10.	Calculatedresistance of conductorin ohms/km at20ºC	0.2792	
11.	Weight of Zinc coatinginrespect ofsteel core (GM/m^2)	150	
12.	Approximatemass ofeachstrandin kg/km		
	a) Aluminum	47.30	
	b)Steel	15.10	
13.	Minimumguaranteedmass inkg/km		
	a) Aluminium	287.6	
	b) Steel	106.4	
	c)Total	394	
14	Lay ratio		
	a)Steel core 6wirelayer(i) Maximum	28	
	(ii)Minimum	13	
	b)Aluminium- IstLayer (i)Maximum	14	
	(ii)Minimum	10	
	IIndLayer(i)Maximum	-	
	(ii)Minimum	-	

SCHEDULEOFTECHNICALPARTICULARS FOR ACSR WOLF

		Minimum Guaranteed Value	Proposed Value
A	Name of tenderer /contractor		
B.	TenderspecificationNo.		
C.	Name of manufacturer ofequipment.		
1.	Code name of conductor	ACSRWolf	
2.	NominalAluminium Area (mm^2)	158.1	
3.	No. ofstrands (a) Aluminium	30	
	(b)Steel	7	
4.	Strand'sDiameter inmm		
	(a) Aluminium i)Standard	2.59	
	ii)Maximum		
	iii)Minimum	2.59	
	(b)Steel i)Standard	2.59	
	ii)Maximum		
	iii)Minimum	2.59	
5.	Toleranceon standarddiameterof		
	i)Aluminimum ofwire	±1%	

	ii)GalvanisedSteelWires	±2%	
6.	Approximateoverall diameter of complete conductor(mm)	18.13	
7.	Minimumbreakingloadofeachstrand in KN		
	a) Aluminium i)Beforestranding	0.89	
	ii)After Stranding	0.85	
	b)Steel i)BeforeStranding	6.92	
	ii)After stranding	6.57	
8.	Approximate calculated breakingload (KN)		
9.	Maximum resistance of eachAluminium strandat20ºC(ohms/km)	5.49	
10.	Calculatedresistance of conductorin ohms/km at 20ºC	0.1871	
11.	Weight of Zinc coatinginrespect ofsteel core (GM/m^2)	190	
12.	Approximatemass ofeachstrandin kgs/km		
	a) Aluminium		
	b)Steel		
13.	Minimumguaranteedmass inkg/km		
	a) Aluminium	436	
	b) Steel	291	
	c) Total	727	
14	Lay ratio		
	a)Steel core 6wirelayer(i) Maximum		
	(ii)Minimum		
	b) Aluminium- (a) 6layer (i) Maximum 14	(b)18layer 16	
	(ii)Minimum 10	10	

SCHEDULEOFTECHNICALPARTICULARS FOR ACSRPANTHER

		Minimum Guaranteed Value	Proposed Value
A	Name of tenderer /contractor		
B.	TenderspecificationNo.		
C.	Name of manufacturer ofequipment.		
1.	Code name of conductor	ACSR Panther	
2.	NominalAluminumArea(mm^2)	212.10	
3.	No. ofstrands (a) Aluminum	30	

	(b)Steel	7	
4.	Strand'sDiameter inmm		
	(a) Aluminium i)Standard	3.00	
	ii)Maximum	3.03	
	iii)Minimum	2.97	
	(b)Steel i)Standard	3.00	
	ii)Maximum	3.06	
	iii)Minimum	2.94	
5.	Toleranceon standarddiameterof		
	i)Aluminimum ofwire	±1%	
	ii)GalvanisedSteelWires	±2%	
6.	Approximateoverall diameter of completeconductor(mm)	21	
7.	Minimumbreakingloadofeachstrand in KN		
	a) Aluminum i)Beforestranding	1.17	
	ii)After Stranding	1.11	
	b)Steel i)BeforeStranding	9.29	
	ii)After stranding	8.83	
8.	Approximate calculatedbreakingload (KN)	89.67	
9.	Maximum resistance of eachAluminum strandat20ºC(ohms/km)	1.650	
10.	Calculatedresistance of conductorin ohms/km at 20ºC	0139	
11.	Weight of Zinc coatinginrespect ofsteel core (GM/m^2)	150	
12.	Approximatemass ofeachstrandin kg/km		
	a) Aluminum	47.30	
	b)Steel	15.10	
13.	Minimumguaranteedmass inkg/km		
	a) Aluminium		
	b) Steel		
	c) Total	974	
14	Lay ratio		
	a)Steel core 6wirelayer(i) Maximum	28	
	(ii)Minimum	13	
	b)Aluminium- IstLayer (i)Maximum	16	

	(ii)Minimum	10	
	IIndLayer(i)Maximum	14	
	(ii)Minimum	10	

Theabove particulars shallstandmodifiediftheprovisionofrelevant IS areamended.

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CHAPTER–5

TECHNICALSPECIFICATIONFOR33/6.9KV,630KVA,1.0MVA,1.6MVA,3.15MVA, 5.0MVAOUTDOOROILIMMERSEDPOWERTRANSFORMERS

1.0 SCOPE

This specification covers the design, manufacture shop testing inspection and supply of above cited rating, 3 phase, 50 Hz, 33/6.9 KV power transformerscomplete with all fittings, accessories, associated equipment, Spares, 10% extra Transformer Oil,required for the MSDSS with off load tap changer/ on load tap changer suitable for local operation.

The offered rating transformer should have been tested for "Short Circuit withstand capability test" and "Impulse test" and "Temperature rise Test" in an NABL accredited Government Laboratory as per relevant IS/IEC and valid Type Test certificates in complete shape shall be accompanied with the bid offer.

2.0 STANDARDS

The transformers shall conform in all respects to ISS: 2026/1977 with latest amendment thereof except where specified otherwise. Fittings and accessories shall also comply generally with latest editions of relevant Indian Standards.

3.0 TECHNICALREQUIREMENTSOFPOWERTRANSFORMER

The transformers shall be core type construction, with two windings oil immersed, naturally cooled weatherproof construction and shall be suitable for installation of step down transformers. The rating and electrical characteristics of transformers shall be as following.

1	RatedMVAofTransformer(ONANrating)	**0.63MVA/1.0 MVA/1.6 MVA/ 3.15MVA/5.0MVA**
2	No. ofPhases	3
3	Typeof Installation	Outdoor
4	Frequency	50HZ(-5%to+3%)
5	Coolingmedium	Insulatingoil(ONAN)
6	Typeof mounting	Onwheels,mountedonrails
7	Ratedvoltage	
	a) Highvoltagewinding	33KV
	b)Lowvoltage winding	6.9KV
8	Highestcontinuoussystemvoltage	
	a)Maximumsystemvoltageratio(HV/LV)	36KV/12KV
	b)Ratedvoltageratio (HV/LV)	33KV/6.9KV
9	No.Of windings	TwowindingTransformers
10	Typeof cooling	ONAN(Oilnatural&airnatural)
11	MVAratingcorrespondingtoONANcoolingsystem	100%
12	Methodofconnection	
	HV:	Delta
	LV:	Star
13	Connectionsymbol	Dyn11
14	Systemofearthing	NeutralofLVsidetobesolidlyearthed
15	Percentageimpedancevoltageonnormaltapand	%impedance for:-

	MVAbaseat75^{0}CcorrespondingtoHV/LVratingand applicable tolerance	630KVA-4% 1.0MVA-5% 1.6MVA-6% 3.15MVA-7% 5.0MVA-7% (Tolerance+10%) (Nonegativetolerancewillbeallowed)
16	Intendedregularcyclicoverloadingofwindingsof winding	AsperIEC-76-1,Clause4.2
17	a)Anticipatedunbalancedloading	Around10%
	b)Anticipatedcontinuousloadingof windings(HV/LV)	110%ofrated current
18	Typeoftapchanger	OFFLoadupto3.15MVATRFand beyondthatON Load
	Rangeoftapping	+5%to–20%insteps of5.0%eachon HV winding, 7 tap positions. Tap No 3 will be the Principal tap position.
19	Neutralterminaltobebroughtout	OnLV side
20	Overvoltageoperatingcapabilityandduration	125%ofratedvoltage(Continuous)
21	Maximum Flux Density in any part of the core and yokeatratedMVA,ratedvoltage(33/6.9KV)and50 HZ.	1.5 Tesla
22	InsulationlevelsofWindings:-	33KV 6.9KV
	a)1.2/50microsecondwaveshape Impulse withstand(KVP)	170 75
	b)Powerfrequencyvoltagewithstand(KVms)	70 35
23	Typeofwinding Insulation	
	a)HV winding	Uniform
	b)LV winding	Uniform
24	Withstandtimeforthreephaseshortcircuit	AsperIS
25	Noiselevelatratedvoltage&frequency	AsperNEMA Publication
26	PermissibleMaximumtemperatureriseoverambient temperatureof50^{0}C	
	a)Oftopoilmeasuredby thermometer	35^{0}C
	b)Ofwindingmeasuredbyresistance	40^{0}C
	c)HotspotTemperature rise	54^{0}C
27	Minimumclearanceinair(mm):-	PhasetoPhase Phasetoground
	a)HV	400 320
	b)LV	280 140
28	Terminals:-	
	a)HVwindinglineend	36KVoilfilledcommunicating type porcelainbushing(Antifogtype)
	b)LV winding	17.5KVporcelaintypeof bushing (Antifogtype)
29	Insulationlevelof bushing:-	HV LV
	a)LightingImpulsewithstand(KVP)	170 95
	b)1minutePowerfrequencywithstandvoltage	70 38

	(KV-rms)	
	c)Creepagedistance(mm)(minimum)	900 300
30	MaterialforHV&LVconductor	Electrolyticcopper
31	MaximumcurrentdensityforHVandLV windingforratedcurrentatnormaltap	2.4A/mm^2
32	Polarisation Indexi.e ratio of Megger values at 600 sec.to60secforHVtoearth,L.VtoearthandHVto LV	Shallbegreaterthanorequalto1.5, but less than or equal to 5.
33	CoreAssembly	Boltless
34	TemperatureIndicator	
	a)Oil	Onenumber
	b)Winding	One number
35	Maximumpermissiblenoloadlossatratedvoltage and rated frequency	3.15MVA-3.0KW(Maximum) 1.6MVA-2.5KW(Maximum) 1.0 MVA- 1.8KW(Maximum) 5.0MVA-Guaranteeddatasheettobe submitted by Manufacturer.
36	Maximumpermissibleloadlossatratedcurrentat normal tape and at 75^0 C	3.15MVA-17.0KW(Maximum) 1.6MVA-13.5KW(Maximum) 1.0MVA-9.5KW(Maximum) 5.0MVA-Guaranteeddatasheettobe submittedbyManufacturer.

4.0 TAPS

4.1 Transformers with off circuit tap changing gear shall have taps ranging from (+) 5 % to (-)20%in equal steps of 5.0% each on HV side with 7 tape position. Tap 3 will be the principal tap position.

4.2 The tap changing switch shall be located in the convenient position so that it can beoperated from ground level. The switch handle will be provided with a locking arrangement along with tap position indication thus enabling the switch to be locked in position.

5.0 CORE

Transformer core shall have construction using high grade, non-aging cold rolled grain oriented (CRGO) silicon steel laminations confirming to HIB grade with lamination thickness notmore than0.23mmto0.27mm orbetter quoted gradecore. The coreshall be properly annealed to relieve stresses. The original invoices of material procured to be furnished. The core and coil assembly shall be securely held in position to avoid any movement under short circuit conditions. Laminations of different grade(s) and different thickness(s) are not allowed to be used in any manner or under any circumstances.

6.0 MAXIMUMFLUXDENSITY

a) The maximum flux density in any part of core and yoke at normal voltage and frequency on any particular tapping shall not exceed 15000 lines per sq. cm (1.5 Tesla). The design calculations in support of flux density shall be furnished by the TRF manufacturer alongwithdrawingofcorestepsandcalculationofeffectiveXsectionalareaofthecore.For

findingoutnoloadcurrentaveragevaluesofallthethreelimbsand phasesshouldbetaken into consideration.The Biddershallprovide saturationcurveofthe corematerial,proposed to be used.

b) LOADINGOFTRANSFORMER

The transformers shall be capable of operation continuously in accordance with IS: 6600-1972 and latest revision thereof at their continuous maximum rating and overload at any ratio.

c) PARALLELOPERATION

The transformers shall operate satisfactorily in parallel among themselves and with similar units to be installed.

d) DUTYUNDERFAULTCONDITIONS

i) Transformer shall be designed and constructed to withstand/without damage the thermal and dynamic effects of external short circuit under the conditions laid down in IS:2026 (Part-I).

ii) The thermal & dynamic ability to withstand short circuit shall be demonstrated by tests thermal and carried out on the transformer of same design.

7.0 NOLOADCURRENT

The no load current at rated voltage and at 112.5% rated voltage shall not exceed 1% and2% respectively. The variation shall be as per IS: 2026(Part-I). The design calculation, in respect of no load current at full voltage shall be furnished by the contractor.

8.0 MAXIMUMCURRENTDENSITY:

Maximum current density for HV and LV winding for rated current at normal tapin any case shall not exceed 2.4 Amp./mm.^{2}

9.0 TRANSFORMEROIL:

The transformer oil shall be EHV grade & comply with IS: 335 and latest amendments thereof. No inhibitors shall be used in the oil. 10% extra oil shall be provided. The extra quantity of oil shall be supplied in non-returnable drums along with the oil required for the radiator banks.

10.0 CONTINUOUSMAXIMUMRATINGANDTEMPERATURERISE:

Each transformer shall be capable of operating continuously at their normal rating without exceeding temperature rise limits with maximum daily average ambient temperature of 50 deg C as specified below:

i) Hot Spot:
Themaximumspottemperatureshallbelimitedto54degCoverambienttemperature.

ii) Winding:
Temperaturesraise40deg.Cbyresistancemeasurement.

iii) Oil:
35degCbythermometermeasurement.

11.0 IMPEDANCEVALUE:

The percentage impedance shall be as per required specification above & guided by IS: 2026 (part-5)/2011.

12.0 TRANSFORMERLOSSES:

12.1 The no load losses in kilowatt at rated voltage and frequency shall be 3.0 KW (Max)and Maximum Load losses at rated full load current and frequency at 75 Deg. C at normal tap position & rated frequency shall be guaranteed to 17 KW with no positive tolerance. (Ref: Sl 35 & 36 of Technical Requirement)

12.2 In case during testing the actual losses are found within guaranteed figures the transformers shall be accepted without any advantage to contractor for lower loss.

Where actual losses during testing are found in excess of maximum guaranteed figures, the transformers shall be rejected.

12.3 Measurement of losses shall form part of type test/routine/ acceptance test. The losses of first and subsequent transformers supplied shall also be guaranteed at the time of pre commissioning test and the losses exceeding guaranteed figures shall stand rejected. The supplier shall replace the transformer without any financial liability to the purchaser.

The supplier shall supply two copies of the type test/routine test certificate to each consignee with each transformer on receipt of dispatch instructions.

13.0 INSULATION

All windings of transformers shall have uniform class insulation when tested in Accordance with relevant IS: 2026/1981. The maximum hot spot temperature rise shall be limited to 54 Deg. C. over ambient temperature. The highest system voltage and the minimum basic impulse with stand level of winding for 1.2/50 μs full wave shall be as given below:

Ratedvoltage(KV)	Highestsystemvolt. (KV)	Minimumbasicimpulse withStandlevel(KVP)
LVSide6.9	12	75
HVSide33	36	170

Temperaturegradientbetweenwindingandoilshouldnotexceedthepermissiblelimits.

14.0 HV/LVTERMINALARRANGEMENT:

i) HV terminal shall be brought out into suitable solid porcelain type weather proof or oil communicating type bushing with single gap arcing horns. Terminal connectors for HV shall be suitable for dog/panther conductor.

LVterminalshallbebrought outinto suitable solidporcelaintypeweatherproof bushingthe terminal connectors for LV shall be suitable for Panther conductor.

The neutral of the transformer winding shall be brought out into separate whether proof bushing on the top cover of the transformer for being earthed.

ii) The electrical characteristics of bushing insulators shall be in accordance with IS: 2099/1977 as amended from time to time. All type and routine test shall be carried out in accordance with IS: 2099/1977. The test voltage for various tests as stipulated in IS: 2099/1977 is reproduced below:-

NormalSystem Voltage(KV)	RatedVoltageof thebushing (KV)	Visible Discharge Test(KV)	Oneminutewet& drywithstandtest (KV)	Lightning Impulse withstandtest(Imp. volt)(KV)
LVSide6.9KV	12	09	38	95
HVSide33	36	27	70	170

iii) Dimensions of the 12 KV bushing (6.6 KV side) shall conform to IS 3347/Part-III) and those of 36KVbushing(33KVSide)shallconformtoIS3347/(Part-V).Thecreepagedistancefor33KV shall be 900mm and for 6.6 KV shall be 300mm.

iv) Thetransformershallbesuppliedwithfirstfillingoffreshinsulationoil.Theoilshallconform to IS/335/1983 and its latest amendment, if any.

v) All insulating materials used in the manufacturer of the transformers shall be of the best quality of their respective kind, containable in the market and shall conform to relevant IS.

vi) The design and all materials including insulating materials used in construction of transformers shall be such as to reduce to maximum the risk of development of acidity in oil during the course of service.

15.0 A)FITTINGSANDACCESSORIESTOBEPROVIDEDONEACHTRANSFORMER:

i) Inspectioncovers
ii) Diagramandrating plate
iii) Terminalmarkingplate
iv) Twoearthingterminals
v) Liftinglugs
vi) Jackinglugs
vii) Flangedwheels
viii) Thermometerpocket
ix) Oilfillingholewithplug
x) Airreleasedevice
xi) Drainvalvewithplugwithlockingarrangements
xii) Filter valves, one suitable valve located at the top of the tank and one of similar size at the bottom of the tank mounted diagonally opposite to each other.
xiii) Three no. oil sampling valve for taking out sample from top, middle and bottom oftank
xiv) Conservator
xv) Dehydratingbreather
xvi) Radiators
xvii) Pressurereliefdevice
xviii) Gasandoilactuatedrelay
xix) Magnetictypeoilgauge
xx) Dialtypeoiltemperatureindicator
xxi) Dialtypewindingtemperatureindicator
xxii) KIOSK
xxiii) Anyotherpartsif necessary.

B) SPAREPARTS:

The suppliers shall provide the following mandatory spares for each of Transformer supplied at no extra cost.

1. H.V.&L.V.Bushing&Studs–Each2Nos

2. BimetallicconnectorforH.V&L.V.Bushings–Each2sets

C) Any fittings, accessories of apparatus which might not have been mentioned in the specification but which are usual and necessary in the equipment of similar nature and are recommendedbythemanufacturerforsatisfactoryoperationaretobeprovidedbythe

contractor without extra cost. All apparatus must be complete in all details whether mentioned in the specification or not.

16.0 RATINGANDTERMINALMARKINGPLATE:

16.1 **RATINGPLATE:**

Each transformer shall be provided with a non-detachable rating and terminal Marking plate(s) of weather proof material, fitted in visible position, mentioning complete information as given in clause-15.1 and 15.2 of latest version of IS: 2026 (Part-I) and clause-20 of IS: 1180 part-I-1989.

In place of serial number of transformer/ unique no. shall be punched on rating plate.Unique number has been allotted indicating the name of firm, capacity, specification and serial number of the transformers. No-load/Load losses must also be engraved on the diagram plate.TheentriesontheratingplateasperClause-15.1 and15.2oflatestversionof IS: 2026 (Part-I) shall be invariable marked (by etching engraving or stamping) Plate should be firmly riveted with tank so that it may not be detached afterwards.

16.2 In addition to aboveplate,the following details shallbe punched on amild steelplate ofsize 150x150x3mm. And this plate shall be welded firmlyon the transformer tank just above the rating plate in a visible position.

(1) Uniquenumber
(2) Nameof firm
(3) Warrantyperiod/Dateofmanufacture.
(4) DoWRPROPERTY.

16.3 The rating diagram plate shall be fixed to the transformer tank at an average height of 1750mm. above the ground level.

17.0 TANK:

17.1 The transformer tank and cover shall be fabricated from good commercial grade low carbon steel of tested quality, suitable for welding. The minimum thickness of which shall be 6mm. for the side and 10mm for the bottom & cover for transformers with longer sides having a horizontal length up to but not exceeding 1800mm. For horizontal length above 1800 mm, the minimum side plate thickness shall be 10mm. and the thickness of bottom and cover plate shall be 12mm.

The tank and the cover shall be welded construction. All seems shall be welded and wherever practicable, they shall be double welded.

Tanks stiffeners shall be continuously welded to the tank and designed to prevent retention of water.

17.2 The main body of the tank shall have sufficient strength to withstand and withoutpermanent distortion.

i) Avacuumof760mm.ofmercury.
ii) Continuous internal gas pressure of 0.7 atmosphere above atmosphere pressure with oil at Operating level i.e. the transformer tank should be able to withstand100% vacuum and also one atmosphere pressure above atmosphere internal pressure.

17.3 The detachable tank cover shall be bolted to the tank and the transformer design shall be such that the tank will not split between the lower and upper cooler connections.

17.4 Eachtankshallbeprovidedwiththefollowing:

a) Lifting lugs suitable for lifting the transformer complete with all accessories filled with oil by cranks.

A minimum of four jacking lugs in accessible position to enable the transformers complete with oil to be raised or Lowered using hydraulic or screw jacks.

Theminimumheightofjackinglugsabovebaseshall be:

a) Transformersabove10tonesweight:500 mm

b) Transformeruptoandincluding10tonesweight:300mm

b) Horizontal plates with 50 mm dia draw holes drilled the rein should be fitted adjacent to each comer of the rectangular tank at more than 750 mm from the base to permit haulagein any direction. On the rounded tanks the draw holes shall be located on the diagonals of the rectangular formed by the overall boundaries of the tank,

17.5 Each tank cover shall be of adequate strength and shall not distort when lifted. Inspection opening shall be provided to give easy access to lower ends of bushing terminals etc. for changing ratio or winding connection or testing to each connection. These shall be of adequate size not less them 450mmx350mm. Inspection hole(s) with welded flange(s) and bolted cover(s) shall be provided on the tank cover. The inspection hole(s) shall be of sufficient size to afford easy access to the lower ends of the bushings, terminals etc.

17.6 All bolted connections to the tank shall be fitted with suitable oil tight gaskets of nitrile rubber or equivalent, which shall give satisfactory service under the operating conditions. Special attentions shall be given to the methods of making the hot oil tight joints between the tank and cover as also between the cover and the bushings and all other outlets to ensure that the joints can be remade satisfactorily and with case, with the help of semi-skilled labor. Gaskets of neoprene and / or any kind of impregnated / bonded core or cork only which can easily be damaged by over-pressing is not acceptable. Use of hemp as gasket material is also not acceptable.

17.7 Suitable guide shall be provided for positioning the various parts during assembly or dismantling. Adequate space should be provided between the cores and winding and the bottom of tank for collection of any sediment.

17.8 Lifting eyes or lugs shall be provided on all parts of the transformers requiring independent handling assembly or dismantling.

18.0 CLEANINGANDPAINTING:

18.1 Before painting or filling with oil, all non galvanized parts shall be completely cleaned, freed from rust, scale and grease and all external surface cavities shall be filled by metaldeposition.

18.2 Interior of all transformer tanks and other oil filled chambers and internal actual works shall be cleaned of all scale and rust by short blasting. In case the process of shot blasting is notadopted it is to be thoroughly cleaned by chipping, wire brushing and sound reporting etc. These surfaces shall be painted with hot oil resisting varnish or paint.

18.3 External surface shall be given a priming coat and two finishing coats of durable oil and weather resisting paint or enamel. The colour of the finishing coast shall be dark admirable, gray conforming to no. 632 of ISS colour for ready mixed paints (second revision).

18.4 The requirement for the dry film thickness (DFT) of paint and the material to be used shall be as given below.

Sl. No.	Painttype	Areatobe painted	Noofcoats	DFT(Min)
1	Liquidpaint			
	a)ZincChromate (Primer)	Outside	02	45micron
	b)Polyurethane (Finished coat)	Outside	02	35micron
	c)Hotoil	Inside	01	35micron

19.0 PACKING:

The packingmay beinaccordance withthemanufacturer's standardpracticesoas toensure safe transit by goods trainwhich may involve transshipment. Special arrangement should be made to facilitate handling and to protect the projecting parts against damage in transit.

Although the method of packing is left to the discretion of manufacturers, it should berobust enough for rough handling that is occasionedduring transportation by ship/rail/road. The transformer shall be dispatched filled with oil/inert gases as per standard practiceof the manufacturer but purchaser shall be informed accordingly.

20.0 COOLINGOFTRANSFORMERS:

The transformer shall have 'ON-AN' cooling only. The cooling arrangement shall consist of detachable radiators, which may be directly mounted on the transformers. Connections between the radiators and tank shall be made with flanges provided with gaskets and an indicating short valve provided at both connection ends, which can be fastened in either open or closed position.

Theradiators shallbeso arrangedthatthesecanbedetachedfrom thetankorbankwithout disturbing the oil in transformer. These shall be designed to withstand the vacuum and pressure specified for the tank.

Radiators shall be so designed as to be accessible for cleaning and painting to prevent accumulation of water on the outer surface, to completely drain oil from the tank or bank and to ensure against formation of gas pockets when the tank is being filled. All connections between the radiators and tank or bank and between the bank and tank shall be provided with blank Flanges when the particular item is detached. Each radiator shall have a lifting eye, an oil drain and Vent at top.

c) CONSERVATOR:

A conservator complete with sump and drain valve shall be provided in such a position so as not to obstruct the electrical connection to the transformer, having a capacity between highest and lowest visible levels to meet the requirement of the expansion of the total cold oil volume in the transformer and cooling equipment from the minimum ambient temperature of 0Deg. C to 90Deg. C. The minimum indicated oil level shall be with the food pipe from thetankcovered with not lessthen15mm.Depthofoiland the indicated rangeof oil level shall be minimum to max.

If the sump is formed by extending the food pipe inside the conservator this extension shall be for at least 25mm.

The conservator shall be provided with two filter valves, one at the bottom and the other at the top at opposite and for filtration purpose.

One oil gaugemagnetictype with provision for low level shall bemountedon conservatorto indicate the minimum normal and maximum level as below: -

Minimum -5Deg.C

Normal +30Deg.C

Maximum +90Deg.C

Oneendoftheconservatorshallbeboltedintopositionsothatitcanberemovedfor clearing/ repairing purpose.

The oil connection from transformer tank to the conservator vessel shall be arranged at a rising angle of 3 to 9 Deg. C to the horizontal up to gas oil actuated relay and shall consist of 50mm. inside diameter pipe.

i) Thepassageofairisthroughsilicagel.

ii) Theexternalatmosphereiscontinuouslyincontactwithsilica gel.

iii) The moisture absorption indicated by a change in colour of the tinted crystals can be observed from distance.

iv) The silica gel Breathers shall have minimum quantity of silica gel as 1 Kg for every3500 Ltrsofoil in the tank. The container forthe dehydring agent shall beoftransparent plasticof best quality, to be approved by DoWR. The breather is mounted at approx. 1400mm. above ground level.

D) PRESSURERELIEFDEVICE:

A safety value of the chimney type with an equalizer pipe inter connecting the top of the conservatoranduppermostpartofthesafetyvalueshouldbeprovidedtopreventriseofoil in the safety value pipe. A stopcock should also be provided in the inter connecting pipe. An air release cock shall also be fitted in convenient position.

The safety value pipe shall preferably take off from the side of the transformer tank near to the tank covers and not from the top of tank cover. This is with a view to prevent the gases forming in the tank, from rising into the safety valve pipe and there by passing the gas andoil actuator Relay (defeating its purpose) and for avoiding the necessity for providing, a bottom diaphragm for the safety valve pipe, which would be necessary in case, it takes off from the tank cover.

E) GASANDOILACTUATEDRELAY:

A double float type gas and oil actuated relay (Buchholz Relay) shall be provided with alarm and ripping contracts to deduct accumulation of gas and sudden change in oil pressure, completewithshutoffvaluesonbothsidesandflangecouplingsandto permiteasy removal without conservator, a bleed valve for gas venting and test valve. The device shall be provided with two electrically independent potential free contracts, one for alarm on gas accumulation and the other for tripping on sudden rise of pressure.

F) TEMPERATUREINDICATINGDEVICE:

Minimum 150mm dia suitable dial type thermometer with maximum pointer and re-setting device with alarm and trip contacts to read the temperature in the hottest of oil shall be provided.

A dial type winding temperature indicator shall be provided to indicate the hottest spot winding temperature with contacts for alarm and tripping to be set at will.

G) MARSHALLINGBOXORKIOSK:

The transformer shall be provided with marshalling box or kiosk made of sheet steel, inwhich all the leads for gas and oil-actuated relays, oil winding temperature indication and alarm, low oil level alarm shall be brought out to suitable terminals. This KIOSK shall be perfectly mounted on transformers. Temperature indicators shall be housed in the KIOSK so that these are clearly visible.

The boxshall haveslopping roof and the interior andexterior painting shall be inaccordance with the specification. Padlock along with duplicate keys shall be supplied for marshalling box. The degree of protection shall be IP-55 or better.
All incoming cables shall enter the kiosk from the bottom and the gland plate shall not beless than 450 mm from the base of the box. The gland plate and associated compartment shall be sealed in suitable manner to prevent the ingress of moisture from the cable trench.

The schematic diagram of the circuitry inside the marshalling box be prepared and fixed inside the door under a suitable sheet.

21.0 AXLESANDWHEELS:

a) The transformer tank shall be supported on a structural steel base equipped with forged steel or cast steel single flanged wheel suitable for moving the transformer completely filled with oil. These wheels shall be suitable for being turned through an angle of 90 Deg. C and locked in that position when the tank is jacked up.

b) CENTEROFGRAVITY:

The center of gravity of the assembled transformer shall be low and as near the vertical center line as possible. The transformer shall be stable with or without oil. The location of center of gravity shall be shown on the outline drawing in all the views showing there in the position of transformer track also.

c) CLEARANCEIN AIR:

The clearance in air between live conductive parts and live conductive parts to earthed structure shall be as IS stipulation.

22.0 CORE:

Stage inspection for core shall be carried out by the owner through a Third party Agency.
Thecoreshallbebuiltupwith**highgrade,non-agingcoldrolledgrainoriented(CRGO) silicon steel laminations confirming to HIB grade with lamination thickness not more than 0.23mm to 0.27mm or better quoted grade core**.
The flux density in any part of cores and yoke at normal voltage and frequency shall not be more than 1.5 Tesla.
For Transformer Manufacturer (TM), who has in-house core-cutting facility, thepacked core coils shall be verified at their works as per followings along with witnessing of core-cutting.

a) Invoiceof supplier
b) Testcertificate
c) Packing list
d) Billoflading
e) Billofentrycertificatetocustoms
f) Grossweight
g) Netweight
h) Grade&thicknessofcorematerial

After being sheared, the lamination shall be treated to remove, all burns and shall be re-annealed to remove all residual stresses. At least oneside ofeach laminationshall be coated with an insulation coating as many as approved by the ISS and as per modern manufacturing

practice which shall be inert to the action of hot transformer oil and shall not deterioratedue to mechanical pressure.

The design of magnetic circuit shall be such as to avoid static discharge, development of short circuit path within itself or to the earthed clamping structure and the production offlux components at Right angles to the plane of laminations which may cause local heating. The laminations shall be flat and the final assembled core shall be free from distortion. Oil ducts shall be provided where necessary to ensure adequate cooling.

The core shall be rigidly clamped and fastened to ensure adequate technical strength and to prevent vibration during operation. The bolts used in the assembly of the core shall be suitably insulated and clamping structure shall be so constructed that eddy currents will be minimum.

The core shall be provided with lugs suitable for lifting the complete core and the coil assembly of the transformer.

The core and coil shall be so fixed in the tank that movement does not occur relative to tank during lifting, transport and installation.

The supporting framework of the core shall be designed so as to avoid the presence of pocketswhich would prevent complete emptying ofthe tank through the drainvalve or case trapping of air during filling.

The magnetic circuit shall be earthed to the clamping structure at one pint only through a link placed in as accessible position beneath an inspection opening in the tank cover. The connection to the link shall be on the same side of the core, as the main earth connection.

Where coil-clamping rings are of metal at earth potential, each ring shall be connected tothe adjacent core clamping structure on the same side of transformer as the main earth connection.

All earthing connection with the exception of these from the individual coils clamping rings shall have a cross sectional area of not less than 0.8 sq. cm.

No metal component including MS bolts and nuts should be kept floating in the vicinity of high voltage of coil and should be earthed.

23.0 WINDINGCONNECTIONANDVECTORS:

a) The primary winding shall be connected in delta and secondary winding in star as per vector symbol DY-11(IS: 2026). So as to produce a positive displacement of 30 deg. From the primary to the secondary vectors of the same phase (Vector rotation assumed counter clock wise).

The neutral point of the secondary (LV) winding shall be solidly earthed and should be brought out to a separate insulated terminal, enabling a current transformer for an earth leakage relay to be connected wherever required.

b) The winding shall be so designed that all coil assemblies of identical voltage ratings shall be inter changeable and field repairs to the windings can be made ready without special equipment's. The coil shall be supported between adjacent sections by insulating spacersand the barriers bracing's and other insulations used in the assembling at the winding shall be arranged to ensure free circulation of the oil and to reduce hot spots in the windings.

C) The coil shall be dried under vacuum and submerged in dried insulating oil to develop thefull electrical strength of the winding. All material used in the insulation and assembly of the windingshallbeinsoluble,non-catalyticandchemicallyinactiveinhottransformeroiland

shall not soften, ooze out, shrink, collapse or otherwise be adversely effected under the operating conditions.

D) All threaded connections shall be provided with locking facilities. All loads from the winding to the terminal board and bushing shall be rigidly supported to prevent injury fromvibration. Guide tubes shall be used where practicable.

E) The windings shall be clamped securely in place, so that they will not be displaced or deformed,during shortcircuits. Theassembledcoreand windings shall bevacuum driedand suitably impregnatedbefore removalfromthe trendingtank.The copperconductors usedin the coil structure shall be best suited to the requirement and all permanent current carrying joints in the windings and the leads shall be welded or brazed.

24.0 TRANSFORMERASSEMBLYANDTESTS:

a) The following tests shall be carried out in order to determine whether the transformer and its components comply with the specification and to provide necessary data. As many testsin the opinion of the purchaser as are possible shall be arranged by the manufacturer.

b) The transformer shall be completely assembled and tested as per ISS: 2026/1977 and any amendment thereof, at the factory. All the tests are to be carried out in the presence of any authorized representative of the EPC Developer/Third party as per direction of Engineer of Contract. Test shall be performed in compliancewithstandard practice and relevant ISS. The routine tests shall be carried out on transformer at the manufacturer's cost at their works/other institute of repute, before dispatch.

However it may be noted that no call for final inspection of the transformer shall be entertained if the transformer has not passed the stage inspection or its waival has not been issued by DoWR. The supplier is required to place the call for stage inspection in advance as illustrated in subsequent clauses of technical specification.

d) **ROUTINETESTS:**

Transformer routinetests shall include tests stated in latest issue of IS: 2026 (Part–1). These tests shall also include but shall not be limited to the following:

i) MeasurementofwindingDCresistance.
ii) Measurementofvoltageratingoneachtapping.
iii) Checkforpolarityandvoltagevectorrelationship.
iv) MeasurementofNoLoadlossandcurrentat90%,100%and110%ofratedvoltage.
v) Measurementofpercentageimpedanceonprincipaltapandextremetaps.
vi) Load loss at principal tap measured at rated frequencyby applying an approximately Sinusoidal supply to one winding sufficient to reduce rated current in the winding with the other winding short-circuited.
vii) Measurementofinsulationresistance.
viii) Polarizationindexi.eInsulationResistancefor10minutesandoneminute(R10mt/R 1 mt).
viii) Inducedovervoltagewithstandtest.
ix) Separatesourcevoltagewithstandtest.
x) Dielectric test on transformer oil shall also include testing of oil sample drawn from transformer out of the offered at the suppliers work for BDV of oil (fresh from storage of tank as well as from transformer).
xi) Oilleakagetest.

All tanks and oil filled compartments shall be tested for oil tightness by being completely filled withair/oilofaviscosity not greater thanthatof insulating oilconformingto IS:335 at an ambient temperature and subject to pressure equal to 0.7 atmosphere above atmospheric pressure measured at the base of tank. This pressure shall be sustain for a period of not less than 12 Hours for oil and one Hours for air during which time no leakage shall be occur.

E) **TYPETEST:**

Theofferedequipmentmustbeofprovendesignthroughsuccessfultypetestingparticularly TemperatureriseTest/ShortcircuitTest/LightningimpulsewithstandTest,asperIS:2026or latest amendment thereof (during last 5 years counted from the date of opening of tender) at CPRI, Bangalore/Bhopal or NTH, Ghaziabad orERDA, Varodara,. The manufacturer shall carry out type tests in accordance with IS: 2026 on one piece of one rating. Before conducting theTemperature rise Test, short circuit test and Impulse test, the firm will offer for both stage inspections and final inspection of the transformer by through a 3rd party agency as well as EPC's authorized executives at the manufacturer's works. If thetransformer complies with the specification and offered technical parameters, the transformer will be sealed by authorized engineer(s) of EPC Developer and thereafter the transformercanbetransportedtoCPRI/NABLunitforrequiredtypetestsinpresenceofEPC Developer's authorized representative(s) who will verify the seal & allow for conducting the type tests.The type tests shall include:

(1) VacuumTest:

Transformer tank at an internal vacuum limiting to one atmosphere but not more than the pressure of 3.33 KN./Sq.m. (25 mm of Hg.) for one Hour.

The permanent deflection of flat plates after vacuum has been released shall not exceed the value specified below without affecting the performance of the transformer:

HorizontalLengthofflatplate(mm)	Permanentdeflection
Upto&including750	05
751to1250	6.5
1251to1750	08
1751to2000	9.0
2001to2250	11
2251to2500	12.5
2501to3000	16
Above3000	19

(2) PressureTest:

Transformertank togetherwith its radiators, conservators,vessels and other fittings shall be able to with stand a pressure corresponding to 0.7 atmosphere above atmospheric pressure measured at the base of the tank and will be maintained for one hour. The permanent deflection of the flat plate after the excess pressure has been released shall not exceed the figures specified above.

(3) ShortCircuitTest:

AsperISS:2026/1977andlatestamendmentthereof.

(4) IMPULSEVOLTAGEWITHSTANDSTESTLIGHTINGIMPULSETEST:

This test is to be carried out as per IS: 2026/1981(Part-III) Para 13 and latest amendments thereof on all limbs of HV and LV. The tapping position for each limb shall be selected as recommended in clause 6.3 of above IS.

(5) Measurementofacousticnoiselevel.

e) The transformer having passed successfully through the type tests along with verification of losses by test house shall be considered as acceptable design. The physical dimensions ofthis transformer shall formthe guidelines for subsequent supplies. In caseof anyvariation in any dimension incorporated in the approved drawings, shall be finally got approved by the engineer of the Contract taking into consideration, the dimensions offered in GTP/drawings as per test reports and drawings finally approved by CPRI/BHEL/Govt. Test House after conduction of type test.

Incase,itisfoundduringthejointinspectionoftransformers(s)bytheexecutiveofEPC Agencyand/orrepresentativeofthethirdpartyentrustedwiththeworkofinspection and/or representative of the firm that the firm has supplied substandard material then also theabovepenalactionshallbetaken.Iftherepresentativeofthethirdpartyand/orof supplier or both are not present at the time of abovejoint inspection, then DoWR has righttotakethepenalaction,asmentionedabove.Intheeventofcancellationofordersno compensation shall be given to the firm by EPC Agency with no liability to DOWR.**TOLERANCE:**

However, no negative tolerance on all the parameters including physical of dimensions tank certificated by test house/ laboratories as mentioned in respect of the equipment which has been successfully type tested shall be allowed.

SPECIALTEST:

Measurement of zero sequence impedance test on one transformer. Inspection shall be carried out only after routine test results are submitted to 'Engineer of the Contract' , giving serial number of transformer.

All the original type test reports including verification of load/No. load losses from CPRI/BHEL/Govt. Test House/ERDA Vadodara along with detailed drawing approved by CPRI/BHEL/Govt. Test House as approved by the purchaser shall be submitted after successful "TypeTesting" to prove that the design as successfully type tested.

25.0 INSPECTION & TESTING OF TESTING INSTRUMENTS AND RAW MATERIALS AND STAGE INSPECTION:

The supplier shall offer the core, windings and tank of each transformer for inspection by a 3rd party agency as well as EPC Agency representative(s). During stage Inspection, all the measurements like diameter, window height, leg centre, stack width, stack thickness, thickness of laminations etc. for core assembly, conductor size, Insulation thickness, I.D.,O.D, winding height, major and minor insulations for both H.V and L.V windings, length, breadth, height and thickness of plates of Transformer tank, the quality of fittings and accessories will be taken / determined. The supplier can offer for final inspection of the transformers subject to clearance of the stage Inspection report by the DOWR.

Transformer manufacturer shall offer type test report of bought out item like HV Bushing, LV bushing, NCT, for review. All the measuring instruments i.e. Voltmeter, Avometer, CT,PT'S and other instruments used in inspection and testing shall be properly calibrated and sealedonceinayear.CalibrationCertificationwhendemandedbytheinspectionofficer

shall be produced for verification purposes. In case of disputes regarding calibration of instruments, instruments shall be sealed and signed by the representative of suppliers and purchaser and will be sent to institution/lab. of reputes or its own lab. for calibration at the cost of supplier. The result of such testing shall be binding on the supplier.

The purchaser reserves the right to depute his representative/agency for carrying out stage inspections at any stage of manufacturing process for checking qualityof manufacturing and also the raw materials.

The contractor shall offer all reasonable facilities for such inspection. The contractor shall furnish detailed production schedule including different phase of material procurement, manufacture and fabrication to facilitate the purchaser for deputing his representative/agency for carrying out stage inspection.

The contractor shall inform the purchaser likely date of assembly of core and readiness of HT & LT coils enabling the purchaser to depute his officers for stage inspection or issuing waivel of stage inspection.

Recordsshallbemaintainedoffallthetestcarriedbythesupplierontransformerofferedfor inspection and test shall produce when demanded by the inspection officer to satisfy that the transformer are being offered after carrying all the necessary tests by the supplier.

26.0 SPAREPARTS:-

Thesuppliersshallprovidethefollowingmandatorysparesforeachof Transformersupplied

1. H.V.&L.V.Bushing&Studs–Each2Nos
2. BimetallicconnectorforH.V&L.V.Bushings –Each2sets

27.DOCUMENTSTOBESUBMITTEDFORCONSIDERATION.

1. Source of purchase of core stampings along with its grade to be used in manufacturer (copy of invoice of CRGO sheet manufacturer or their authorized agent in India or quotation from their reputed processors of core lamination may be enclosed).
2. Calculationoffluxdensity.
3. Calculationofeffectivecrosssectionalareaofthecoreat97%stakingfactor.
4. Calculationofcore weight.
5. Calculationofnoloadcurrentat100%and112.5%voltage.
6 Calculationofno-loadloss.
7. Calculationofloadlossat75Deg.C
8. Calculationofheatdissipation.
9. Enclosure of curves relating to characteristics of CRGO steel and from which the values are read off for above calculation.

28.0 DRAWING/INSTRUCTIONSBOOKS/OPERATION&MAINTENANCEMANUALETC:

TheManufacturershallsubmitfollowingdrawings:

a) Outline dimensions drawings of transformers and accessories giving complete details ofmain components parts and transportation details showing dimension and weight of the each package. (Top, Front & side views). Off load tap changer equipment earthing details, top cover/flange fill arrangement.

b) Name plate diagram with tap changing details and guaranteed maximum load and no- Load losses without any plus tolerance.

c) Systematic controlandwiringdiagram of allauxiliaryequipment includingmarshallingBoxes with terminal number of various accessories.

d) Bushingdrawing,porcelainportiondrawingsandterminalconnectordrawingwiththeir Electrical and mechanical characteristics in tabular form.

e) Drawinggivingtheweightforfoundationoftransformer.

f) Drawing of core and winding (including sectional view) along with the clampingArrangement giving details viz. Core dia, weight, stacking HV/LV winding weight and size/ number of coils/limbs, inner dia, outer dia, axial length, clamping channel, Sizeof the rod dia meter, it's nos. and length etc. Cores steps details to be shown Separately and clearly indicating the clearance provided inside and outside the transformer.

The manufacturer shall supply 2 copies of instruction books/operation and maintenance manuals spare parts booklets along with descriptive literature and date of transformer construction, winding, bushing, heat exchanger, tap changing gear etc. to each consignees with each transformer and to DoWR.

All tests and inspection shall be made at the place of manufacturer unless otherwise specificallyagreed upon bythemanufacturerand theengineerof thecontractatthe timeof the purchaser. The manufacturer shall offer the inspecting officer (s). Representing the Engineer of the Contract, all reasonable facilities without charge to satisfy him that the materials are being manufactured in accordance with this specification.

NOTE: Inspection shall be carried out only after routine test results are submitted to Engineer of the contract and Unique number of transformers are given.

29.0 GUARANTEEDTECHNICALPARTICULARS:

The guaranteed technical particulars shall be subject to tolerance as per relevant ISS. However no negative tolerance shall be allowed on ways and dimensions thatofquoted and further no negative tolerance shall be allowed in weights and dimensions then that of short circuit tested transformers.

The toleranceof guaranteedperformancefigures shallbe specifiedinISS:2026/1985 (Part-I) amended from time to time except where specified otherwise.

a) Thetendershallberequiredtogivethefollowingdetailsintheirtenders:

i) Materialstoconfirmtotherelevant ISStechnicalspecificationetc.

ii) Tenders shall confirm that the raw material would be of standard quality giving of source of purchase, name of manufacturer etc.

iii) Incaseanylocalitems(rawmaterials)purchasedfromlocalmarket,aretobeusedthesame shall clearly satisfied.

iv) Details of facilities if any, for testing of raw materials. In case the same is to be tested at the raw material supplier's premises, or any other test house, the same shall be mentioned. If only test certificates of raw materials are proposed to be submitted, details of theauthorities issuing the test certificate shall be mentioned.

v) A facility available at the works and details of equipment's available for the manufacturing process and their capacity.

vi) Detailsoftechnicalsupervisorystaffavailable.

vii) DetailsoftestfacilitiesavailableforthetestingasperISS/technicalspecification.

viii) Test certificates of the testing and calibration of test equipments. This will be inspected by the inspecting teams at the time of acceptance of material.

ix) Detailsofaftersalesserviceavailable.

x) Tenderers will have to submit his quality assurance plan, vender rating will be decided on QAP submitted by the tenderer, manufacturing facilities adequate testing facilities etc. available with him.

b) Inspectionatthesupplier'sinspectionpoint(SIP).Thestagewillbeasfollow:-

i) Rawmaterial/componentsinspection.

ii) InprocessinspectionORstageinspection.

iii) The work of stage inspection referred to above will for the time being confirmed to all types of transformers. In case of provision of stage inspection, the manufacturing work shall continue only after approval of the inspection team.

26.0 SPARES:

a) Tenderers shall submit list for any special tools required during erection and maintenanceand the spares are given below:-

i) HVBushing.

ii) LVcableboxcompletewithbushing.

iii) Neutralbushing.

iv) Setofgaskets.

v) Oiltemperatureindicator.

vi) Magneticoillevelgauge.

vii) Silicagelchargeforbreather.

viii) Explosionventdiaphragm.

ix) Setofcoilsforcorelimitofwinding.

b) The tenderer shall also submit for any other items of spares recommended for five years normal operation. The purchaser will decide the actual spares to be ordered on the basis or the list and the item-wise price of spare parts.

c) The cost of spare tools and accessories will not be taken into consideration for bidevaluation purposes.

SCHEDULEOFGUARANTEEDTECHNICALPARTICULARSFOR33/6.9KV,TRANSFORMERS

1.	Nameof Manufacturer	
2.	Typeof Transformer	
3.	**Rating**	
a.	Ratedoutput (MVA)	
b.	RatedVoltageofHV&LV (KV)	
c.	RatedCurrentofHV&LV(A)	
d.	NoloadVoltageratio	
e.	No. ofPhases	
f.	Ratedfrequency	
4.	**Connections**	
a.	HighVoltage	

b.	LowVoltage	
c.	VectorGroupSymbol	
5.	**CoolingArrangement**	
a.	Typeof cooling	
b.	NumberofCoolingtubes/finsperradiatorandnumberof radiators	
c.	Sizeofradiator fins	
d.	Thicknessofsheet	
e.	Horizontaldistancebetweenradiators	
f.	VerticaldistancebetweenCorecenterlineandradiatorcenter line	
6.	**Dimensionofinsideoftank (mm)**	
a.	Length	
b.	Breadth	
c.	Height	
d.	Weightoftankwithout fitting	
7.	**ThicknessoftransformertankPlate(mm)**	
a.	Sides	
b.	Bottom	
c.	Cover	
8.	**OverallDimensionofTankwithFittings(mm)**	
a.	Length	
b.	Breadth	
c.	Height	
9.	**DetailsofOil**	
a.	StandardsofOil	
b.	QuantityofOil(Ltr.andKg.)	
C	Quantityofextraoil(LtrandKg)	
10.	**DetailsofCore**	
a.	Materialofcorelamination&Grade	
b.	Thicknessofcoreplates	
c.	InsulationofCore lamination	
d.	Window Height	
e.	LegCenter	
f.	CoreDiameter(approx.)(mm)	
g.	Corecrosssectionalarea(gross)(mm^2)	
h.	Corecrosssectionalarea(net)(mm^2)	
i.	Maximumfluxdensityincoreatnormalvoltage,frequency andratio	
j.	WeightofstampingincoreandyokeseparatelyinKgs.	
	i)Core	
	ii)Yoke	
i.	SizeandNo.ofclampingchannels	

li	Weightofclampingchannelswithstiffeners	
k.	Size&numberoftierod(ifused)	
l.	Size&numberofcore bolt	
(Note:Pleaseenclosedetailsofcore-steps,itsdrawingandfluxdensity,weightofcore, fittings,copper,oil,OffLoadTapChangerseparately).		
11.	**Weightoftransformer**	
a.	Weightofcoreonly	
b.	WeightofcoreassemblyexcludingHV&LVcoils	
c.	Weightofcompletecorecoilassembly	
d.	ValueofTransformerOil	
e.	WeightofTransformer oil	
f.	WeightofinsulatedconductorinHV	
g.	Weightofinsulatedconductorin LV	
h.	WeightofTankandfittings(Kgs.)includingtapchanger.	
i.	Totalweightoftransformerwith oil	
12.	**DetailsofWinding**	**HV/LV**
a.	Typeofwindingand material	
b.	ConductorSize(bare)	
c.	Crosssectionalarea(mm^2)	
i.	Gross	
ii.	Net	
d.	Typeofinsulationof conductor	
e.	Sizeofinsulatedconductor	
f.	Numberofdisc/coilperlimb	
g.	No.ofcoilsper disc	
h.	Internaldiaofcoil	
i.	Outerdiaofcoil	
j.	Axiallength	
k.	Meanlengthofturns(mm)	
l.	No. ofturns	
m.	Interturn insulation	
n.	Endturninsulation	
o.	Typeofaxialcoil supports	
p.	Detailsofendclampingrings	
q.	Whetherwindingsareinterleaved	
r.	Sizeofcoolingducts	
s.	Weightofbareconductorusedinoneleg(kg.)	
t.	Weightofinsulatedconductorusedinoneleg(kg.)(dry)	
u.	I^2Rlossat75^0C(per phase)	
v.	MaximumcurrentdensityinwindingatCMR–Amp./Sq cm.	
W	Polarizationindex(ratioof Megger valuesat600secto60 secforHVtoearthandHVtoLV)	Shallbegreater thanorequalto

		1.5
u.	Resistanceofwinding(with5%tolerance) a) at20 °C(Ohms) : b) at75 °C (Ohms)	
(Note:Enclosecalculationoflosseswithcompletedetailsoffactorassumed,core& windingdetailsofdrawing)		
13.	Thermaltimeconstants– Hrs.	
14.	TerminalarrangementHVside	
15.	TerminalarrangementLVside	
16.	Regulationatfullloadat 75^0C	
a.	Atunitypower factor	
b.	At0.8powerfactor (lagging)	
17.	**Percentageefficientlyatnormalratio,ratedvoltageandat75^0Caverage windingtemp.**	
		UPF
a.	FullLoad	
b.	3/4FullLoad	
c.	1/2FullLoad	
d.	1/4FullLoad	
18.	Noloadcurrentaspercentageoffullloadcurrentatrated volt.andfrequencyin%	
19.	Powerfactorandnoloadcurrentatnormalvolt.and frequencyin%	
20.	**RMSvalueofsymmetricalshorttimecurrentratingasperISSwhichthe transformercanwithstandanditsduration**	
a.	H.V.Winding	
b.	L.V.Winding	
21.	Maximumoutofbalanceforceinwindingonshortcircuit atthe terminals	
22.	**ClearancebetweenphasesinAir(mm)**	
a.	H.V.Side	
b.	L.V.Side	
c.	L.V.toEarth	
23.	**Clearanceinoil(mm)**	
a.	InternalclearancebetweeninnerwallsofTank&corecoil	
b.	Onlengthside	
c.	OnBreadthSide	
d.	RadialclearancebetweenH.V.&L.V. Winding	
e.	PhaseofphaseclearancebetweenH.V. Limb	
f.	RadialclearanceofL.V.coilfromcore	
g.	MinimumclearancebetweenLVPoleto earth	
h.	HorizontalductbetweenH.T. disc	
i.	EndclearanceofH.T.coilfromYoke(withangleshaped windings)	

j.	Minimumclearancebetweencore&tankbottom	
k.	AngularductsbetweenLT&HTwinding	
24.	**InsulationDetails**	
a.	EndspacingofL.V.	
b.	EndspacingofH.V.	
c.	L.V.windingtocore	
d.	BetweenHV&LVwinding	
e.	Interphase barrier	
f.	Endphasebarrier	
25.	**InsulationLevel**	**H.V.**
a.	SeparatesourcepowerfrequencyVolt.Withstand–KV.	
b.	Inducedovervoltagewithstand–KV	
c.	1.2/50μsfullwavelightingimpulsewithstandvoltage-KV	
	i) Impulse	
	ii) Powerfrequency(Dry&Wet)	
d.	Voltagetoearth forwhichthestarpointwill beinsulated– KV	
	i) Impulse	
	ii) Powerfrequency(Dry&Wet)	
26.	PerformancereferenceTemp.(Deg. C)	
27.	VoltspercoilofHVwinding(Volts)	
28.	Approx.VoltsperlayerofHVwinding(Volts)	
29.	Impedancevoltageatratedfullloadandtransformation	
30.	PercentagereactanceRatioatratedvoltage&frequency at75^{0}C.	
31.	Percentageresistanceat75^{0}C	
32.	Impendencevoltageatprincipaltappingandat75^{0}C average winding temperature expressed as percentage of rated voltage between HV & LV winding - %	
33.	Permissibledurationofoverloadfollowingcontinuous runningatnormalratedloadinanambientTemp.of50 Deg. C.	
a.	10% overload	
b.	20% overload	
c.	30% overload	
34.	**Maximumtemperatureriseatfullload(abovemax.averageambientTemp. of50 ^{0}C.)**	
a.	OftopoilbythermometerDeg.C.	
b.	OfwindingbyresistancemethodDeg.C.	
c.	ByhotspottemperatureindicatorDeg.C.	
35.	Limitofhotspottemperatureforwhichdesigned –Deg.C.	
36.	TemperatureGradientbetweenwindingandoil–Deg.C.	
37.	MaximumNo.loadlossatratedvoltageonprincipal	

	tapping at rated frequency (Guaranteed without any plus tolerance)(including25%strayno loadlossforconsidering in-consistenciesofB-Hcharacteristicsofcorematerialand workmanship).	
38.	Maximumloadlossat ratedcurrentonprincipaltappingat 75^0C.(Guaranteedwithoutanyplustolerance)including 10% stray load loss)	
39.	Resistancevoltagedropatratedcurrentforprincipaltappingat 75^0Caveragewindingtemperatureaspercent of ratedvoltage-%	
40.	Reactancevoltagedropexpressedaspercentforrated voltage-%	
41.	**Temperatureindictors**	**OilTempInd.**
a.	MakeandType	
b.	Permissiblesettingrangesforalarm&trip.	
c.	No.ofcontacts	
d.	Currentratingofeachcontact.	
42.	Gasandoilactuatedrelaydescriptiondata&rangeof settings,schematicdiagrametc.	
43.	Typeofpressurereliefdevice&pressureatwhichit operates.	
44.	Detailsofmagneticoilgauge	
45.	Weightofsilicagel(Grm.)	
46.	**ParticularofBushings**	**H.V./ LV**
a.	Nameof manufacturer	
b.	Type	
c.	Voltagerating–KV	
d.	Visiblepowerfrequencyvoltagedischargetest–KV	
e.	Drypowerfrequencywithstandvoltageforoneminute	
f.	Wetpowerfrequencywithstandvoltagefor30minutes	
g.	Drystandardlightningimpulsewithstandvolt-KV	
h.	Creepagedistanceinair(mm)(protectedandtotal)	
i.	RecommendedGapsetting– mm	
j.	Weightofassembledbushing KG	
47.	Freespacerequiredatthetopforremovalofbushing– mm	
48.	Minimumclearanceheightforliftingcore&windingsfrom tank	
Note:TypetestsReportsofbushingsshallbesubmitted		
49.	DetailsofOffloadtapchanger	
a.	Make	
b.	Type	
c.	Rating	
	i)Ratedvoltage	

	ii)Ratedcurrent	
	iii)stepvoltage	
	iv)No.of steps.	
50.	**Shippingdetails**	
a.	Partsdetachedfortransport	
b.	Approx.Weightofheaviestpackage–kg.	
c.	Approx.dimensionoflargespackage-mm	
	i) Length	
	ii) Breadth	
	iii) Height	
51.	**TypeTesting**	
a.	Whetherthetransformer oftheoffereddesignhasbeen typetestedduringlast5yearsfromthedateofopeningof tender?	
b.	Ifyes,whenandwherewasittypetested?	
c.	Isthereanydeviationinthetechnicalspecificationof offeredfor33/6.9KV,powertransformer?	
52.	Detailsoftestreports	

Sl. No.	**NameofTest**	**Dateof Test**	**Whethertest reports enclosed or not(Yes/No)**	**Ifyesno.of sheets.**
1.	TemperatureRiseTest			
2.	VacuumTest			
3.	PressureTest			
4.	ImpulseVoltagewithstandtest (lightningImpulseTest)			
5.	ShortCircuitTest			
6.	ThermalabilityTest			
7.	ZerosequenceImpedanceTest			

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CHAPTER-6

TECHNICALSPECIFICATIONFOR33KVOUTDOORVACUUMCIRCUITBREAKERS

1. SCOPE

1.1 This specification covers design,engineering,manufacture,testing, and inspection before dispatch packing of 33KV Outdoor Vacuum Circuit Breakers for use in the 33/6.6KV MSDSS and/ or DSS for Power Supply to the project.

1.2 All vacuum circuit breakers must be manufactured by ISO9000 certified Organization and shall have been type tested at CPRI or any Govt. approved laboratory within last 5 years. The Bidder shall demonstrate compliance with this requirement by supplying with the bid, copies of the type test certificates together with performance certificates from purchasers/ users.

Theuserscertificatemustincludethedetailaddressoftheuser,date ofcommissioningof the equipment, date of issue of the letter, No. of years of satisfactory performance of the equipmentwithModel/Typeused.Atleastoneoftheuserscertificateshallbesubmitted from the state or Central Government or their undertaking.

1.3 **TheDimensionofTypeTestedVCBscanonlybeaccepted.**

1.4 The scope also includes **G.I.** supporting structure for the circuit breaker and current and potential transformers, operating mechanism, local/ remote control cabinet, relay control panel, foundation bolts, all the accessories and auxiliary equipment mandatory spares and specialtoolsforsatisfactoryinstallationandoperation.

1.5 Thecircuitbreakersshallconforminallrespectstothehigheststandardsofengineering, design, workmanship, this specification and the latest revisions of relevant standards at the time of offer and the owner shall have the power to reject any work or materials, which, in his judgment, is not in full accordance therewith.

2. STANDARDS

Expectwheremodifiedbythisspecification,thecircuitbreakersandtheaccessoriesshall bedesigned,manufacturedandtestedinaccordancewithlatest editionsofthefollowing standards.

IEC/ISO/BS	**IS**	**Subject**
IEC:56 **IEC:62271-100& 200**		Highvoltagealternatingcurrentcircuitbreakersgeneral requirement.
IEC:694	IS:12729	Commonclausesofhighvoltageswitch-gearandcontrolgear standards (for voltage exceeding 1000 V).
IEC:60	IS:9135	HighVoltagetestingtechniques.
IEC:427	IS:13516	MethodofsynthetictestingofHV.A.Ccircuit breakers.
IEC: 1233		HV.AC.Circuitbreakers-inductiveloadswitching.
IEC:17A/CD:474		HV.AC.Circuitbreakers-capacitiveswitching.
IEC:529	IS:13947	Degreeofprotectionprovidedby enclosure.

IEC:137	IS:2099	InsulatingbushingforA.C.voltagesabove1000V
IEC:233	IS:5621	Hollowinsulatorsforuseinelectricalequipment&testing.
IEC:273	IS:5350	Characteristicsofindoorandoutdoorpostinsulatorsfor systems with nominal voltages greater than 1000V.
IEC:815	IS:13134	Guideforselectionofinsulatorsinrespectofpolluted conditions.
IEC:34	IS:996	A.Cmotors
ISO:1460BS:729	IS:2629	Hotdipgalvanizing
	IS:2633	Methodoftestinguniformityofzinccoatedarticles.
	IS:5	Colourforreadymissedpaintsandenamels
	IS:6005	Codeofpracticeforphosphatingorironandsteel.
IEC:227	IS:1554	P.V.CInsulatedcablesforvoltagesuptoandincluding1100 Volt.
IEC:269	IS:13703	Lowvoltagefusesforvoltagesnotexceeding1000volt.
ISO:800	IS:1300	Phenolicmouldingmaterials.
	IS:13118	Guideforuniformmarkingandidentificationofconductors and apparatus terminals.
IEC:185	IS:2705	Currenttransformers.
IEC:296	IS:335	Specificationforunusedinsulatingoilfortransformerand switchgear.
IEC:186	IS:3156	Potentialtransformers.
CBIP Technical Report No. 88 revised July, 1996 read with amendment issued (April, 99, September,99andalsoanyother amendmentthereafter)		SpecificationforACStaticElectricalEnergyMeter.

This list is not to be considered exhaustive and reference to a particular standard or recommendationinthisspecification doesnotrelievetheSupplierofthenecessityof providing the goods and services complying with other relevant standards or recommendations.

3.

REQUIREMENTS:

The circuit breakers to be supplied against this specification shall be required tocontrol the primary side of 33/6.6 KV power transformers in MSDSS, incoming 33KV feeders or the outgoing feeders in these sub-stations. The circuit breakers shall be suitable for 3 phase 50Hz solidly grounded neutral system and shall have normal current carrying capacity and symmetrical short circuit current breaking capability as mentioned hereunder. **Preference will be on the following make Vacuum Interrupter such as AREVA, ABB, CGL, Megawin & BEL, as per the vendors listed in the Bid documents. No other make will be considered.**

3.1 BASICTECHNICALREQUIREMENTS:

The vacuum circuit breakers are required to meet the following basic technical requirements.(ReferencestandardsIEC:62271 -100&200andassociatedstandardslisted in this specification.

BasicTechnicalRequirements

Sl.No	Particulars	Requirements
1	Servicetype	Outdoor
2	No. ofPoles	3
3	Nominalsystemvoltage	33KV
4	Highestsystemvoltage	36KV
5	Rednormalcurrentat50^{0}C	
i)	ForBus-barofCircuitBreaker	1250A
ii)	For Interrupter	2000A
iii)	ForOutgoingFeeders/Forincomer	1250A
6	Ratedshortcircuitbreakingcurrent(rms)for3Sec	25KA
7	Ratedshortcircuitmakingcurrent(peak)	62.5KA
8	Ratedshorttimecurrentwithstandcapabilityfor3 sec.	25KA(Panel)/25KA (Interrupter)
9.	Ratedinsulationlevel:	
i)	Oneminutepowerfrequencywithstandvoltagetoearth(wet and dry) rms Dry	95

	Wet	75
ii)	Impulsewithstandvoltagetoearthwith1.2/50μsec,waveof +veand–vepolarity (Peak)	170KV
10	First–pole–toclear factor	1.5
11	Ratedoperatingsequence(forauto reclosing)	O-0.3Sec-CO-3min-CO
12	Maximumbreaktime	3cycles
13	Ratedoutofphasebreakingcurrent	25%ofthesymmetrical short circuit breaking current
14	Maximumpolescatter	10miliseconds
15	RatedAuxiliarysupplyforspringchargemotor,lamp&heater circuit.	230VA.C
16	Ratedsupplyvoltagefortrip/closecoil	48VD.C/110VDCasper manufacturer
17	Minimumcreepagedistance(mm)	900mm
18	Minimumprotectedcreepagedistance(mm)	580mm

4. SERVICECONDITIONS:

Theserviceconditionsshallbeasfollows:

- Maximumaaltitudeabovesealevel 1,000m
- Maximumambientairtemperature 50^0C
- Maximumdailyaverageambientairtemperature 35^0C
- Minimumambientairtemperature 5^0C
- Maximumtemperatureattainablebyanobjectexposedtothe sun 60^0C
- Maximumyearlyweightaverageambienttemperature 32^0C
- Maximumrelativehumidity 100%
- Averagenumberofthunderstormdaysperannum (isokeraunic level) 70
- Averagenumberofrainydaysperannum 120
- Averageannualrainfall 1500mm
- Maximumwindpressure 260Kg/m^2

5. 33KVVACUUMCIRCUITBREAKERS

5.1 General

The circuit breakers shall be structure mounted open type with vacuum as interrupting media incorporating separate interrupters of 2000 A rating for each phase mounted on single frame. There shall be a common drive mechanism actuating the interrupters, which must work in synchronism. These breakers shall be provided with suitable local control while provision shall be made for remote control.

The circuit breakers shall be fitted with spring mechanism type. The inherent design of these circuit breakers shall be such that they shall satisfactorily perform all test duties and interrupt out-of-phase current and produce very low over voltage (<2.0p.u.) on allswitching circuits, capacitive and inductive to **IEC:62271 - 100 & 200** and other associated standards mentioned in the clause of this specification.

The terminal pads shall have **Al. Alloy with very smooth finishing's & carry 2000 A W/oany temperature rise.** The design of the circuit breakers shall be such that inspection and replacement of contracts, coils, vacuum bottles and any worn or damaged components can becarriedoutquickly andthisease.Thecontractgapsshallbeadjustableto allowfor wear.

The mechanism and the connected interrupters shall satisfy the mechanical endurance requirements of **IEC: 62271 - 100 & 200** and all additional requirements specified herein.

5.2 PorcelainInsulator

External parts of the circuit breakers, which are under continuous electrical stress, shall be of hollow porcelain. The creepage and flashover distance of the insulators shall be dimensionedandthe typeandprofile designedinaccordancewithIEC:815orIS:13134 and shall be suitable for the worst environmental conditions specified in this specification. The creepage distance across the interrupting chambers shall suite the outdoor service conditions mentioned in the relevant standards for heavily polluted atmosphere and shall be not less than 900 mm with protected creepage distance 50 percent of the total. Internal surfaces of hollow insulators shall also be glazed. The insulators shall comply with IS: 5621 and tested in accordance with IEC:233.

All porcelain whether, used on the interrupting chamber or on the support insulator shall have the following properties:

Higher strength, homogeneity, uniform glaze, free from cavities and other flaws and high quality uniform finish porcelain components and shall withstand the maximum expected staticanddynamicloadstowhichthecircuitbreakersmaybesubjectedduringtheirservice life.

5.3 Interruptingmedia

5.3.1 Vacuum:

In vacuum circuit breakers, facilities shall be provided for monitoring the contact erosion and any change in contact gap. The vacuum bottles shall be easily replaceable at site and the mechanism shall be conveniently adjustable to permit resetting the contact gap.

The vacuum circuit breaker poles shall be sealed to prevent contamination of the spaces surrounding the interrupters. The Bidder shall demonstrate how this is achieved by supplying technical details with the bid.

5.4 Auxiliarycontacts

12 auxiliary contacts (6N.O. +6N.C.) of 48 Volt D.C grade and 10 amps DC rating shall be provided in each circuit breaker.

5.5 Indication

A mechanically operated circuit breaker position indicator of non corroding material shallbe provided in a location visible from the operating side of the breaker without the necessity to openthemechanism door.Theword‘OFF’inwhiteletterongreenbackground shall be used to indicate that the breaker is in the opening position and the word ‘ON’ in white letters on a red background to indicate that the breaker is in the closed position. The drive for thedevice shall be positivein both directions and provision shall be made for local and remote electrical indication.

Indication of spring charging condition shall be provided as mentioned in this specification. Mechanical counters to record the number of closing operations shall be provided for each circuit breaker mechanism.

5.7 Operationandcontrols

The breaker shall normally be operated by remote electrical control with electrical tripping by **two nos. shunt trip coil**. Provision shall be made for local electrical operation and mechanical operation.

Thefollowingfacilitiesshallbeprovidedinthecircuitbreakerlocalcontrolcabinet:

- LOCAL/ REMOTE selector switch of stay put type. The selection of ‘local’ operation shall inhibit the operation of the breaker from any remote source.
- ON/NEUTRAL/ OFF control switch or ON and OFF push buttons. The push buttons shall be momentary contract type with rear terminal connections. The close push button shall be of green colour and the open push button red colour.
- MECHANICAL EMERGENCY TRIP DEVICE: suitable for manual operation in the event of failure of electrical supplies. **The device shall be accessible without opening any access doors and distinctly labeled**. It shall be shrouded and protected against inadvertent operation.

- Means shall be provided for manual operation of these circuit breakers during failure of auxiliary power in addition to electrical operation.
- Means shall be provided to prevent the mechanism from responding to a close signal when the trip coil is energized or to reclosing from a sustained close signal either opening due to a trip signal or failure to hold in the closed position.

The circuit breaker shall be able to perform 10,000 operating cycles at no load in accordance with IEC: 17A/474/CD for circuit breakers for auto reclosing duties.

6 PROTECTIVERELAY&METERSOFCONTROLPANEL

Indoor & Outdoor control panels with protective relay and meter shall be provided by the supplier suitable for abovebreakers. The equipment shall have protection scheme with the following relay & shall comply with provisions contained under Odisha Grid Code:

(i) Triple pole IDMTL type combined over current (3Nos) & Earth fault (1No) relay (Drawout type) preferably Communicable numerical relay **of AREVA, ER,ABB or SIEMENS make with supporting protocol IEC:61850 or 60870.**

Plugsettingrangeoftheovercurrentandearthfaultrelaysshallbe5%to250%.

(ii) 3 elements auxiliary relay for transformer fault, trip for Buchholz, winding temperature & oil temperature. **(Electro mechanical AREVA & Megawin)**

(iii) Mastertriprelayforintertripping.**(ElectromechanicalAREVA,Megawin)**

(iv) Restricted Earth fault relay. **(Only for Transformer CR Panel) (Numerical Communicable type AREVA, ER, ABB & SIEMENS with supporting protocol IEC: 61850 or 60870.)**

(v) Onealarmbellschemewithbell(24VDC).

7. METERS:

Thefollowingmetersshallbeprovided.

i) Ammeter:-1No.,0-100-200A/1Amp(**Size:96x96mm**).

ii) Voltmeter:-1No.,0-40KV(**size:96 x96mm**).

iii) Ammeterselectorswitch-1No.Make–Kayceeoranyotherreputedmake.

iv) Voltmeterselectorswitch-1No.Make-Kayceeoranyotherreputedmake.

v) 09wattCFLlampwithswitch-1 No.

vi) Plug& Socket-1 No.

vii) Fuses&Links-1 No.

viii) TestterminalBlocks-TestterminalBlock**should**beprovidedfortestingrelays& **meters**.

ix) IndicationLamp- (24VDCLED type)

Red-Breaker'ON'

GreenBreaker'OFF'

Amber- Breaker 'AUTO TRIP'

Blue-Springchargeindication.

White-HealthyTripilluminatedpushbottomswitch

7.1 CONTROLCIRCUIT&ANNUNCIATION

1. OneTNCSwitch

2. AlarmBellAcceptPushButton

3. AlarmBellResetPushButton

8. OTHEREQUIPMENTS

8.1 IndoorControl-RelayPanel

8.1.1 General

The electrical controls,relays, instruments,meters, annunciation schemeshall beprovided in a sheet steel enclosure conforming to IEC: 298 or IS:3427 mounted on support base on the floor. The panel shall be free standing, dust, moisture and rodent and vermin proof suitable for outdoor/Indoor installation. The panel shall have a high degree of protection IP: 54 for outdoor installation with relevant standard.

Each panel shall comprise of rigid welded structure frame enclosed completely by metal sheet of thickness not less than **2.5mm**. The sheets shall be cold rolled with smooth finish leveled and free from flaws. The structural frame and all load bearing members of the enclosure shall have minimum thicknessof 2.5mm. Size of the CR panel should be **750** mm Width x 600mm Depth x 1600 mm Height.

The Indoor CR Panels shall have hinged door at the back for excess to low voltage wiring. All door panels and removable covers shall be gasketed all round with neoprene bonded gasket. Ventilating louvers shall be provided to limit the temperature rise as provided in IEC: 694 and 298 or IS:12729 and 3427. They shall be provided with filters encased in fine wire screens for non-ferrous metal or stainless steel unaffected by moisture and rain water. A 230V AC heater with auto temperature control shall be provided in the cabinet to prevent moisture condensation.

The housing shall be surface treated and painted in accordance with the clause on Surface Treatment of this specification.

9.0 ProtectiveRelay&MeterofControl Panel.

9.1 Wiring

Eachpanelshallbesuppliedwithallinternalwiringcomplete.

Panel wiring shall be suitably bunched and clamped for neat appearance. The conductors usedforwiringpusposeshall **bePVC** insulated**1100** voltgradesemi-flexibleheatresistant, flame retardant and vermin proof electrolytic copper cable conforming to IEC:227, 502 or IS:1554. The wiring shall be securely supported and taken though PVC through PVC troughs. Each wire shall be continuous from end to end without any joint in between. All panel wiring shall be capable of withstanding a voltage of 2KV AC 50Hz for one minute.

Cable and wire for connections within the switchgear and between the switchgear and terminal blocks shall have a minimum temperature rating of 90 degree Celsius. The size of the conductors for panel wiring shall be not less than 2.5mm^2. For CT secondary wiring,two such wires shall be used in parallel or 4mm^2conductor can be used.

9.2 Panelwiringprotection

The panels shall be equipped with links and HRC cartridge fuses conforming to IEC:269 or IS:13703 in **1100** Volt grade phenolic moulded fuse holder consisting of fuse carrier and base or miniature circuit breakers conforming to IEC:947-2 or IS:13947-2 at appropriate locations. The carriers and bases shall be made of high grade flame retardant and non hygroscopic phenolic moulded material with hard glass surface. Each fuse or MCB shall be identified with engraved plastic label.

In general, fuses and MCBs shall be limited to the minimum required for safety. The protection scheme shall include fuses for VT secondary circuits and DC supply to eachpanel and fuses for MCB for spring charging motor and incoming AC supply.

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9.3 Terminalblocks

Terminal blocks of brass studs rated for 10 amps continuous current, 650 volt DC grade covered by moulded insulating materials with adequate electrical clearances shall be provided for terminating the panel wiring and outgoing connections. The termination shall be made by crimping lugs or bare conductor with insulating sleevesat ends. The arrangement can be horizontal or vertical as per standard practice adopted by the manufacturer. All terminals must be numbered and wire termination provided with numbered ferrules for identification. All numbering and marking including those in wiring diagram shall follow the guidelines provided in IS:11353. All circuit breaker auxiliary **contacts** including spare contacts shall be wired to the terminal blocks. Ten percent spare terminals shall be provided.

9.4 Colourandnumbering

The wiring used for 230V AC supply for illumination lamp, panel heater and other devices shall be coloured red for phase wire and black for the neutral. The colour of wires connecting directly to Earth shall be black. All other panel wires shall be of one colour tobe approved.

Engraved core identification plastic ferrules marked to correspond with the panel wiring diagram shall be fixed at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from the terminal block. Numbers 6 and 9,if used shall be under scored to enable differentiation.

9.5 Circuitdiagram

A durable copyofthecircuit wiring diagram shallbe affixed tothe innersideofthe doorof theControlcompartment.Labelsshallbeprovidedinsidethecompartmenttodescribethe functions of the various items of equipment.

The scope of the supply shall include the panel mounting base plate and all special equipment, bolts, nuts and washers necessary for making the supporting.

9.6 SupportingStructureforBreaker

The supply of the material shall be complete with mounting structures of mild steel sections conforming to IS:226 or equivalent ISO. The supporting structure shall bedesigned and constructed to withstand the maximum combined effects of the circuit breaker dead weight, itsmaximum dynamicload andmaximumeffectofwind loading. The supporting structure shall be **hot dip galvanized** as per clause on surface treatment of this specification.

9.7 Localcontrolcabinet

The operating mechanism, local controls and monitoring shall be provided in a metal clad control cabinet fitted to the same structure supporting the breaker and mounted at a convenient height for safe operation from ground level or from platform to be supplied under the contract.

The cabinet shall be made of minimum **2.5mm** sheet steel and shall be constructed as a dust, weather and vermin proof outdoor housing with protection of IP-54 class as defined in IEC:529 or IS:13947. It shall have single door and transparent windows for reading the circuit breaker ON or OFF position and spring charge position without opening the door. The door and any removable covers shall be gasketed all round with neoprene bonded gaskets. Aventilating louver shall be provided with fine wire non-ferrousmetalor stainless steel screen and filter. A 230V AC heather with auto temperature control shall be provided in the cabinet to prevent moisture condensation and also a 230 volt lamp for internal illumination with door operated switch.

Thelocalcontrolcabinetshall besubjectedtosurfacetreatmentandpaintingasperclause on surface treatment of this specification.

9.8 Panelwiringandaccessories

Panel wiring shall be suitably bunched and clamped for neat appearance. The conductor used for wiring purpose shall be PVC insulated **1100V** grade semi-flexible copper cable conforming to IEC: 227 or IS:1554, heat resistant, flame, vermin and rodent proof. The wiring shall besecurely supportedand taken throughPVC troughs. All panelwiring shall be capable of withstanding a voltage of 2KV AC 50Hz for 1 minute. Each wire shall be continuous from end to end without any joint in between.

The sizes of the control cable for wiring in the cabinet shall be not less than 2.5mm^2. CT secondary wiring shall be not less than 4 mm2 wires.

9.9 Fuseprotection

The cabinet shall be equipped with links and HRC cartridge fuses in **1100** volt grade fuse holders consisting of fuse carrier and base. The holders shall be made of high grade, flame retardant and non hygroscopic phenolic moulded material of dark brown colour with hard glass surface. Each fuse shall be identified with engragved plastic labels.

9.10 Terminalblocks

Terminal blocks rated for 10 amps continuous current, **1100** volt grade covered bymoulded insulating materials with adequate electrical clearances shall be provided for terminating the panel wiring and outgoing connections. The termination shall be made by crimping lugs or bare wire with insulating sleevesat ends. The arrangement can be horizontal or vertical as per standard practice adopted by the manufacturer. All terminals must be numbered and wire termination provided with numbered ferrule foridentification. All numbering and marking include those in wiring diagram shall follow the guidelines provided in IS: 11353. Ten percent spare terminals shall be provided.

9.11 Colours

The wiring used for AC supply for illumination lamp and heater shall be differentlycoloured from control wiring so that these can be distinguished from each other. The colour of all earth wire shall be black.

9.112Circuitdiagram

A durable copyof the circuit wiring diagram shall be affixed tothe inner sideof the control cabinet. Labelsshall be provided inside thecabinet todescribe the functionsof the various items of equipment.

9.13Cable Entry

A removable gland plate shall be provided at the bottom of the cabinet for entry of Purchaser's control and auxiliary power cables in the cabinet. Required number of electroplated brass cable glands of appropriate sizes with shrouds shall be provided in consultation with the Purchaser in the gland plate for the control and power cables. Provision shall be make for earthing of the cable armours in the gland.

10 OPERATINGMECHANISM

10.1 General

Theoperatingmechanismofthecircuitbreakershallbemotorwoundspringchargedtype. It shall be electrically and mechanically trip free with anti pumping device (as per IEC: 694 definition). All working parts in the mechanism shall be of corrosion resistantmaterial. Self lubricating, wearing resistant bearings shall be provided in the mechanism.

The mechanism shall fully close the circuit breaker and sustain it in the closed position against the forces of the rated making current and shall fully open the circuit breaker without undue contact bounce at a speed commensurate with that shown by tests to be necessarytoachievetheratedbreakingcapacityinaccordancewithIEC:62271-100& 200. The mechanism shall be capable of being lockedin either the open or closed position. The mechanism shall be capable of fully closing and opening again after the auto-reclose time interval specified as 0.3 second in this specification.

10.2 Springmechanism(ForSpringChargedBreakersOnly)

The spring operating mechanism shall be with spring charging motor, opening and closing springs with limit switches and all accessories necessary for automatic charging. In normal operation, recharging of the operating springs shall commence immediately and automatically upon completion of the closing operation so that a complete sequence of closing and opening operation should be possible.

It shall be possible to hand charge the operating spring with the circuit breaker in eitherthe open or closed position conveniently from the ground level. Closure whilst a spring charging operation is in progress shall be prevented and release of the springs shall not be possible until they are fully charged.

The state of charge of the operating springs shall be indicated by a mechanical device showing **'SPRING CHARGED'** when closing spring is fully charged and operation is permissible and **'SPRING FREE'** when closing spring is not fully charged and the operationis not possible. Provision shall be made for remote electrical indication of 'Spring Charged' and 'Spring Free' conditions.

The operating mechanism shall be such that the failure of any auxiliary spring shall not cause tripping or closing the circuit breaker but shall not prevent tripping against trip command.

Closing action of the circuit breaker shall charge the opening spring ready for tripping. From the close position with spring charged, one open-close-open operation shall be possible without recharging the spring.

10.3 Motor

The motor for spring charging shall be single phase 230 Volt A. C motor. Continuous motor rating shall be at least ten percent above the maximum load demand of the driven equipment. It shall remain within its rated capacity at all operating points that will arise in service. It shall be protected by MCB. The motor shall comply with IEC: 34 or IS:996.

11. AUXILIARYPOWERSUPPLY

The operating mechanism shall be suitable to operate with the following auxiliary power supplies.

a)	230V,50HzSinglephaseA.C-	Forspringchargingmotor
b)	DCsupply48Voltsor110Vasper manufacturer specificication	Forcloseandopencoils,indication&Alarm

The mechanism shall be designed to operate satisfactorily despite fluctuations of auxiliary power supplies as under:

ACsupply:	Voltage	From115%to85%ofnormal voltage
	Frequency	From105%to95%ofnormal frequency
	Combinedvoltageand frequency variation	From115%to85%ofnormal
DC supply:	Voltage	From120%to70%ofnormal voltage

12. INTERLOCKS

The circuit breaker shall be capable of being mechanically and electrically interlocked with the associated line isolator so that the isolator cannot be operated with the breaker in the closed position.

All doors or shutters which give access to live parts shall be interlocked in such a way that these cannot be opened unless the circuit breaker is in the open position.

Otherinterlocksshallbeprovidedasdeemednecessaryforsafety.

13. PROTECTIONANDMETERING

- Inter-trippingforsimultaneoustrippingothercircuitbreaker.

14. TERMINALCONNECTOR

Suitable terminal connectors of bi-metallic type suitable for both horizontal and vertical connection shall be provided on the terminal pad both on the incoming and the outgoing side for connection of jumpers of ACSR or AAAC conductor. The size of the conductor may vary between 100mm^2 and 232mm^2 depending upon the location of the circuit breaker. The terminal connection drawing and details are to be approved by the Purchaser before fabrication. The terminal connectors shall be bi-metallic type to avoid bi-metalliccorrosion.

15. INSULATIONANDCLEARANCE

a) The insulation to ground, the insulation between open contacts and insulation between phases of the circuit breaker shall be capable of satisfactorily withstanding dielectric test voltages.

b) Theminimumclearanceinopenairshallbeas follows:

- Betweenpoles - 460mm
- Phasetoearth - 400mm
- Groundclearanceforlive part - 3700mm

16. TEMPERATURERISE

The temperature rise and the maximum temperature of any part of the circuit breaker under continuous load condition and exposed in the direct raysof the sun shall not exceed the permissible limits as provided in Table V of IEC publication 694 or table 4 of IS:12729. Theselimitsshallnotbeexceededwhencorrectedforthedifferencebetweentheambient temperatureatsite andtheambienttemperaturespecifiedinthestandard.Thecorrection proposed shall be stated in the tender.

17. TESTS

17.1 Typeandroutinetests

The circuit breakers shall be subjected to routine and type tests in accordance with the standards listed in this specification including the following IEC and IS standards with the latest amendments: Type test reports shall be submitted with the Offer.

- Circuitbreaker IEC:62271-100&200andrelevantotherstandards
- Porcelain insulator IEC:233andIS:5621andrelevantotherstandards

The tests shall include but not limited to the following:

17.2 Shortcircuittests

The circuit breaker shall satisfactorily perform the out of phase and short circuit duties specified in IEC:62271 - 100 & 200, IEC:17A(Sectt.) and IEC:17A/CD/474, IS-13118 and IS:13516.

Thecircuitbreakershallbecapableofperformingatleasttwentyfive(25)openoperations at the rated short circuit current before maintenance or inspection is required.

17.3 Capacitivecurrentswitching

Capacitive switching tests shall be performed in accordance with IEC: 62271 - 100 & 200 and IEC: 17A/CD/474 at 1.3U preferably by direct test method or alternatively using syntheticmethod to IEC: 427 or IS:13516. The test circuits shall simulate the most onerous site conditions.

17.4 Dielectrictests

At zero gauge loss of vacuum inside the interrupter chamber, the open contracts shall withstandcontinuously,the ratedphasetogroundvoltage anditshallbepossible to break normal current in these conditions. During the dielectric type tests, no flashover externalor internal shall be acceptable.

The circuit breakers shall be subjected to a power frequency AC voltage test for oneminute in dry and wet conditions and there shall be no external flash over to earth.

17.5 Mechanicalendurance

In addition to the requirements of IEC:62271 – 100 & 200, an extended mechanical endurance test is required to show that the circuit breaker is capable of at least 10,000 operations at no load in accordance with IEC:17A/474/CD. Between the specified test series in IEC: 17A/474/CD, some maintenance such as lubrication and mechanical adjustment is allowed and shall be performed in accordance with manufacturer's instructions. Change of contracts is not permitted.

17.6 Lowcurrentswitching

The circuit breakers shall produce very low over voltage (<2.0 pu) on all switching circuits inductive current including reactor switching to IEC-1233 and capacitive current switching to IEC:17A (Secretariat) 438 and IEC 17A/CD/474 the circuit breaker shall be re-ignition or re-strike free for all duties.

17.7 Dutyrequirementtests

Apart from auto-reclosing and the other duties mentioned above, the breakers shall be able to perform the following duties for which type tests are to be conducted as per IEC:62271 - 100 & 200.

1. Breakingthesteadyandthetransientmagnetisingcurrentofthetransformer.

2. Breaking25%ofratedfaultcurrentattwicetheratedvoltageasperIEC/IS.

3. Cablechargingbreakingcurrent.

4. Back-to-backcapacitorbankbreakingcurrent.

5. Singlecapacitorbankbreakingcurrent.

6. Capacitorbankinrushmakingcurrent.

Testfortheresistanceofthemaincircuitshallalsobe conducted.

17.8 Temperaturerisetest

Temperature rise test is to be conducted on the circuit breaker and the accessories in accordance with IEC: 62271 - 100 & 200. The temperature rise shall be limited as per this specification.

18. PERFORMANCEREQUIREMENTS

Thesuppliershalldeclarethecircuitbreakeropeningandclosingtimesat120percent,100 percent and 70 per cent of the rated voltage of the opening and closing devices when measured at the terminals of the trip and closing coils. The minimum make break time at rated voltage and total break time of the CB shall be stated. The total break time must not exceed 60m. sec.

19. EARTHING

All metal parts not intended for carrying current or not alive shall be connected to duplicate earthing system and suitable electroplated brass earthing terminals shall be provided on each circuit breaker in conformity with IEC:62271 - 100 & 200. Suitable identification mark for the earth terminals shall be provided adjacent to the terminal.

Earth continuity conductors shall be provided down to the ground level for earth connection to purchaser's earthing grid. It shall have sufficient cross sectional area to afford a low resistance path for the full fault current envisaged. Such conductor shall also be provided for the CTs up to the ground level.

The size of the earth continuity conductor shall be large enough to reduce the potentialrise of the metal frame of the breaker in the even of fault to minimum but in any case not more than 10V. The size of the conductor shall also be adequate to restrict the temperature rise without causing any damage to the earth connection in the case of fault. No riveted joints intheearth conducting path shallbepermissible andonly bolted jointsof adequate sizeshallbe providedwithnuts,boltsandplainandspringwashers.The surfaces to be jointed shall be perfectly flat without any unevenness to ensure that there is no contact resistance.

An earth busbar of copper strip shall be provided inside the local control cabinet to which all earthing connections must be made. The earth busbar shall be terminated into two electroplated brass earthing terminals of adequate size with nuts, bolts and washers for connecting to earth continuity conductor mentioned above.

20. MandatorySparePartsfor33KV VCB

Thesuppliershallprovidethemandatorysparesasfollows.

Sl.No	Description
1	Completepoleassemblyofthecircuitbreaker
2	Vacuuminterrupterbottle(forvacuumtypeonly)
3	Trippingcoils
4	Closingcoils
5	Insulateddriverod
6	Springchargingmotor
7	Setofspringcharginglimitswitches
8	Setforgasketscompleteforonecircuitbreaker
9	**UpperHousingPorcelainInsulator**
10	**LowerHousingassemblyPorcelainInsulator**

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GUARANTEEDTECHNICALPARTICULARSFOR33KVOUTDOORVACUUMCIRCUITBREAKER

SL. NO.	DESCRIPTION	AsPerSpecification	UNITS	BIDDER'sOFFER
1	**GENERAL**			
	-Nameof manufacture			
	-Make,type/Modelof Vacuum Interupter			
	-Governingstandards	**IEC:62271-100& 200**		
	-No.ofpolesofcircuit breaker	3	no.	
	-No.ofbreaksperphase	1	no.	
	-Totallengthofbreakper phase		mm	
	Type–Vacuum	Yes, Vacuum	Yes/No	
2.	**NOMINALVOLTAGE**			
	-Ratedvoltage	33	KV	
	Maximum(continuous)service rated voltage	36	KV	
3.	**RATEDNORMALCURRENT**			
	-Undernormalcondition	1250	Amps	
	-Undersite condition	1250	Amps	
4.	**SHORT CIRCUIT PERFORMANCES**			
	-Ratedshortcircuitbreaking current for 3 Sec:			
	Symmetrical,rms	25	KA	
	AsymmetricalincludingDC component	31.25	KA	
	-Ratedshortcircuitmaking current; peak	62.5	KA	
	- Short time current withstandcapability:			
	Peakvalue	62.5	KA	
	Rmsvalue	25	KA	
	Duration	3Seconds	Sec	

SL. NO.	DESCRIPTION	AsPerSpecification	UNITS	BIDDER'sOFFER
5.	**MAX.TEMP.RISEOVER AMBIENT OF 50^{0}C**			
	-Atnormalcontinuous current		^{0}C	
	-Afterperformingthe operating sequence		^{0}C	
	-At10%rupturing capacity		milli-sec	
6	**Make&BreakTimes**			
	Totalbreak times			
	At10%rupturingcapacity	60	milli-sec	
	Atratedrupturingcapacity	60	milli-sec	
	Arcingtimeatrated breaking current	60	milli-sec	
	Maketimeformgivingclose command	60	milli-sec	
	-Minimumreclosetimeat full rated interrupting Capacity from trip coil energisation		sec	
	-Minimumdeadtimefor3 phase reclosing		mill-sec	
	-Circuitbreakeropening time:			
	at125%ofratedvoltageof opening device	60	milli-sec	
	at100%ofratedvoltageof opening device	60	milli-sec	
	at70%ofratedvoltageof opening device	60	milli-sec	
	-Circuitbreakerclosing time:			
	at125%ofratedvoltageof closing device	60	milli-sec	
	at100%ofratedvoltageof closing device	60	milli-sec	
	at70%ofratedvoltageof closing device	60	milli-sec	

SL. NO.	DESCRIPTION	AsPerSpecification	UNITS	BIDDER'sOFFER
7	**RESTRIKINGVOLTAGESFOR 100% RATED CAPACITY**			
	- Amplitudefactor		KV	
	- Phasefactor		KV	
	- Naturalfrequency		KHz	
	- Rateofriseofrecovery voltage	0.57	kv/µs	
8	**RATEDINSULATIONLEVEL**			
	-Dry and wet power frequencywithstandtest voltage(rms)for1 minute			
	Betweenliveterminalsand groundedobjects	**70**	KV	
	Betweenterminalswith breakercontactsopen	70	KV	
	-1.2/50 µsec full wave impulsewithstandvoltage +veand-vepolarity(peak)			
	Betweenliveterminalsand groundedobject	170	KV	
	Betweenterminalswith breakercontactsopen	170	KV	
	One mimute power frequencyvoltageofauxiliary wiring	2	KV	
9	**OPERATINGPERFORMANCE**			
	- Ratedtransient recoveryvoltage	0.57	KV/µs	
	Ratedcablecharging breaking current	50	Amps.	
	Ratedsinglecapacitorbank breaking current	400	Amps.	
	Ratedback-to-backcapacitor bank breaking current		Amps	
	Ratedcapacitorbankin-rush making current		KA	

SL. NO.	DESCRIPTION	AsPerSpecification	UNITS	BIDDER'sOFFER
	Ratedsmallinductive breakingcurrent	25	KA	
	Firstpole-to-clearfactor	1.5		
	Ratedoperatingsequence	O-0.3Sec-CO-3Min-CO		
	Ratedout-of-phasebreaking current	25	KAmp	
	Re-ignitionandRe-strike free	Yes	Yes/No	
10	**NUMBEROFOPERATION POSSIBLE WITHOUT MAINTENANCE**			
	atfullratedinterrupting current	>100	no.	
	at50%ofrated interrupting current	>100	no	
	at100%offullload current	10,000	no	
	atno load		no	
11	**MINIMUMCLRARANCEIN AIR**			
	- Betweenphases	460	mm	
	- Livepartstoearth	400	mm	
	- Livepartsto ground level	3700	mm	
12	**WEIGHTSANDDIMENSIONS**			
	Total weight of one completebreaker,including mountingstructure		kg	
	Mountingstructureweight		kg	
	Controlcabinetweight		kg	
	Dimensions: Height		mm	
	Width		mm	
	Depth		mm	
	Drawingsmustbe provided			
13	**HOLLOW INSULATOR HOUSING**			
	Typeandmakeofinsulators.			
	Powerfrequencywithstand testvoltageforoneminute:			
	- Dry	70	KV	

SL. NO.	DESCRIPTION	AsPerSpecification	UNITS	BIDDER'sOFFER
	- Wet	70	KV	
	Flashovervalue			
	- Dry	135	KV	
	- Wet	95	KV	
	1.2/50impulsevoltage withstandcapability			
	- positivepolarity	170	KV	
	- negativepolarity	170	KV	
	Creepagedistancetotal	900	mm	
	Creepagedistanceprotected	450	mm	
	Weightofassembled housing		kg	
	Coronashieldprovidedor not	Yes		
14	**SUPPORTINSULATOR**			
	Typeandmakeofinsulators			
	Powerfrequencywithstand testvoltageforoneminute:			
	- Dry	**70**	KV	
	- Wet	**70**	KV	
	Flashovervalue			
	- Dry	135	KV	
	- Wet	95	KV	
	1.2/50impulsevoltage withstandcapability			
	- positivepolarity	170	KVp	
	- negativepolarity	170	KVp	
	Creepagedistance,total	900	mm	
	Creepagedistance, protected	450	mm	
	Weightofassembled housing		kg	
	Coronashieldprovidedor not	Yes		
15	**CONTACTS**			
	Typeofmaincontacts	Butt		
	Typeofauxiliary contacts			
	Materialof auxiliary contacts	SilverPlatedBrass		

SL. NO.	DESCRIPTION	AsPerSpecification	UNITS	BIDDER'sOFFER
	Typeofplating,ifany	Silver		
	Thicknessofplating	20	micron	
	Contactpressure		gm/sq.mm	
	Noofauxiliarycontacts provided:	6 NO+ 6NC		
	Thoseclosedwhenbreaker is closed	6	no	
	Thoseopenwhenbreakeris closed	6	no	
	Thoseadjustable		no	
16	**OPERATINGMECHANISM**			
	Openingtype	Shunt Trip		
	Closingtype	Motor / Manual springcharge,Shunt operation		
	Forceappliedbycharged spring for closing		kg	
	Time taken by motor for chargingthespringformfully discharged to fully charged position	<30	sec	
	Fullsequenceofoperation	O-0.3sec-CO-3min-CO		
	Whetherlimitswitchesare provided with spring	Yes	yes/no	
	Whether spring limit switchesstart&stopthe motor	Yes	yes/no	
	Typeandmaterialofspring employed			
	Whethertripfree	Yes		
	Whetherantipumping device provided	Yes		

SL. NO.	DESCRIPTION	As Per Specification	UNITS	BIDDER'sOFFER
17	**AUXILIARY AND CONTROL POWER SUPPLY**			
	NormalauxiliaryA.Csupply voltage	230	Volts	
	Voltagelimitsforproper operation		Volts	
	Maximum	115%	Volts	
	Minimum	85%	Volts	
	Frequencylimitsforproper operation			
	Maximum	+5%	Hz	
	Minimum	-5%	Hz	
	forcircuitbreakers:		Volts	
	NormalDCcontrol circuit voltage	24	Volts	
	Voltagelimitsforproper operation			
	Maximum	120%	Volts	
	Minimum	70%	Volts	
	Powerrequiredfortripcoil	300	Watts	
	Powerrequiredforclosing coil	300	Watts	
18	**LOCALCONTROLPANEL**			
	- Material			
	- Degreeofprotection			
	- Verminproof provisions	Yes	Yes/no	
	- Weatherproof provision	Yes	Yes/no	
	- Dustproofprovision	Yes	Yes/no	
	- Ventilationprovision	Yes	Yes/no	
	- Thicknessofsheet materialsused	3	mm	
	- Overalldimensions		mm	
	- Totalweight		kg	
	- Mounting arrangement			
19	**TERMINALCONNECTOR**			
	- Material			
	- Bi-metallicornot	Yes		
	- Weight		kg	

SL. NO.	DESCRIPTION	AsPer Specification	UNITS	BIDDER'sOFFER
	- Dimensions		mm	
	- Sizeandtypeof conductor it can accommodate	100	sqmm	
	- Terminalpads silver plated or not	Yes		
	- Thicknessofsilver plating		microns	
20	**CORROSION PREVENTION SYSTEM FOR CIRCUIT BREAKER AND CONTROL CABINET**	Preferable Galvanised		
	- Surface preparation			
	- Rustinhibition			
	- Zinc thickness/paintthickness		microns	
	- Treatmentof fasteners			
21	**CORROSION PREVENTION SYSTEM FOR SUPPORT STRUCTURE**	HotDipGalvanised		
	Surfacepreparation			
	Rustinhibition			
	Zincthickness		microns	
	Treatmentoffasteners.			
22	**VACUUMCIRCUITBREAKER SEALING**	HermeticallySealed		
	Degreeofprotectionof circuit breaker pole enclosure. (IEC 529, IS 13947)			
	Methodofsealingthecircuit breaker pole enclosure.			

SL. NO.	DESCRIPTION	AsPerSpecification	UNITS	BIDDER's OFFER
	Oilresistancevarnish			
23 A.	**INSTRUMENTS&METERS (Ammeter& Voltmeter)**			
	1. Type&makeofinstruments& meter	Analogue		
	2. Size	96X96	Mm	
	3. Whethermagneticallyshielded ornot	Yes		
	4. Limitsorerrorintheeffective range	± 2%		
	5. Scalelength	90^0	KV	
	6. WhetherTropicalised	Yes		
	7. shorttimeoverloadrating	200%		
	8. V A Burden:			
	Currentcoil			
	Potentialcoil			
	9. Powerconsumptionofcurrent & potential coil			
B.	**BACKUPRELAYS**			
	1. Typeofrelay	3 O/C + 1 E/F or 2 O/C + 1 E/F, Self actuated , 1 Amp, aux. Volt-24 V DC/Numerical & CommunicableType		
	Make	SIEMENS/AREVA/ABB/,ERmake		
	2. Currentcoilrating	1	Amp	
	3. Taprange	5%-250%		
	4. VABurdenHighesttap&lowest tap	3	VA	
	5. Powerconsumptionathighest tap & lowest tap		Watts	
	6. Timeofoperationatmaximum timedialsetingat			
	i)5timestapsetting current	1.6-1.9	Second	
	ii)10timestapsettingcurrent	1.3	Second	

SL. NO.	DESCRIPTION	AsPer Specification	UNITS	BIDDER's OFFER
	7. Typeof characteristic	IDMTL		
	8. Whetherdrawouttypeornot.	Yes		
	9. TripcontactratingsAmps.	5Amp-Continuos	Amp	
	10. WhethersealIncontacts provided or not	Yes		
	11.No.of contacts	2NO+2NC		
	12. Flag	Required		
C.	**ThreeelementvoltageoperatedAux. Relay**			
	Type&makeoftheRelay	JVS/AREVA/ Megawinmake		
	Voltagecoilrating	24VDC	Volts	
	No. ofelements	3	No.	
	Mounting	Flush		
	Aux.Contactoneach pole	1 NO+ 1NC		
	Flag	Required		
	Purpose	Trfprotection		
D.	**HighspeedTrippingRelay**			
	Type&makeoftheRelay	AREVA/Megawin make		
	Voltagecoilrating	24VDC	Volts	
	Contact(Handreset)	3 NO+1NC		
	Flag	Required		
E.	**HighspeedHarmonicRestraint Differential Relay**	Onlyfortransformer CR Panels		
	Type&makeoftheRelay	AREVA, ABB, SIEMENS,ER,make Numerical communicabletype		
	Voltagecoilrating	24VDC	Volts	
	Aux.Contacts(Handreset)	2NO		
	Mounting	Flush		
	CTsecondary	1Amp.		
	Differentialcurrentsetting	15%		
	Biassetting	15-30-40%		
	Flag	Required		

CHAPTER–7
TECHNICALSPECIFICATIONOF33KVLIGHTNINGARRESTOR(VOLTAGECLASSSURGEARRESTORS)

1.0 SCOPE:

The specification covers the design, manufacture, shop & laboratory testing beforedispatch, supply delivery of Station class heavy duty, gapless metal oxide Surge Arrestors, withinsulating base, clamps, complete fittings & accessories suitable for 33/6.6 kV, SDS including arrester's electrode earthing.

2.0 STANDARDS

2.1 The design, manufacture and performance of Surge Arrestors shall comply with IS: 3070Part-3 and other specific requirement stipulated in the specification Unless otherwise, specified, the equipment, material and processes shall conform to the latest applicable Indian/International Standards as listed hereunder:

IS:2071-1993(Part-1)	:	MethodsofHighVoltageTestingGeneralDefinitions&Test Requirements.
IS:2071-1974(Part-2)	:	TestProcedures
IS:2633-1986	:	MethodsforTestinguniformityofzinccoatedArticles.
IS:3070-1993(Part-3)	:	Specificationforsurgearrestorforalternatingcurrent systemMetal-OxidelighteningArrestorswithoutgaps.
IS:4759-1996	:	SpecificationforhotdipzinccoatingonStructuralSteeland otheralliedproducts.
IS:5621-1980	:	HollowInsulatorsforuseinElectricalEquipment.
IS:6209-1982	:	MethodsofPartialdischargemeasurement.
IS:6745-1980	:	Methodsfordeterminationofmassofzinccoatingonzinc coatedironandsteel articles.
IEC:TC-37	:	TestProcedures.
ANSI/IEEE-C.62.11(1982)	:	MetalOxide,SurgeArrestorforA.C.PowerCircuits.
IEE-99-4	:	SurgeArrestors.

Theequipmentcomplyingwithany other internationallyacceptedstandardsshallalsobe considered if it ensures performance equivalent to or superior to the India Standards.

3.0 GENERALREQUIREMENT

3.1 The Metal Oxide gap less Surge Arrestor without any series or shunt gap shall be suitable for protection of33 KV powertransformers, associated equipment and 33 KV lines from voltage surges resulting from natural disturbance like lightening as well as system disturbances.

3.2 The surge arrestor shall draw negligible current at operating voltage and at the same time offer least resistance during the flow of surge current.

3.3 The surge arrestor shall consist of non-linear resistor elements placed in series and housedin electrical grade porcelain housing/silicon polymeric of specified creepage distance.

3.4 The assembly shallbe hermetically sealed withsuitable rubber gaskets witheffective sealing system arrangement to prevent ingress of moisture.

3.5 The surge arrestor shall be provided with line suitable for 100 $mm^{2,}$ 148 mm^2& 232 mm^2AAAC/ ACSRforverticalandhorizontaltakeoff.Theearthterminalsshallbeprovidedof suitable size. The groundside terminal of surge arrestor shall be connected with50x6 mm - galvanized strip, one end connected to the surge arrestor and second end to a separate ground electrode (Electrode type of earthing). The contractor shall also recommend the procedure which shall be followed in providing the ear thing/system to the Surge Arrestor.

3.6 The surge arrestor shall not operate under power frequency and temporary over voltage conditions but under surge conditions, the surge arrestor shall change over to theconducting mode.

3.7 Surge arrestor shall have a suitable pressure relief system to avoid damage to the porcelain/silicon polymeric housing and providing path for flow of rated fault currents in the event of arrestor failure.

3.8 The reference current of the arrestor shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.

3.9 The surge arrestor shall be thermally stable and the contractor shall furnish a copy ofthermal stability test with the bid.

3.10 The arrestors for 33 KV systems shall be suitable for mounting on transformers as well as in the yard. The supplier shall furnish the drawing indicating the dimensions, weight etc. of the surge arrestors for the design of mounting brackets.

3.11 The arrestor shall be capable of handling terminal energy for high surges, external pollution and transient over voltage and have low losses at operating voltage.

4.0 ARRESTORHOUSING

4.1 The arrestor housing shall be made up of porcelain/silicon polymeric housing and shall be homogenous, free from laminations, cavities and other flaws of imperfections that might affect the mechanical and dielectric quality. The housing shall be uniform browncolour, free from blisters, burrs and other similar defects.

Arrestors shallbecompletewithinsulatingcases,fastenersforstackingunitstogether,surge counters with leakage current meters and terminal connectors.

4.2 The housing shall be so coordinated that external flashover shall not occur due toapplication of any impulse or switching surge voltage up to the maximum design value for arrestor. The arrestors shall not fail due to contamination. The 33 KV arrestors housing shall be designed for pressure relief class as given in Technical Parameters of the specification.

4.3 Sealedhousingshallexhibitnomeasurableleakage.

5.0 TESTS

5.1 TestonSurgeArrestors

The Surge Arrestors offered shall be type tested not earlier than 5 years before the date of agreement with EPC Developer. The surge arrestors shall be subjected to routine and acceptance tests in accordance with IS: 3070(Part3)-1993. In addition, the suitability of the Surge Arrestors shall also be established for the following:

* Residualvoltagetest
* Referencevoltagetest
* LeakagecurrentatM.C.O.V.
* P.D. Test
* Sealingtest

* Thermalstability test
* AgingandEnergycapabilitytest
* Wattlosstest

Each metal oxide block shall be tested for guaranteed specific energy capability in additionto routine/acceptance test as per IEC/IS.

5.2 The maximum residual voltages corresponding to nominal discharge current of 10KA for steep current, impulse residual voltage test, lightningimpulse protection level and switching impulse level shall generally conform to Annexure-K of IEC-99-4.

5.3 The contractor shall furnish the copies of the type tests and the characteristics curves between the residual voltage and nominal discharge current of the offered surge arrestor and power frequency voltage V/s time characteristic of the surge arrestor subsequent to impulseenergyconsumptionas per clause6.6of IS:3070 (Part-3)offeredalongwiththebid.

5.4 The surge arrestors housing shall also be type tested and shall be subjected to routine and acceptance tests in accordance with IS: 2071.

5.5 GalvanizationTest

All Ferrous parts exposed to atmospheric condition shall have passed the type test and be subjected to routine and acceptance test in accordance with IS: 2633 & IS: 6745.

6.0 NAMEPLATE

6.1 Thenameplateattachedtothearrestorsshallcarrythefollowinginformation:-

* ManufacturingTradeMark
* Yearof Manufacturer
* RatedVoltage
* ContinuousOperationVoltage
* Pressurereliefratedcurrent
* NameofClient-DoWR, GoO.
* PurchaseOrderRef.

7.0 INSPECTION

7.1 All tests and inspection shall be made in the manufacturer's works unless otherwise specifically agreed upon by the manufacturer and purchaser at the time of placement of purchase order. The manufacturer shall afford to the inspector representing the purchaser, all reasonable facilities, without charge to satisfy him that the material being furnished is in accordance with these specifications. The purchaser reserves the right to get any component/material being used by the manufacturer of the Surge Arrestor tested from any recognized test house.

7.2 The inspection by the purchaser or his authorized representative shall not relieve the contractor of his obligation of furnishing equipment in accordance with the specifications.

8.0 DRAWINGANDINSTRUCTIONMANUALS

TenderershallfurnishtothepurchaserthefollowingdrawingsandliteratureforapprovaI:

(i) OutlinedimensionaldrawingsofSurgeArrestorandallaccessories.
(ii) Assemblydrawingsandweightsofmaincomponentparts.
(iii) Instructionsmanual
(iv) Drawingshowingdetailsofpressurereliefvalue
(v) Volt-timecharacteristicsofsurgearrestors.

(vi) Detailed dimensional drawing of porcelain housing/Silicon polymeric i.e. internal diameter, external diameter, thickness, height profile, creepage distance, dryarching distance etc.

GUARANTEEDTECHNICALPARTICULARS33KVLIGHTNINGARRESTOR(VOLTAGECLASSSURGE ARRESTORS)

A	Nameoftenderer/ contractor	
B.	TenderspecificationNo.	
1.	Nameofmanufacturerof equipment.	
	SurgeArrester	
	LineDis-Connector	
	Metaloxide block	
	TerminalClamp	
2.	Name&Addressofcollaboratorifany	
3.	Standardtowhichsurgearrestorsconfirms	
4.	SurgeArrestor	
4.1	Voltagerating(kVrms)	
A	ContinuousOperatingVoltage(kV rms)	
B	Leakagecurrentatcontinuousoperationvoltage:	
C	Partialdischargeat1.05COV (PC)	
D	Permittedleakagecurrentofarrestorbeyondwhicharrestorisfaulty:	
5.	Frequency (Hz)	
6.	Nominaldischargecurrent (waveshape=8/20microsecond)(kA)	
7.	Pressurereliefratedcurrent(kA rms)	
8.	Steepcurrentprotectionlevelat 10Ka	
A	Lightingimpulseprotectorlevelat 5kAand10kA(kVP)	
B	SwitchingImpulseprotectionlevelwith40x80micro-sec.Waveat 500/1000A.	
9.	Longdurationcurrentimpulsewithstandcapacityandvirtualduration	
10.	Linedischargeclass	
11.	Thermalrunawaylimitofarrestor	
12.	Energycapability(kJ/KV)	
13.	Pressurereliefrating	
14.	Dryarcingdistance	
15.	Referencecurrentandreferencevoltage	
16.	Arrestorhousing	
16.1	Powerfrequencyoneminutewetwithstandvoltage(kVrms)	
16.2	Lightingimplusedrywithstandvoltage(kVP)	
16.3	**Creepagedistance**	
A	ConstructionDetails	
B	Total	
16.4	Shortcircuitwithstandcapacity	
16.5	Bendingmoment (mm)	

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CHAPTER-8
TECHNICALSPECIFICATIONFOR33KV1PHASEDUELCORE,OUTDOORTYPE,POTENTIAL TRANSFORMER.

1.0 SCOPE:

1.1 This specification covers the design, manufacture, assembly, testing at Manufacturer's works, supply & delivery at site of Potential Transformers in three phase system of 33 KV class.

1.2 These Potential Transformers will be used Bus-side PT, for voltage indication by voltmeter through selector switch and supply of voltage to meters, protection relays for feeder protection and synchronized devices.

2.0 STANDARDS:

The Potential Transformers and accessories covered by this specification shall comply withtherequirementoflatesteditionofthefollowingstandardsunlessotherwisestated in this specification:

IS:3156Part(I-IV)	:	SpecificationforvoltageTransformer.
IS:4146	:	ApplicationguideforvoltageTransformers.
IS:2099/IS:5621	:	Specificationforbushingsforalternatingvoltages above1000volts.
IS:335	:	SpecificationforInsulatingoil.
IS;3024	:	SpecificationforCoreMaterials.
IEC:60044-2	:	SpecificationforVoltageTransformer.

3.0 DEVIATION: Normally the offer should be as per the Technical Specification without any deviation.Butanydeviationfeltnecessarytoimproveperformance,efficiencyandutility of equipmentmust bementionedinthe deviationschedule withreasons duly supported by documentary evidence. Such deviation suggested may or may not be accepted by DoWR.

4.0 DESIGN& CONSTUCTION OF POTENTIAL TRANSFORMERS: The design features and construction detailsshall be in accordance with the requirement stipulated hereunder;

i)	ThePTshallbecompleteinallrespectsandshallconfirmtothemodernpracticeof designandmanufacture.		
ii)	ThePTshallbeelectromagnetic,outdoortype,singlephase,oilfilled,selfcooled, havingshadedporcelainbushingasperIS:2099orDryoutdoorPT,suitablefor operationundertheserviceconditionswithoutprotectionfromsun,rainanddust.		
iii)	The maximum temperature rise at 1.1 times rated primary voltage, rated frequency andratedburden,shallnotexceedthefollowingvaluesabovestatedmaximum ambienttemperature.		
	ClassofInsulation		Maxtemrise ^{0}C
	A	For winding with classA insulation immersed in oil (measuredbyresistance method)	50^{0}C
	B	Oilatthetopofthetank	40^{0}C

		(measuredby Thermometer)	
	C	With 1.5 times rated voltagefor30seconds	10^0Cmorethanabovevalueaftercontentious applicationof1.1timesratedvoltage
	D	Max.ambienttemptobe considered	50^0C
	E	ForDrytype	55^0Caboveambientof50^0C
IV)	ThePTshallbecapabletowithstandlinedischargeeffectandalsotheferro resonanceeffect.		
V)	ThePTshallbesuitableforuprightmountingonsteelstructure.		
VI)	ThePTshallbecompletewithaccessorieslikeprimaryterminals,terminalconnectors		
VII)	OilimmersedPT,shallbeprovidedwithclassAinsulationandDrytypeshallhave minimumclassAinsulationorbetter.OiltypePTshallbehermeticallysealedtype constructiontopreventair&moisturefromenteringthetank.		
VIII)	ThecoreofthePTshallbehighgradenon-aging,siliconlaminatedsteeloflow hysteresislossandhighlypermeabilitytoensurehighaccuracyatnormalandover voltagesconfirmingtoIS:3024.		
IX)	PT Characteristics shall be such asto provide satisfactory performance for burdens ranging from at least 25% to 100% of the rated burden over a range of at least 5% to 110%ratedvoltageincaseofprotectivecoresandvoltagerangeof80%to129% (0.8lagging)incaseofmeasuringcore.		
X)	ThePTsecondaryterminalsshallbebroughtoutthroughfuseofsuitableratingin weatherpoofterminalboxforeasyaccess.		

5.0 BUSHING(applicableforoilimmersedtype):

a) Shaded porcelain bushingconfirmingto latest edition of IS:5621 & IS:8603 shall be used for PT

b) Cast metal end caps for the bushings shall be of high strengths & made of Brass. They shall have smooth surface to prevent discharge taking place between metal parts and porcelain as a result of ionization.

c) The insulation of bushing shall be co-ordinate with that of potential transformer such that the flash over, if any will occur only external tothe PT.

d) Each of the Bushing cap/ head shall be complete with the following features: Primary terminals suitable for connection through rigid connectors for AAAC/ ACSR Conductor.

e) Oil level gauge and convenient means of oil and nitrogen filling,sampling and draining of oil is to be provided in the tank.

6.0 INSULATINGOIL:(applicableforoilimmersedtype)

Thequalityofinsulatingoilforfillingofcompleteunitshallcomplyinallrespectwit provisions of the latest edition of IS:335.

7.0 GROUDING TERMINALS:Two grounding terminals on diagonally opposite sides of adequate size suitable for connecting MS Flat of size 50mmx6mmshall be provided. HV Nutral Terminal earthing and body earthing should be marked distinctly and bephysically well separated. The terminal of high voltage winding intended to be earthed shall be brought out through a bushing, insulated from case or frame to be earthed by separate arrangement (Through link).

8.0 TERMINALCONNECTOR:

a) Allcastingofconnectorsshallbefreefromholes,surfaceblisters,cracksand cavities.

b) Nopartoftheconnectorshallbelessthan10mmthick.

c) Allferrouspartsshallbehotdipgalvanizedconfirmingto IS:2633.

d) RigidconnectorsshallbemadefromAluminumAlloy.

e) Allcurrentcarryingpartsoftheconnectorsshallhaveminimumcontact resistance.

f) ConnectorshallbesuitableforconnectionwithAAAC100,148&232mm^2.

9.0 SECONDARYTERMINALBOX:

i. All secondary terminals shall be brought out in a compartment on one side ofeach PT.

ii. The terminal box shall be provided with removable cable gland plates at the bottom of the mounting cable glands suitable for 1.1 KV grade steel wire armoured, PVC insulated 3Cx 2.5 sq. mm stranded cupper conductor cables.

iii. The terminal box shall be provided with cover in front so as to have easy access of secondary terminals. The cover shall have sealing/locking arrangement and shall be suitable to prevent ingress of moisture and rain water.The degree of protection shall not be less than IP-55 as per IS; 2147.

iv. All terminals shall be clearly marked with identification number to facilitate connection to external wiring in accordance with relevant IS.

10. PAINING:

a) The tank and top metallic parts shall be hot-dip galvanized/ painted. All steel surfaces shall be cleaned by sand blasting or chemical procress as requiredto produce smooth surface, free from scale, grease and dirt.

b) Steel surface in contact with insulating oil shall be painted with heat resistance oil insoluble insulating varnish.

11. TESTSATFACTORYANDTESTCERTIFICATES:

i. EachPTshallcomplywiththerequirementofroutinetestasperspecifiedinthe relevant Part (I to III) of IS: 3156 and IS: 4146.

12. SPECIFICTECHNICALPARAMETERSOF33KVPT:

SL. No.	DESCRIPTION	33KV
1	RatedSystemVoltageKV(rms)	33
2	HighestSystemVoltage(rms)	36
3	SystemFrequency(HZ)	50
4	SystemNeutralearthing	Rigidearthed
5	Installation	Outdoor
6	Voltagevariation	10%
7	RatedinsulationLevel	
	1.2/50microsecondimpulsewithstandvoltageKV(peak)	170
	Oneminute.DrypowerfrequencywithstandvoltageKV (rms)	3KV
8	Powerfrequencyovervoltagewithstandrequirements forsecondarywinding	3KV
9	Creepagedistance (mm)	900
10	Accuracy	PT shall be of accuracy class 0.5 for metering and 3P for protectionasperIS;3156/IEC 186,60044-2
11	Ratio	
	Primaryside(KV)	33/√3
	Secondaryside (V)	110/√3
	No.Core	2
	RatedBurden[Formeteringperphase(VA)]	100
	RatedBurden[ForProtectionperphase(VA)]	100

GUARANTEEDTECHNICALPARTICULARS
(TobefilledupbytheTenderer)

1.	Nameofthe Manufacturer		
2.	RatedPrimaryVoltage		
3.	RatedSecondaryVoltage		
	Winding-I		
	Winding-II		
4	VoltfactorandDuration		
5	RatedburdenandaccuracyClass		
	Core-I		
	Core-II		
6	TemperatureRise:		
	With1.2timesratedprimaryvolt continuously		
	Byresistancemethod		
	BYthermocouple/thermometer		
7	RatedInsulationLevel:		

	With1.2/50microsec.Impulsewithstand voltageonprimaryside		
	1minutepowerfrequencywithstand voltage(dry)onprimaryside		
	1minutepowerfrequencywithstand voltage(wet)onprimaryside		
	1minutepowerfrequencywithstands voltageonsecondary side.		
8	MinimumCreepagedistance(mm)		
	WhetherPTishermeticallysealedornot (foroiltypePTonly)		
	NameofDryInertGas(foroiltypePTonly)		
9	WhetherPressureReleaseValveProvided(ForoiltypePT only)		
10	Characteristics:		
	Ratio&Phaseangleerror		
11	TotalWeight		
12	Weightofoil(Foroiltype)		
13	Overalldimensions		
14	Mountingdetails		
15	Drawing&Literatures		
16	Testreports		
17	Deviationsheet		
18	Applicablestandards		

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CHAPTER-9

TECHNICALSPECIFICATIONFOR33KVCURRENTTRANSFORMERS

1.0 SCOPE:

This specification covers the design, engineering, manufacture, inspection, assembly, packing, and forwarding & FOR destination and testing at manufacture's works for outdoor type 33 KV current transformers as per the schedule of requirement.

2.0 STANDARD:

Thecurrenttransformersshallcomplyinallrespectswithlatestissuesof IS:2705(part-I,II,III&IV)-1992.

3.0 CLIMATICCONDITIONS:

1	Maximumambientairtemperature(shade).	50^0C
2	Maximumdailyaverageairtemperature	35^0C
3	Maximumyearlyaverageambientairtemperature	30 ^{0}C
4	Maximumtemperatureattainablebyabodyexposedtothesun.	50 ^{0}C
5	Max.altitudeabovemeansealevel(Meters)	Not exceeding 1000
6	Minimumambientairtemperature	5 ^{0}C
7	Maximumrelativehumidity.	100%
8	Minimumnumberofrainydaysperannum	70
9	Averagenumberofrainydaysperannum	120
10	Averageannualrainfall.	150cm
11	Numberofmonthsoftropicalmonsoonconditions	4
12	Maximumwindpressure.	260Kg./m^2
13	Degreeofexposuretoatmosphericpollution	Normal

4.0 TYPE& RATING:

4.1 Thecurrenttransformersshallbeoutdoortype,singlephasesuitablefor3phase,33KV solidly earthed system under the climatic conditions specified above.

4.2 Theratingandotherelectricalcharacteristicsshallbeasfollows:

33KVtransformerCTsofratio200-100/1-1-1amp/300-150-75/1-1-1

		Core-I	Core-II	Core-III
I	Purpose	REF	Backup(O/C)	E/F
II	Primarycurrentrating	200-100 Amp	200-100 Amp	200-100 Amp
III	Secondarycurrentrating	1.0 A	1.0 A	1.0 A

IV	Ratedburden	-	15VA	15VA
V	Accuracyclass	PS	0.5	5P
VI	Accuracylimitfactor	PS	10	10
VII	Min.kneepointvoltage&CT secondary Res. At 75^0 C	TobegovernedbyrelationV$_K$= 90(R_{ct}+0.5). R_{ct} = Resistance of secondary winding at 75^0 C	-	-
VIII	Max.Excitingcurrent	Not exceeding 75 mm at Vk/2 whereVKistheminimumknee point voltage	-	-

[Note: 1. Restricted earth fault protection is not required for T/F having the capacity of 5 MVA& below.2.For33KVtransformersforsinglebreakercontrollingtwotransformersupto2x1MVA, the CT ratio shall be 200-100/1-1-1]

4.3 33KVLineCTsofRatio300-150-75/1Ampor200/100/1Amp.[Purpose:-Compositeover current/Earth fault protection & ammeter]

I	Primarycurrentrating	300-150-75Amps
Ii	Secondarycurrentrating	1Amp
Iii	Accuracyclass	5P
Iv	Accuracyfactor	10
V	Ratedburden	20VA

4.4 Highestsystemvoltage 36 KV

4.5 Normalsystemvoltage 33 KV

4.6 Frequency 50HZ+3%and –5%

4.7 1.2/50Microsecondimpulsewithstandvoltage 170KV(Peak)

4.8 Oneminutepowerfrequencywithstandvoltage 70KV(rms)

4.9 Shorttimecurrentrating 25KA for3sec.

4.10 Dynamicpeakcurrent 40 KA

4.11 Maxtemp.riseintermsofclause7.2of IS:2705(part-I)-1992 50^0C

4.12 Creepagedistance 900 mm

5.0 GENERAL: The current transformer shall be single phase oil immersed and self cooled type for services indicated and complete in all respects confirming to the modern practice of design and manufacture.

5.1 The core shall be high grade, non ageing electric silicon lamination steel of low hysterias loss and high permeability to ensure high accuracy at both normal and over current.

5.2 The current transformer shall be hermetically sealed to eliminate breathing and prevent air and moisture from entering into tank. These shall be provided with oil level gaugeand suitable means in form of pressure release device shall be provided to relieve abnormal internal pressure.

5.3 All exposed ferrous parts shall be either hot dip galvanized conforming to latest IS: 2633 or painted with corrosion resistive paints.

6.0 WINDING:

6.1 The rating & accuracy of the secondary winding shall be as specified. The secondary terminals shall be brought out in weather proof terminal box, having an open on one side of CT for each access. The terminal box shall have provision for suitable sealing & the same shall be temper-proof. Facility shallbe provided forshortcircuiting and grounding the CTs secondaries at the terminal box. The secondary taps shall be adequately reinforced to withstand normal handling without damage.

6.2 EarthingofCTstobeprovidedasspecifiedat5.2ofIS:2705(Part-I)-1992.

6.3 Terminal and polaritymarks shall be legibly marked on each CT and all the lead terminations at the associated terminals and polarity marks shall be in accordance with relevant IS.

6.4 Each CT shall be provided with rating & connection diagram plate showing the particulars as required by relevant IS.

7.0 MARKING: In order to facilitate shorting and erection at site, every part of the equipment shall be suitably marked. The markings on the rating plate shall carry all theparticulars specified inclauses 6.2 &6.2.2 of IS: 2705/1992, Part-I and clause 5 of IS: 2705 of IS: 2705/1992 (Part-IV) or equivalent IEC where applicable.

8.0 PACKING: All material shall be suitably packed for transportation and contractor shall be responsible for all damages/ losses due to improper packing.

9.0 INSULATION OIL: The oil shall be a type normally marked in India and shall confirm to the requirement of IS: 335-1993 (Latest addition) or equivalent IEC The oil required for first filling ofeach CT shall be included in the scope of supply.

10.0 TYPE & MOUNTING: The current transformers shall be suitable for mounting on RCC or Steel structures. Necessary flanges bolts etc for base of CT shall be supplied and these shall be galvanized.

11.0 TERMINAL CONNECTORS: Suitable terminal connectors for connecting ACSR conductor and/or AAAC 232 sq.mm shall be supplied. Suitable terminal earth connectors for earthing connection shall also be provided. The terminals shall be such as avoid bimetallic action.

12.0 TESTS: Each CT shall comply with the type test stipulated in latest edition ofIS: 2705 (Part-I,II,III & IV). The reports of all type test and other tests conducted shall be supplied along with the bid documents. Type test reports should not more than 5 years old reckoned from date of bid opening. The type tests should be got carried out from the Govt / Govt approved test house as per relevant ISS.

13.0 INSPECTION: All tests and inspection shall be made at the place of manufacture unless otherwise especially agreed upon by the manufacturer and the purchaser at the time of purchase. The purchaser has the right to get the tests carried out at his own cost by independent agency, whenever there is dispute regarding the quality of supply.

14.0 DRAWINGS: The tendered should submit with his bid, dimensioned drawings of the equipment offered along with illustrated and descriptive literature. Magnetization covers for each of the core CTs should be furnished with tender.

15.0 SPARE PARTS: A list of spare part recommended for 5 years operation for each CT shall be furnished with the tender.

16.0 DEVIATIONS FROM SPECIFICATIONS: Any deviation from this specification shall be clearly brought out separately. In the absence of any specific mention, it shall be implied that theequipment offered is entirely according to this specification.

17.0 COMPLETENESS OF EQUIPMENT: Any fittings, accessories or apparatus which might not have been specifically mentioned in this specification, but which are usual and necessary shall deemed to have included in the contract and shall be supplied by the supplier without any extra charges. All plants and equipment shall be complete in all details whether such details have mentioned in this specification or not.

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GUARANTEEDTECHNICALPARTICULARSFOR33KVOUTDOORCURRENTTRANSFORMERS.

Sl.No.	Description	200-100/1-1-1A	200-100/1-1A	Bidder'sOffer
1	Nameandaddressofthe Manufacture			
2	Manufacture'stype designation			
3	Standardsapplicable	AsPerIS-2705/1992		
4	Ratedfrequency(HZ)	50HZ		
5	RatedVoltage(KV)	33KV		
6	Ratedcurrent(A)	200-100/1-1-1A	200-100/1-1A	
6.1	Ratedextendedprimary current(A)	120%ofratedprimarycurrent		
6.2	Rated extended primary current(A)			
7	Shorttimethermalcurrent withstandfor3secs(KA)	25kafor3sec		
8	1.2/50microsecondimpulse withstandvoltage (KA_P)	170		
9	One minute dry and wet powerfrequencywithstand voltage(KVrms)	70		
10	No.ofcoresperCT	3	2	
11	TransformationRatio	33KV		
12	Ratedoutputatallratiosfor meteringcore(VA)	15	15	
13	Accuracyclass	0.5	0.5	
14	MinimumKneepointvoltage atdifferenttapsforall'PS' class cores (V)	400		
15	Instrumentsecurityfactorat differentratios.	5	5	
16	WhetherauxiliaryCTprovided formeteringwinding			
17	Coronaextinctionvoltage (KV rms)			
18	Totalcreepagedistance (mm)			
19	Primary			
19.1	No.ofprimaryturns			
19.2	Materialandcross-sectionof primary(mm^2)			
19.3	Whetherbartypeorringtype primary?			
20	WhetherCTissuitablefor transportationhorizontally?			
21	Percentage current (ratio) errorandphasedisplacement in minutes at rated burden and at:			
21.1	20%ratedcurrent	AsPerIS-2705/1992		

21.2	120%ratedcurrent			
22	QuantityofoilperCT(Litres)			
23	Standardtowhich oil conformsgenerally.	AsperIS-335		
24	Characteristicsofoil(prior to filling)	AsperIS-335		
24.1	Breakdownvoltage(KVrms)			
24.2	Dielectricdissipationconstant (tan delta)			
24.3	Watercontent(ppm)			
24.4	Gas content			
24.5	Interfacialtensionat27^{0}C (N/m)			
24.6	Specificresistance			
24.6.1	At90^{0}C(Wcm)	AsperIS-335		
24.6.2	At27^{0}C(Wcm)			
25	Whethercurrenttransformers are hermetically sealed, if so, how?	Yes		
26	Totalweight(Kg)			
27	Transportweight(Kg)			
28	Temperature rise over an ambienttemperatureof50^{0}C for continuous operation at rated continuous thermal current.	40ºC		
28.1	Winding	40ºC		
28.2	Oil	35ºC		
28.3	External surface of the core, metallicpartsincontactwith oradjacentto insulation.	40ºC		
29	WhetherCTcharacteristic curvesenclosed	Yes/No		
29.1	Ratioandphaseangel curve	Yes/No		
29.2	Magnetizationcurves	Yes/No		
29.3	Ratiocorrectionfactorcurves	Yes/No		
30	DATAONPRIMARYWINDING			
30.1	RatedPrimaryCurrent(A)	200-100A	200-100A	
30.2	No.ofconductorsinoneturn	1	1	
30.3	No.ofturnsofprimarywdg.			
30.4	Materialoftheprimary conductors	Electricalgradecopper		
30.5	Sizeoftheprimaryconductor (Bare/Insulated(mmx mm)			
30.6	Cross- sectional area of primarywinding(mm^2)			
30.7	Totalcorss-sectionareaof primary winding (mm^2) conductors.			
30.8	Currentdensity(A/mm^2)			

	i)Athighestratio			
	ii)Atintermediate ratio			
	iii)Atlowestratio			
30.9	Shortcircuitcurrentdensity (A/mm2)			
	i)Athighestratio			
	ii)Atintermediate ratio			
	iii)Atlowestratio			
30.10	Ampere-turnofprimary(AT)			
	i)Athighestratio			
	ii)Atintermediate ratio			
	iii)Atlowestratio			
31	CORE			
31.1	Metalandgradeofthecore	CRGOM3or Better		
31.2	Thicknessofcorelaminations (mm)	0.23 mm		
31.3	NetIroncross-sectionalarea ofcore (mm2)			
31.3.1	Core-1			
31.3.2	Core-2			
31.3.3	Core–3			
31.4	Meanmagneticpathlength			
31.4.1	Core-1			
31.4.2	Core-2			
31.4.3	Core-3			
31.5	WhetherfurnishedB-Hcurve forthecorematerialused?(B-wb/m2, H-AT/cm)			
31.6	Whetherspecificlossvs.flux density graph for the core materialusedfurnished?			
31.7	Weightofthecore (kg)			
31.7.1	Core-1			
31.7.2	Core-2			
31.7.3	Core-3			
32	SECONDARYWINDING			
32.1	Ratedsecondarycurrent(A)			
32.2	Materialofthesecondary windings	Electrolytic Copper		
33	INSULATION			
33.1	Nameandclassofinsulating materialsbetweencoreand secondarywinding.	Polyster B / CrapePaperA, OilA		
33.2	Name/sof Insulatingmaterials betweensecondarywinding and primary windings.	CrapePaperA, Oil A		
33.3	Insulatingmaterialsusedto achievegradingofcapacitance	CrapePaperA, OilA		

34	DIAMETEROFWINDINGS			
34.1	Inside/outsidediameterof secondarywindings(mm)			
34.1.1	Core-1			
34.1.2	Core-2			
34.1.3	Core-3			
34.2	Inside/outsidediameterof primarywindings(mm)			
34.3	Minimumclearanceof primaryfromtank(mm)			
34.4	Minimumclearanceof secondaryfromtank(mm)			
35	TERMINALCONNECTOR			
35.1	Manufacturer'sname			
35.2	Applicablestandard	IS-5561		
35.3	Type			
35.4	Materialofconnector			
35.5	Clampbody			
35.6	BoltsandNuts			
35.7	Springwashers			
35.8	Ratedcurrent (Amp)			
35.9	Ratedterminalload(Kg)	---		
35.10	Factorof safety	---		
35.11	Minimumthicknessofany part(mm)			
35.12	Weightofclampcomplete withhardware (kg)			
35.13	TypetestreportsasperIS enclosed.	Yes/No		
35.14	OGAdrawingenclosed.	Yes/No		
36	INSULATOR			
36.1	Manufacturer'sname			
36.2	Type			
36.3	Applicablestandard	AsperIS2099		
36.4	Height (mm)			
36.5	Diameter(top) (mm)			
36.6	Totalcreepagedistance (mm)	900mm		
36.7	RatedVoltage(KV)	33KV		
36.8	Powerfrequencywithstand voltagefor1min.dryandwet. (KV-rms)	70KV		
36.9	1.2/50µsecimpulsewithstand voltage(KVp)	170KVP		
36.10	Coronaextinctionvoltage (KV rms)	AsperIS-2099		
36.11	Weight(kg)	.		
36.12	Maximumallowablespan (mm)			
36.13	Cantileverstrength(kg)	AsperIS-2099		
36.14	Thedrawingenclosed.	Yes/No		

37	Dielectricdissipationfactorat 36/1.732 KV (33KV C.T) and 12/1.732KV(12KVCT)at ambienttemperature.	AsperIS-2099	
38	AccuracyclassofstandardC.T. to be used towards determination of ratio errors and phase angle errors for meteringcores.	0.05	

****

CHAPTER– 10
TECHNICALSPECIFICATIONFOR33kVMSCROSS-ARMS

1.0 'V'SHAPEM.S.CROSSARMWITHCLAMPS

1.1 X-armsshallbemadeoutof100x50x6mm and75x40x6mm M.S.Channel.

1.2 Thecrossarmshallbehotdippedgalvanizedgenerallyconformingto IS–2633/72.

1.3 TheX-armshouldnotbewelded/jointedatanyplaceexceptas specified.

1.4 TheclampsfortheX-armshallbeofG.I.&shallbehotdippedgalvanizedgenerallyconforming to IS – 2633/72.

1.5 Theclampsshallbedesignedtofitforthespecifiedrail&PSCpoles.

2.0 Shape& Size

2.1 ThecrossarmsshallbeofMSchannel.

2.2 Thecross arms shall have two holes of 26 mm dia for fixing of pin insulators. The center- to-centre distance between the holes shall be 1525 mm and holes shall be in the middle of the top width of cross arm.

2.3 If required by the owner, holes of specified size and spacing shall also be provided for fixing of pole back clamp to suit the pole.

3.0 Marking

Thefollowinginformationshallbemarkedoneachcrossarm:

a) Manufacturer'snameortrademark.

b) Yearof manufacture

****

CHAPTER–11

TECHNICALSPECIFICATIONFOR33KVPORCELAINPININSULATORSSUITABLEFOR33KVOVER HEAD LINE.

1. **SCOPE:**

This specification covers the details regarding design, manufacture and supply of the porcelain Insulators for use on 33KV Overhead Lines.

2. **GENERALREQUIREMENTS:**

2.1 Theporcelainshallbesound,freefromdefects,thoroughlyvitrifiedandsmoothlyglazed.

2.2 The glaze shall be BROWN in colour. The glaze shall cover all the porcelain parts of the insulators except those areas, which serve as supports during firing or are left unglazed for the purpose of assembly.

2.3 The design of the Insulators shall be such that stresses due to expansion and contraction in any part of the insulators shall not lead to deterioration. The porcelain shall not be engaged directly with hard metal.

2.4 Cement used in the construction of the Insulator shall not cause fracture by expansion or loosening by contraction and proper care shall be taken to locate the individual parts correctly during cementing. The cement shall not give rise to chemical reaction with metal fittings and its thickness shall be as uniform as possible.

2.5 Metal parts made of any other metal/alloy having composition other than specified in respect of different items shall not be acceptable under any circumstances.

3. **MARKING:**

3.1 Eachinsulatorshallbelegiblyandindeliblymarkedtoshowthefollowing: -

(a) Nameandtrademarkofthe manufacturer.
(b) Monthandyearofmanufacturer.
(c) Minimumfailingloadin KN
(d) Countryofmanufacturer.

3.2 InsulatorsmayalsobemarkedwithISIcertificationmarks,ifany.

3.3 Markingonporcelainshallbeprintedandshallbeappliedbeforefiring.

4. **PACKING:**

All Insulators shall be packed in wooden crates suitable for easy but rough handling and acceptable for rail/road transport. Where more than one insulator is packed in a crate, wooden separators shall be fixed between the Insulators, to keep individual Insulators in position without movement within the crate.

5. **SALIENTFEATURES:**

5.1 **33KVPININSULATORS**:

5.1.1 **APPLICABLESTANDARD**:

Unless otherwise stipulated in this specification, the insulators shall comply with the Indian Standard specification IS: 731-1971 or its latest version thereof.

5.1.2 CLASSIFICATION:

TheseinsulatorsshallconformtoType'B'ofISI:731-1971.

5.1.3 BASICINSULATIONLEVELS:

(a) TheBasicinsulationlevelsoftheinsulatorsaregivenasunderinTable-'A'.

TABL E–'A'

Highest system voltageKV(rms.)	Visible dischargetest KV (rms.)	Wet power withstandKV (rms.)	Power frequency puncturewithstand test KV (Peak)	Impulse voltage withstandtest KV (Peak)
1.	2.	3.	4.	5.
36	27	75	180	170

(b) In this specification, power frequency voltages are expressed as peak divided by √2 and impulse voltage are expressed as Peak values.

(c) Thewithstandandflashovervoltagesarereferredtothereferenceatmospheric conditions specified in IS: 731-1971 or the latest version thereof.

5.1.4 **MECHANICALFAILINGLOAD**:

(a) 33KVPinInsulatorshallbesuitableforaminimumfailingloadof10KN.

5.1.5 CREEPAGEDISTANCE:

Theminimumcreepagedistanceisgivenbelowin Table- 'B'.

TABL E–'B'

HighestSystemVoltage (KV)	Normalandmoderatelypollutedatmosphere (Total)
1.	2.
36	580 mm.

5.1.6 **TESTS**:

The Insulators shall simply to all the type routine and acceptance tests as per latest editionof IS: 731-1971 and its amendment thereof, if any.

They shall furnish along with the Bid attested Photostat copy of the latest certificate for all the Type Tests from Govt. tests house/recognized laboratory of repute along with the Drawing duly certified by the testing authorities in accordance with the ISS.

5.1.7 **GUARANTEEDTECHNICALPARTICULARS**:

Thecontractorshallfurnishtheguaranteedtechnicalparticularsintheproformaenclosed.

6. **DRAWING**:

The bidders are required to submit drawing of the Insulator indicating all dimensional details and materials used in different parts of the Insulators along with their tender.

THIMBLE:

The Pin hole for 33 KV Pin Insulators shall be completed with cemented Zinc or Lead thimble and shall be suitable for receiving a steel headed galvanized pin, the dimensions of which shall be as per Fig., 1 ref L & B ref. of IS: 2486 part-II 1974 and its latest amendment thereof.

GUARANTEEDTECHNICALPARTICULARSFOR33KVPORCELAINPININSULATORS

Sl. No.	Nameof Firm/ Particulars.	
1.	Maker'sname	
2.	ElectricalcharacteristicsofInsulators	
(a)	Nominalsystemvoltage.	
(b)	Highestsystemvoltage	
(c)	Visibledischargevoltage	
(d)	Dryoneminutepowerfrequencywithstandvoltage	
(e)	Wetoneminutepowerfrequencywithstand voltage.	
(f)	Powerfrequencypuncturewithstandvoltage.	
(g)	Impulse(1.2/50Microsecondwave)withstandvoltage.	
(h)	Impulseflashover(1.2/50Microsecondwave)withstand voltage.	
	Positive	
	Negative	
(i)	Wetpowerfrequencyflashovervoltage.	
3.	MechanicalcharacteristicsofInsulator.	
(a)	Minimumfailingload	
(b)	Minimumcreepagedistances.	
4.	Colourof Glaze	
5.	StandardaccordingtowhichPinInsulatorsshallbe manufacturedandtested.	
6.	SizeofInsulators	
(a)	Height	
(b)	Overalloutsidediameter.	
7.	Minimumweightperunit.	
8.	Packingparticulars.	
(a)	Weightofeachpackage(App.)	
(b)	NumberofInsulatorsineachpackage.	
9.	Toleranceindimension,ifany.	
10.	Otherparticulars,if any.	

****

CHAPTER– 12

SPECIFICATIONFOR33KVG.I.PINSWITHNUTFOR33KVPININSULATORS

1. **SCOPE**

This specificationcovers the design,manufacture,testing,supply anddeliveryofG.I.Pins for 33 kV Pin Insulators suitable for use on 33 kV Over Head Power Lines.

2. **APPLICABLESTANDARD:**

Except when they conflict with the specific requirements in the specification the Pins shall comply with the Indian Standard Specification IS: 2486 (Part-I) 1971, IS: 2486 (Part-II & III) 1974 or the latest version thereof.

3. **GENERALREQUIREMENT:**

The pins shall be of single piece obtained preferable by the process of forging. These shall not be made by joining, welding, shrinks fitting of any other process from more than one piece of material. These shall be of good finish free from flaws and other defects. The finish of the collar shall be such that a sharp angle between the collar and the shank is avoided.

3.1.1 **G.I.PINSFOR33KVPIN INSULATORS:**

Pins withlarge steel head type L300 N asper figure1B(ref. L)of IS: 2486 (Part-II)having stalk length 300 mm and shank length 150 mm with minimum failing load of 10 KN shall be used. **Weight of a G.I. Pin including nut and washer shall not be less than 2.80 kg.** They shall be screwed into a thimble of equivalent component fixed in the pin hold of insulators. The completedetailsofpinaregiveninDrawingESPC-III/5/90 (Figure-1)for33kVPin(enclosed).

3.1.2 The nuts provided with the Pins shall be hexagonal and threads and nuts shall be with worth type throughout.

3.2 **SUITABILITY**

The pins shall be so as to match with the Pin Insulators as per IS: 731-1971 or its latest version thereof.

4. **MATERIAL**

4.1 The Pins shall be made of forged steel conforming to clause '2' of IS: 2004-1970 or its latest version thereof.

4.2 Thenutsshallbemadeofmaterialconformingtopropertyclass'4'ofIS:1367(Table-12).

4.3 Springwashersshallbemadeofspringsteel.

4.4 Forgalvanizing,ZincconformingtogradeZn98ofIS:209-1966shallbeused.

5. **GALVANISING**

The pins, spring washers and nuts shall be not dip galvanized including the threaded portion of the pin with the exception of female threads of nuts which shall be out after galvanism and shall be protected from rust by means of greasing. The hot dip galvanizing shall be done conforming to IS: -1985or its latest edition if any and shall also fulfill the requirementsof IS: 2633-1977, 1984 or latest edition, if any in respect of uniformity, thickness and weight ofzinc coating. The galvanizing should be uniform so as to give smooth finish.

6. **TESTING**

The Pins shall be subjected to all the tests as per IS:2486 (Part-I) IS:2486 (Part-II) and Galvanizing test as per IS:2629, IS:2633 and IS:4759 and material test as per IS:2004 and IS:288 as enumerated below: -

(i) **ACCEPTANCETEST**

(a)	Checkingofthreadsofheads.	Tobecarriedoutbyinspectionteam on each lot offered.
(b)	Galvansing Tests.	
(c)	MechanicalTests	

(ii) **ROUTINETESTS**

(a)	Visualexaminationtestshallbecarried out as routine test.	Certificate of having done routine test to be submitted alongwith each offer of inspection for a particular lot.

7. **MARKING**

The pins shall be legible and invariable marked / embossed with trade mark of the manufacturer.

8. **PACKING**

The packing of the Pins shall be done in rail worthy double gunny bags. The heads and threaded portion of pins shall be properly protected against damage. The gross weight of each packing will not normally exceed 50 kg.

9. **TOLERANCE**

±2.5%indimensiononly.No(-)toleranceinpermittedinminimumguaranteedweight.

10. **GUARANTEEDTECHNICALPARTICULARS**

Theguaranteedtechnicalparticularsaregiveninproformaenclosed.

GUARANTEEDTECHINICALPARTICULARSFOR33KVG.I.PINS

Sl No.	Nameof Firms/ Particulars	Bidder'sOFFER
1	2	3
1	Maker'snameandAddress	
2	Standardtowhichthepinsconform	
3	Minimumfailingload	
4	Typeofsteelhead	
5	Lengthofthreadportionintheshank	
6	GalvanizingshallconfirmstoIS:2633–1964and zincconfirmingtogradeZn–98ofIS:209–1966 had to be used	
7	ShankLength	
8	Minimumweightofthepin	
9	Toleranceindimensions	
10	Markingasper specification	
11	Otherparticulars,ifany	
12	Packing	

****

CHAPTER– 13

TECHNICALSPECIFICATIONSFOR33KVPORCELAINPOSTINSULATORSSUITABLEFOR33KV OVERHEAD POWER LINES

1. GENERALREQUIREMENT:

1.1 Theporcelainshallbesound,freefromdefects,thoroughlyvitrifiedandsmoothlyglazed.

1.2 The glaze shall be BROWN in colour. The glaze shall cover all the porcelain parts of the insulators except those areas, which serve as supports during firing or are left unglazed for the purpose of assembly.

1.3 The design of the Insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration.

2. MARKING:

2.1 Eachinsulatorshallbelegiblyandindeliblymarkedtoshowthefollowing:-

(a) Nameandtrademarkofthe manufacturer.

(b) Monthandyearofmanufacture.

(c) MinimumfailingloadinKN(exceptincaseof33KVPost Insulators).

(d) Countryofmanufacturer.

3.2 InsulatorsmayalsobemarkedwithISIcertificationmarks,ifany.

3.3 Markingonporcelainshallbeprintedandshallbeappliedbeforefiring.

4. PACKING:

4.1 AllInsulatorsshallbepackedinwoodencratessuitableforeasybutroughhandlingand acceptable for rail/road transport.

4.2 33KVPostInsulators(2×22KVpedestaltypes)

4.2.1 ApplicableStandard:
Unlessotherwisestipulatedinthisspecificationtheinsulatorsshallcomplywiththe IS: 2544.

4.2.2 Classification:
TheseInsulatorsshallconformtoType-BofIS:2544.

4.2.3 Precaution shall be taken during design and manufacture to avoid retention of water in the recesses of metal fittings. Also shapes which do not facilitate easy cleaning by normal method shall be avoided.

4.2.4 The threads of the tapped holes in the Post Insulators metal fittings shall be cut after giving anticorrosion protection and shall be protected against rust by greasing or other similar means; all other threads shall be cut before giving anticorrosion protection. The tappedholes shall be suitable for bolts with threads having anticorrosion protection and shall conform to IS: 4218 (Part-I to IV). The effective length of thread shall not be less than the nominal diameter of the bolt.

4.2.5 The post insulator unit shall be assembled in a suitable jig to ensure the correct positioning of the top and bottom metal fittings relative to one another. The faces of the metal fittings shall be parallel and at right angles to the axis of the insulators and corresponding holes in the top and the bottom metal fittings shall be in a vertical plane containing the axis of the insulators.

4.2.6 The cap and pedestal shall be of malleable cast iron properly cemented. The malleable cast iron parts shall be hot dip galvanized as per IS: 2629 and shall also fulfill requirements of IS:

2633 in respect of uniformity, thickness and weight of Zinc coating. The galvanizing shall be uniform so as to give smooth surface finish. The top metal cap shall be provided with 4 nos. tapped holes of 12 mm diameter and 16 mm depth having with worth threads .The base of the pedestal shall be provided with 4 nos. holes of 15 mm diameter & 76 mm PCD. The thickness of the base shall not be less than 11 mm.

4.2.7 TheBasicInsulationLevel:

Thebasicinsulationlevelsshouldcomplywith;

Table–'A'(IS:2544-Table-1)

Highest System voltage KV (rms)	Visible dischargetest KV (rms)	Wet power frequencywith stand units KV (rms)	Power frequency puncturewithstand testontestKV (rms)	Impulsevoltage withstand KV (rms)
1	2	3	4	5
36	27	75	1.3 times the actual dryflashovervoltage of theunit	170

4.2.8 MechanicalCharacteristics:

Theminimummechanicalstrengthvalueoftheoutdoorpedestalpostinsulatorsshall not be less than the value specified below: -

Cantileverstrength:-

(i) Upright:450Kg.

(ii) Inverted:340Kg.

4.2.9 CreepageDistance:

The minimum creep age distance shall be 760 mm as specified for PA 170 Post Insulator inTable '5' of IS: 5350 (Para-III 1971).

4.2.10 Tests:

The insulators shall comply with all type routine and acceptance test as per latest edition of IS: 2544.SuppliershallfurnishattestedPhotostatcopyofthelatesttypetestscertificatesfor all tests in accordance with the ISS from Govt / recognized laboratory of repute along with the Drawings duly certified by the Testing authorities.

5.0 GUARANTEEDTECHNICALPARTICULARSFORPOSTINSULATOR.

Sl. No.	**Particulars.**	
I.	MakersName	
1.	StandardaccordingtowhichPostInsulatorsshallbemanufacturedandtested.	
II.	ElectricalcharacteristicsofInsulators	
(a)	Nominalsystemvoltage.	
(b)	Highestsystemvoltage	
(c)	Visibledischargevoltage	
(d)	Dryoneminutepowerfrequencywithstandvoltage	
(e)	Wetoneminutepowerfrequency	
(f)	Powerfrequencypuncturewithstandvoltage.	
(g)	Impulse(1.2/50Microsecondwave)withstandvoltage.	
(h)	Impulseflashover(1.2/50Microsecondwave)withstandvoltage.	
(i)	Positive	
(ii)	Negative	
(i)	Dryflashovervoltage	
(j)	Wetflashovervoltage.	
III.	MechanicalcharacteristicsofInsulator.	
(a)	Minimumfailingload	
(i)	Upright	
(ii)	Inverted	
(b)	Minimumcreepagedistances.	
IV.	Colourof Glaze	
V.	Minimumweightofinsulatorsasperlatesttypetestreport	
VI.	Dimensions	
(a)	Height	
(b)	Overalloutsidediameter.	
(c)	Topmetalfittingpitchcircledia	
(d)	Bottommetalfittingpitchcircledia	
VII	Fixingarrangement	
(i)	Pitchcirclediatopandbottommetal fittings	
(ii)	No.ofholes	
(iii)	Diaof holes	
(iv)	Depthof holes	
(v)	Thicknessofbase	
VIII.	Packingparticulars.	
(a)	Typeof packing	
(b)	Dimensionofeachcrate	
(c)	No.ofinsulatorsineachpackage	
(d)	Weightofeachcrate	
IX	Otherparticulars,ifany	

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CHAPTER– 14

TECHNICALSPECIFICATIONFORDISCFITTING(T&CTYPE)45KNFOROVERHEADLINES

1. SCOPE:

This specification covers the design, manufacturing, testing, supply and delivery of disc fitting suitable for use on high tension overhead power lines.

2. APPLICABLESTANDARD:

Unless otherwise stipulated in this specification the disc fitting shall comply with the latest edition of IS: 2486 (Part-I) 1993 and IS: 2486 (Part-II&III) 1979 or their latest version.

3. GENERALREQUIREMENTS:

All forgings and casting shall be of good finish and free from flaws and other defects. The edges on outside of the fittings such as at the eye, clevis and holes shall be rounded.

All parts of different fittings which provides inter connection, shall be made such that sufficient clearance is provided at the connection point to ensure free movement and suspension of the insulator string assembly. All eye and clevis connection shall be free in such a manner that too much clearance between eye and tongue of the clevis is avoided.

All ferrous fittings and the parts other than those of stainless steel shall be hot dip galvanized in accordance with IS: 2669/1985 and IS: 6745/1972 or its latest edition if any and shall also fulfill the requirements of IS: 2633/1986 and 4759/1996 or their latest editions in respect of uniformity, thickness andweight ofZinc coating. Thegalvanizing should be uniformso asto give smooth finish. Small fitting parts like spring washer, nuts etc., shall also be hot dip galvanized.

4. MATERIAL:

The material for the string insulator fittings shall be such that is gives the required mechanical strength with specified dimensions. The following materials for particular type of fitting may beused.

(a) MildsteelconformingtoIS: 1570/1961
(b) ForgedsteelconformingtoIS:2004/1970.
(c) MalleableironconformingtoIS:2108/1962.
(d) Aluminumalloy (for clamps only). Preferably the composition of the AluminumAlloyshall be declared by the manufacturer giving reference to the relevant Indian standard.

NOTE: - strainclampsofaluminumalloyonlyshallbeacceptable.Noothermaterial composition except Aluminum alloy be acceptable for strain clamps.

Securityclipsandsplitpinsshallbeofphosphorbronzeconformingto IS:1385ofsuitable temper with minimum hardness of 100HV conforming to IS: 410.

CotterpinsandBoltsshallbemadeofforgedsteelconformingtoclass2ofIS:2004.

All nuts shall be made of material conforming to proper class 4.8 of IS: 1367 with regard to its mechanical properties.

Springwashershallbemadeofspringsteel;

PlainwashershallbemadeofmildsteelconformingtoIS:1570.

Forgalvanizing,ZincconformingtogradeZn98ofIS:205,1966 shallbeused.

5.1 TENSIONFITTING(T&C)TYPE45KN:

5.1.1 The fitting shall be suitable for use with tongue and clevis type 11 KV Disc Insulators having E.M., strength of 4500 Kg. Conforming to IS: 2486 Part-II and IS: 731.

5.1.2 Thefittingsshallcompriseofthefollowingparts.

(i) A setof cross arm straps completewithone16 mm dia bolt,one spring washer,one nut and split pin suitable for fitting to cross arm channel having flanges 125 mm apart on one side and to the clevis on the other side as per fig., 26 of IS: 2486 (Part-II).

(ii) Set of clevis cum snail type strain clamp complete with keeper having 'U' Bolt of 10 mm diameter, nuts, plain washer, spring washer etc., and cotter bolt with drawing as per drawingenclosed.Theclevisarrangementshall beasperfig.25ofIS:2486(Part-II).The clamp shall be accommodating ACSR conductor up to size 80 mm^2 (ACSR Raccoon Conductor). The slip strength of the strain clamp shall not be less than 90% of the breaking strength of the conductor for which fitting are to be used.

5.1.3 Theminimum failingloadofcompletediscfittingaswellasthatofcleviscum snailtypestrain clamp shall not be less than 4500 kgs. When tested in accordance with IS:2486 (Part-I)/1971.

6.0 INSPECTIONTESTING:

Material shall be inspected and tested at the manufacturers' works / at stores of DoWR to verify that these are being supplied in accordance with technical specification guaranteed technical particular and approved drawing, if any.

All instruments used in inspection and testing should be properly calibrated and sealed oncea year. Calibration certificate when demanded by the inspecting officer shall be produced for verification purpose. In case of any dispute regarding calibration of instrument, instrument shall be sealed and signed by representative of the supplier and purchaser and will be sent to institution / laboratory of repute & govt. approved as decided by purchaser for calibration at the cost of the supplier. The result of such testing shall be binding on supplier.

7.0 TESTS:-

Disc fitting shall comply with all type, routine and acceptance tests as per IS: 2486 (Part-I)/Part-II or their latest amendment. They shall furnish all attested Photostat copy of latest type test certificate for the test in accordance with ISS from Govt. test house/recognized laboratory of repute along with certified copy of drawing with their offer. **The type test should be conducted within five years from the date of opening of tender.**

7.1 ACCEPTANCETESTS:-

Acceptance tests as per relevant ISS (as per ISS: 2486 Part –I or their latest amendment) shall be carried out in the presence of inspection team for each lot offered.

7.2 **ROUTINETESTS:**

RoutinetestsasperrelevantISS(asperISS:2486Part-IIortheirlatestamendment)shallbe submitted along with every offer for inspection.

8.0 Thefirmshallalsosubmitalongwiththeiroffer:-

(a) Testcertificates fortheitemsofferedforthe test showingthe respective drawingduly signed by the testing laboratory authorities.

(b) Detailed drawing of each item offered indicating the material composition, dimension etc.

(c) Billofmaterialsforeachitemsoffered.

9.0 MARKING:

The tension clamp of the fittings shall be legibly and invariably embossed with the trademark of manufacturer & DoWR.....and sl. no. from 1 to last no of supply.

10.0 PACKING;

Thepacking ofthefittingsshallbedoneinrailworthydoublegunnybags.TheGrossweightof each packing shall not normally exceed 50 Kg.

11.0 TOLRANCES:

(±)2.5%indimensionsonly(±1mmfordimensionslessthan2.5mm).

12.0 GUARANTEEDTECHNICALPARTICULARS:

Thebiddersshallfillintheguaranteedtechnicalparticularin Performaenclosedasperschedule.

SL. No.	Nameof Firms/Particulars	
1	**2**	**3**
1	Manufacturer'sName	
2	Type	
3	Ultimatestrength	
4	Whetherdimensionotherthanspecifiedareinaccordancetoli S: 2486	
5	MATERIALUSED&REFERENCETOSTANDARD	
	(i)Crossarmsnailtype	
	(ii)Clevisarmsnailtype	
	(iii)Slitpin	
	(iv)Nuts	
	(v)CoulterPinsandbolts	
	(vi)SpringWasher	
	(vii)PlainWasher	
	(vii)Zincconfirmingtograde	
6	WEIGHTPERSET	
	(i)Grossweightofcompletefitting	
	(ii)Weightofclamp	
	(iii)WeightofNutsandBolt&rivets	
	(iv)WeightofcrossArm straps	
	(v)Weightofferrousparts	
	(vi)Minimumguaranteedweightof completefitting	
	(vii)WhethergalvanizedconformtoIS:2633– 1964	
7	PACKINGDETAILS	
	(i)Net weight	
	(ii)GrossWeight	
	(iii)Contentsofeachpack	
	(iv)Typeof packing	
8	Toleranceindimensions,ifany	

****

CHAPTER– 15
TECHNICALSPECIFICATION:20MMDIABLACKSTAYSETSFOR33KVLINES (NONE GALVANIZED, NOT-PAINTED):

AVERAGE WEIGHT OF FINISHED STAY SETS: 7.922 Kg. (Minimum)
(EXCLUDING NUTS, THIMBLES & WASHERS): 8.699Kg.(Maximum)

1. Thestaysets(LineGuyset)willconsistofthefollowingcomponents:-

   i) Anchor rod with one washer and nuts: Overall length of rod should be 1800mm to be made out of 20mm MS rod, one end threaded up to 40mm length with pitch of 4 threadsper cm and provided with one square MSwasher of size 50x50x1.6mm and one MS Hexagonal nut conforming to IS:1367/1967 and IS:1363/1967. Both washer and nut to suit the threaded rod of 20mm dia. The other end of rod to be made into a round are having an inner dia of 40mm with best quality welding.

   ii) Anchor Plate Size 300x300x8mm: To be made out of MS plate of 8mm thickness. The Anchor plate should have at its center 22mm dia hole.

   iii) Turn Buckle: (a) Eye bolt with 2 nuts: To be made of 20mm dia MS Rod having an overall length of 450mm. One end of rod to be threaded up to 300mm length of pitch of 4 threads per cm. The 20mm dia bolt so made shall be provided with two MS Hexagonal nuts of suitable size conforming to IS:1637/1967 & IS:1363/1967. The other end of rod shall be rounded into a circular eye of 40 mm inner dia with proper and good quality welding.

   (b) Bow with welded angle: To be made out of 20mm dia MS Rod. The finished bow shall have an overall length of 995mm and height of 450mm. The apex or top of the bow shall be bent at an angle of 10 R. The other end shall be welded with proper and good qualitywelding to a MS Channel 200mm long having a dimension of 100x50x4.7mm. The channel shall have 2 holes of 18mm dia and 1.22mm dia hole at its centre.

   iv) Thimble:2Nostobemadeon1.5mmthickMSsheetintoasizeof 75x22x40mm.

2. WELDING:

   The minimum strength of welding provided on various components of 20mm dia stay sets shall be 4900Kgs. Minimum 6mm fillet weld or its equivalent weld area should be deposited in all positions of the job i.e. at any point of the weld length. The welding shall beconforming to relevant IS: 823/1964 or its latest amendment. Welding if found short in lengths or not done properly as required shall be rejected.

3. THREADING:

   The threads on the Anchor Rod, Eye Bolt and Nuts shall be as per specifications IS: 4218/1967(ISO Metric Screw Threads). The nuts shall be conforming to the requirement of IS:1367/1967&havedimensionsasperIS:1363/1967.AVERAGEWEIGHTOFFINISHEDSTAY SETS:14.523Kg.(Minimum).(EXCLUDINGNUTS,THIMBLES&WASHERS):15.569Kg. (Maximum).

   TEST CERTIFICATE: The supplier shall be required to furnish the test certificates from Govt./Recognizedtestinglaboratory givingresult of followingtests alongwiththe inspection report of material of first lot in individual size separately.

   Tensile load of 3100Kg/4900Kg applied for one minute on the welding & maintained for one minute for 16 mm & 20 mm dia Stay Sets respectively.

   In view of non-submission of above test certificates inspection report shall not beacceptable.

IV. IDENTIFICATIONMARK:

All stay sets should carry the identification markof the manufacturer. For this, the firm must engrave identification mark of about 3 capital letters as advised in the order. This should be engraved on the stay plate and possible on stay rods to ensure proper identification of the material. On account of this, no extra charges will be paid.

V. The nuts should be a size compatible with the threaded portion of rods and there should be no play or slippage of nuts.

VI. Weldingwhereverrequiredshouldbeperfectandshouldnotgivewayaftererection.

II. TOLERANCES:

The tolerances for various components of the stay sets are indicated below subject to the condition that the average weight of finished stay sets of 16 mm and 20mm dia excluding nuts & thimbles and washers shall not be less than the weight specified above:-

SL. NO.	Item	Section Tolerance	Fabricationtolerance	Material
1	Anchor plate	6mmthick (+12.5%,-5%) 8mm thick (+12.5%,-5%)	200x200mm(+1%), 33x300mm (+1%)	MS plate 6mm MSplate8mm
2	Anchor rod	16mmdia(+5%,-3%), 20mmdia(+3%,-2%),	Length1800mm (+5%), Round wire 40mm inside Threading40mm +11% -5%	MSRod16mm MSRod20mm
3	Turn Buckle	16mmdia+5%	Length995mm	MSRound 16mm
4	Eye Bolt Rod	16mmdia+5% 20mmdia+3%	Length 450mm, Threading300mm+1%, Round Eye 40mm inside dia +3%. Threading300mm+1% Round Eye 40mminsidedia +3%.	MSRod16mm MSRod20mm

CHAPTER– 16
TECHNICALSPECIFICATIONFORPORCELAINDISCINSULATORS70KN(B&STYPE)FOR33KV OVERHEAD POWER LINES.

1. SCOPE:

This specification covers the details regarding design manufacture and supply of the porcelain insulator for use on Overhead Power Lines.

2. **GENERALREQUIREMENTS**:

Theporcelainshallbesound,freefromdefects,thoroughlyvitrifiedandsmoothlyglazed.

The glaze shall be brown in color. The glaze shall cover all the porcelain parts of the insulator except those areas, which serve as supports during firing or left unglazed for the purpose of assembly.

The design of the insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. The porcelain shall not engage directly with the hard metal.

Cement used in the construction of the insulator shall not cause fracture by expansion or loosening by contraction, and proper care shall be taken to locate the individual parts correctly during cementing. The cement shall not give rise to chemical reaction with metal fittings and its thickness shall be as uniform as possible.

3. MARKING:

3.1 Eachinsulatorshallbelegiblyandindeliblymarkedtoshowthefollowing:

(a) NameofTradeMarkofthemanufacturer.
(b) Monthandyearofmanufacture.
(c) Minimumfailingloadin KN.
(d) Countryofmanufacture.

3.2 InsulatorsmayalsobemarkedwithISIcertificationmarks,ifany.

3.3 Markingsonporcelainshallbeprintedandshallbeappliedbeforefiring.

4. **PACKING**:

All insulators shall be packed in wooden crates suitable for easy but rough handling and acceptable for Rail / Road transport. Where more than one insulator is packed in a crate, woodenseparatorsshallbefixedbetweentheinsulatorstokeepindividualinsulatorinposition, without movement within the crates.

5. SALIENTFEATURES:

DISC INSULATORS:

5.5.1 APPLICABLESTANDARDS:

Unless otherwise stipulated in this specification, the insulator shall comply with the Indian Standard specification, IS: 731-1971 or its latest version thereof.

5.1.2 CLASSIFICATION:

TheinsulatorsshallconformtoType‘B’ofIS:731-1971.

5.1.3 BASICINSULATIONLEVEL:

a. Thebasicinsulationlevelsoftheinsulatorsaregivenasunderintable ‘A’

TABLE'A'

Highest system voltageKV (rms.)	Visible dischargetest voltage KV (rms.)	Wetpower frequency withstand voltage.KV (rms.)	Power frequency puncture withstandtest voltage. KV (Peak)	Impulsevoltage withstandtest. KV (Peak.)
1.	**2.**	**3.**	**4.**	**5.**
12	9	35	105	75

b. Inthisspecification,powerfrequencyvoltageisexpressedaspeakdividedby √2and impulse voltage is expressed as peak value.

c. The withstand flashover voltage are referred to the atmospheric conditions specified in IS: 731-1971 and the latest version thereof.

5.1.4 MECHANICALFAILINGLOAD:

11 KVInsulatorsBallandSockettype70KNshallbesuitableforminimumfailingloadof70KN.

5.1.5 CREEPAGEDISTANCE:

Theminimumcreepagedistanceshallbegivenhereunderin Table 'B'.

Table 'B'

Highestsystemvoltage(KV)	Normalandmoderatelypollutedatmosphere (total)
12	230 mm.

5.1.6 BALL&SOCKETARRANGEMENTDESTINATION&MATERIAL.

The ball and Socket arrangement to be provided inthe disc Insulation shall be ofdesignation 16mm alternatively 'B'for70KNEMShavingdimensionsaspertableoffigure-8forpinballs and as per table of figure -9 for socket provided in the latest edition of IS: 2486 (Part-II).

The figure or ball and socket arrangement shall be black heart malleable cast ironconforming to latest edition of IS: 2108 and shall be hot dip galvanised as per latest editionof IS: 2629 and shall fulfill the requirement of IS: 2633. The metal parts shall be such that it gives the required mechanical strength with specified dimensions and it shall be in accordance with latest edition of IS: 2486 (Part-I).

6. **TESTS:**

The insulators shall comply with all the type, Routine and Acceptance tests as per latest editions of IS: 731-1971 and amendment thereof, if any.

They shall furnish attested Photostat copy of the latest certificate for all the type testsinaccordancewiththeISSfromGovt.testhouse/recognizedlaboratoryofreputealong with the drawing duly certified by the testing authorities.

6.1 **TYPETEST:**

(a) Visualexamination.
(b) VerificationofDimensions.
(c) VisiblydischargeTests.
(d) Impulsevoltagewithstandtest.
(e) Wetpowerfrequencywithstandtest.
(f) TemperatureCycleTest.

(g) MechanicalfailingloadTest.
(h) PunctureTest.
(i) PorosityTest.

6.2 **ACCEPTANCETESTS:**

(a) VerificationofDimensions.
(b) TemperatureCycleTest.
(c) MechanicalfailingloadTest.
(d) PunctureTest.
(e) PorosityTest.

} To be carried out in the presence of inspectionTeamoneachlotoffered.

6.3 **ROUTINETEST:**

(a) VisibleexaminationTest.
(b) ElectricalRoutineTest.

} To be submitted along with each offer of inspection for a particular lot and its record to be maintained at your works. This record maybe availabletotheinspectionteamon their request.

7. **GuaranteedTechnicalParticulars(G.T.P.):**

The material shall conform to the Guaranteed Technical particulars, required to be filled in the annexed proforma.

GUARANTEEDTECHNICALPARTICULARSFORDISCINSULATORS70KN(B&S)

Sl.No.	NameofFirm/ Particulars.	`	
1.	Nameof Manufacturer.		
2.	ElectricalcharacteristicsofInsulators		
(a)	Nominalsystemvoltage.	KV	
(b)	Highestsystemvoltage	KV	
(c)	Visibledischargevoltage	KV	
(d)	Dryoneminutepowerfrequency withstand voltage	KV	
(e)	Wet one minute power frequency withstandvoltage.	KV	
(f)	Power frequency puncture withstand voltage.	KV	
(g)	Impulse (1.2/50 Micro second wave) withstandvoltage.	KV	
(h)	Impulseflashover(1.2/50Microsecond wave)withstandvoltage.		
(i)	Positive	KV (Peak)	
(ii)	Negative	KV (Peak)	
(i)	Wetpowerfrequencyflashovervoltage.	KV	
3.	MechanicalcharacteristicsofInsulator.		
(a)	Minimumfailingload/EMS	KN	
(b)	Minimumcreepagedistances.	mm.	

4.	Colourof Glaze	Brown	
5.	Standardaccordingtowhichporcelain Insulatorsshallbemanufactured&tested		
6.	SizeofInsulators		
(a)	Height	Mm	
(b)	Overalloutsidediameter.	Mm	
7.	Minimumweightperunit asperlatesttype testreport..	Kg.	
8.	Packingparticulars.		
(a)	Weightofeachpackage(Approx.)	Kg.	
(b)	NumberofInsulatorsineachpackage.	Nos.	
9.	Toleranceindimension,ifany.		

CHAPTER– 17
TECHNICALSPECIFICATIONFORCONTROL&RELAYPANEL

TYPEOF PANELS

1.1 **SimplexPanel**

Simplex panel shall consist of a vertical front panel with equipment mounted thereon and having wiring access from rear for control panels & either front or rear for relay panels. In case of panel having width more than 800mm, double leaf-doors shall be provided. Doors shall have handles with either built in locking facility or will be provided with pad-lock.

All the equipments/ Relays/CTs/PTs to be installed / housed in the Air insulated panel, must be type tested & from short listed approved vendors. Dimension of Type Tested equipments are only be accepted.

1.2 CONSTRUCTIONALFEATURES

(i) Control and Relay Board shall be of panels of simplex type design as indicated in bill of quantity. It is the responsibility of the contractor to ensure that the equipment specified and such unspecified complementary equipment required for completeness of the protective/control schemes is properly accommodated in the panels without congestion and if necessary, provide panels with larger dimensions. No price increase at a later date on this account shall be allowed. However, the width of panels that are being offered to be placed in existing switchyard control rooms, should be in conformity with the space availability in the control room.

(ii) Panels shall becompletelymetal enclosed and shall be dust,moisture andvermin proof. The enclosure shall provide a degree of protection not less than *IP-52* in accordance with IS: 2147.

(iii) Panels shall be free standing, floor mounting type and shall comprise structural frames completelyenclosed with specially selected smooth finished, cold rolled sheetsteelof thickness not less than 3 mm for weight bearing members of the panels such as base frame, front sheet and door frames, and 2.0mm for sides, door, top and bottom portions. There shall be sufficient reinforcement to provide level transportation and installation.

(iv) All doors, removable covers and panels shall be gasketed all around with neoprene gaskets. Ventilating louvers, if provided shall have screens and filters. The screens shall be made ofeither brass or GI wire mesh.

(v) Design, materials selection and workmanship shall be such as to result in neat appearance, inside and outside with no welds, rivets or bolt head apparent from outside, with all exterior surfaces
tuneand smooth.

(vi) Panels shall have base frame with smooth bearing surface, which shall be fixed on the embedded foundation channels/insert plates. Anti vibration strips made of shock absorbing materials that shall be supplied by the contractor, shall be placed between panel& base frame.

(vii) Cableentriestothepanelsshallbefromthebottom.Cableglandplatefittedonthebottom of the panel shall be connected to earthing of the panel/station through a flexible braided copper conductor rigidly.

1.3 MOUNTING

(i) All equipment on and in panels shall be mounted and completely wired to the terminal blocks ready for external connections. The equipment on front of panel shall be mounted flush. No equipment shall be mounted on the doors.

(ii) Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent devices and are readily accessible without use of special tools. Terminal marking on the equipment shall be clearly visible.

(iii) Contractor shall carry out cut out, mounting and wiring of the free issue items supplied by others which are to be mounted in his panel in accordance with the corresponding equipment manufacturer's drawings. Cut outs if any, provided for future mounting of equipment shall be properly blanked off with blanking plate.

(iv) The center lines of switches, push buttons and indicating lamps shall be not less than 750mm from the bottom of the panel. The center lines of relays, meters and recorders shall be not less than 450mm from the bottom of the panel

(v) The center lines of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Likewise the top lines of all meters, relays and recorders etc.shall be matched.

(vi) Noequipmentshallbemountedonthe doors.

(vii) Atexistingstation,panelsshallbematchedwithotherpanelsinthecontrolroominrespect of dimensions, colour, appearance and arrangement of equipment (center lines of switches, push buttons and other equipment) on the front of the panel.

1.4 PANELINTERNALWIRING

(i) Panels shallbe suppliedcomplete withinterconnectingwiringprovidedbetweenallelectrical devices mounted and wired in the panels and between the devices and terminal blocks for the devices to be connected to equipment outside the panels. When panels are arranged to be located adjacent to each other all inter panel wiring and connections between the panels shall be furnished and the wiring shall be carried out internally.

(ii) All wiring shall be carried out with 650V grade, single core, stranded copper conductor wires withPVCinsulation.Theminimumsizeofthemultistrandedcopperconductorusedforinternal wiring shall be as follows:

• All circuits except current transformer circuits and voltage transfer circuits meant for energy metering - one 1.5mm sq. per lead.

• Allcurrenttransformercircuitsone2.5sqmmlead.

• Voltagetransformercircuit(forenergymeters):Two2.5sqmmperlead.

(iii) All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters & troughs shall be used for this purpose.

(iv) Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall be provided near the top of the panels running throughout the entire length of the panels.

(v) Wiretermination shallbe made withsolder lesscrimping typeand tinned copper lugs, which firmly grip the conductor. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shallbefittedatbothendsofeachwire.Ferrulesshallfittightlyonthewireandshallnotfalloff when the wire is disconnected from terminal blocks. All wires directly connected to trip circuit breaker or device shall be distinguished by the addition of red coloured unlettered ferrule.

(vi) Longitudinal troughs extending throughoutthe fulllength ofthe panel shall be preferred for inter panel wiring. Inter-connections to adjacent panel shall be brought out to a separate set of terminal blocks located near the slots of holes meant for taking the inter-connecting wires.

(vii) Contractor shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipments

1.5 TERMINALBLOCKS

(i) All internal wiring to be connected to external equipment shall terminate on 'Elmex' type CAT-M4 or equivalent type terminal blocks. Terminal blocks shall be 650 V grade and have 10 Amps continuous rating, moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Markings on the terminal blocks shall correspond to wire number and terminal numbers on the wiring diagrams. All terminal blocks shall have shrouding with transparent unbreakable material.

(ii) Disconnecting type terminal blocks for current transformer and voltage transformer secondary leads shall be provided. Also current transformer secondary leads shall be provided with short circuiting and earthing facilities.

(iii) Atleast20%spareterminalsshallbeprovidedoneachpanelandthesespareterminalsshall be uniformly distributed on all terminal blocks.

(iv) Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors of external cable on each side

- AllCT&PTcircuits:minimumoftwoof2.5mmSq.copper.
- AC/DCPowerSupplyCircuits:Oneof6mmSq. Aluminum.
- Allothercircuits:minimumofoneof2.5mmSq. Copper.

(v) There shall be a minimum clearance of 250mm between the first row of terminal blocks and the associated cable gland plate or panel side wall. Also the clearance between two rows of terminal blocks edges shall be minimum of 150mm.

(vi) Arrangement of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal blocks is run in parallel and close proximity along each side ofthewiring-ducttoprovideforconvenientattachmentofinternalpanelwiring.Thesideofthe terminal block opposite the wiring duct shall be reserved for the Owner's external cable connections. All adjacent terminal blocks shall also share this field wiring corridor. All wiring shall be provided with adequate support inside the panels to hold them firmly and to enable free and flexible termination without causing strain on terminals.

(vii) The number and sizes of the Owner's multi core incoming external cables will be furnished to the contractor after placement of the order. All necessary cable terminating accessories such as gland plates, supporting clamps & brackets, wiring troughs and gutters etc. (except glands & lugs) for external cables shall be included the scope of supply.

1.6 PAINTING

(i) All sheet steel work shall be phosphated in accordance with the IS:6005 "Codeof practice for phosphating iron and steel".

(ii) Oil,grease,dirtandswarfshallbethoroughlyremovedbyemulsioncleaning.

(iii) Rustandscaleshallberemovedbypicklingwithdiluteacidfollowedbywashingwith running water rinsing with a slightly alkaline hot water and drying.

(iv) After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying.

(v) The phosphate coating shall be sealed with application of twocoats of ready mixed, stoved type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.

(vi) After application of the primer, two coats of finishing,synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting. The exterior colour of paint shall be of a slightly different shade to enable inspection of the painting.

(vii) A small quantity of finished paint shall be supplied for minor touching up required at site after installation of the panels.

(viii) In case the contractor proposes to follow any other established painting procedure like electrostatic painting, the procedure shall be submitted for Engr- In-Charge's review and approval.

1.7 MIMICDIAGRAM

(i) Coloured mimic diagram and symbols showing the exact representation of the system shall be provided in the front of control panels.

(ii) Mimic diagram shall be made preferably of anodised aluminum or plastic of approved fast colour material, which shall be screwed on to the panel and can be easily cleaned. Painted overlaid mimic is also acceptable. The mimic bus shall be 2mm thick. The width of the mimicbus shall be 10mm for bus bars and 7mm for other connections.

(iii) Mimic bus colour will be decided by the Engr- In- Charge and shall be furnished to the successful contractor during Engineering.

(iv) When semaphore indicators are used for equipment position they shall be so mounted in the mimic that the equipment close position shall complete the continuity of mimic.

(v) Indicating lamp, one for each phase, for each bus shall be provided on the mimic to indicate bus charged condition.

1.8 NAMEPLATESANDMARKINGS

(i) All equipment mounted on front and rear side as well as equipment mounted inside the panels shall be provided with individual name plates with equipment designation engraved.Also on the top of each panel on front as well as rear side, large and bold name plates shall be provided for circuit/ feeder designation.

(ii) All front mounted equipment shall also be provided at the rear with individual name plates engraved with tag numbers corresponding to the one shown in the panel internal wiring to facilitate easy tracing of the wiring.

(iii) Each instrument and meter shall be prominently marked with the quantity measured e.g. KV, A, MW, etc. All relays and other devices shall be clearly marked with manufacturer's name, manufacturer's type, serial number and electrical rating data.

(iv) Name Plates shall be made of non-rusting metal or 3 ply lamicoid. Name plates shall be black with white engraving lettering.

(v) AllthepanelsshallbeprovidedwithnameplatemountedinsidethepanelbearingLOANo & Date, Name of the Substation & feeder and reference drawing number.

1.9 MISCELLANEOUSACCESSORIES

(i) PlugPoint:

240V, Single phase 50Hz, AC socket with switch suitable to accept 5 Amps and 15 Amps pin round standard Indian plug, shall be provided in the interior of each cubicle with ON-OFFswitch.

(ii) InteriorLighting:

Each panel shall be provided with a fluorescent lighting fixture rated for240 Volts, single phase, 50 Hz supply for the interior illumination of the panel controlled by the respective panel door switch. Adequate lighting shall also be provided for the corridor in Duplex panels.

(iii) SwitchesandFuses:

Each panel shall be provided with necessary arrangements for receiving, distributing and isolating of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breakers (MCB). Selection of the main and sub-circuit MCB rating shall be such as to ensure selective clearance of sub-circuit faults. MCBs shall confirm to IS :13947 . Each MCB shall be providedwith one potential free contact and thesame shall bewired for annunciation purpose. However voltage transformer circuits for relaying and meteringshall be protected by fuses. All fuses shall be HRC cartridge type conforming to IS:13703 mounted on plug-in type fuse bases. . Fusecarrier base as well as MCBs shall have imprints of the fuse 'rating' and 'voltage'.

(iv) SpaceHeater:

Each panel shall be provided with a space heater rated for 240V, single phase, 50 Hz Ac supply for the internal heating of the panel to prevent condensation of moisture. The fittings shall be complete with switch unit.

1.10 EARTHING

(i) All panels shall be equipped with an earth bus securely fixed. Location of earth bus shall ensure no radiation interference for earth systems under various switching conditions of isolators and breakers. The material and the sizes of the bus bar shall be at least 25 X 6 sq.mm perforated copper with threaded holes at a gap of 50mm with a provision of bolts and nuts for connection with cable armours and mounted equipment etc for effective earthing. When several panels are mounted adjoining each other, the earth bus shall be made continuous and necessary connectors and clamps for this purpose shall be included in the scope of supply of Contractor. Provision shall be made for extending the earth bus bars to future adjoining panels on either side.

(ii) Allmetallic casesof relays,instruments andotherpanelmountedequipmentincludinggland plate, shall be connected to the earth bus by copper wires of size not less than 2.5 sq. mm. The color code of earthing wires shall be green.

(iii) Loopingofearthconnectionswhichwouldresultinlossofearthconnectiontootherdevices when the loop is broken, shall not be permitted. However, looping of earth connections between equipment to provide alternative paths to earth bus shall be provided.

(iv) VT and CT secondary neutral or common lead shall be earthed at one place only at the terminal blocks where they enter the panel. Such earthing shall be made through links so that earthing may be removed from one group without disturbing continuity of earthing system for other groups.

1.11 INDICATINGINSTRUMENTS

All instruments, meters, recorders and transducers shall be enclosed in dust proof, moisture resistant, black finished cases and shall be suitable for tropical use. All Watt /Var, Bus Voltage and Line current indicating instruments shall of Moving Iron (MI) type and these shall be calibrated to read directly the primary quantities. They shall be accurately adjusted and calibrated at works and shall have means of calibration check and adjustment at site. The suppliershallsubmitcalibrationcertificatesatthetimeofdelivery.Howevernoseparate

transducers are envisaged for digital bus voltmeters and digital frequency meters and the indicating meters provided in the synchronising equipment.

(i) IndicatingInstruments

a. Unless otherwise specified, all electrical indicating instruments shall have circular scale and with a dial of 96mm x 96mm. They shall be suitable for flush mounting.

b. Instruments dial shall be with white circular scale and black pointer and with black numerals and lettering. The dial shall be free from warping, fading, and discoloring. The dial shall also be free from parallax error.

c. Instruments shall conform to IS: 1248 and shall have accuracy class of 5 or better. The design of the scales shall be such as to have resolution suitable for the application. The marking of centre zero Watt /Var meters shall be IMPORT (on left) and EXPORT (on right) to indicate the direction of active/reactive power flow towards or away from the substation bus bars respectively.

(ii) EnergyMeteringInstruments

(a) WattandVarhourmetersshallbeofstatictrivectortypeasperdetailsgivenelse.

(b) EnergyMetershallbeprovidedonall33and11kVfeeders.

(iii) AnnunciationSystem

a. Alarm annunciation system shall be provided in the control board by means of visual and audible alarm in order to draw the attention of the operator to the abnormal operating conditions or the operation of some protective devices. The annunciation equipment shall be suitable for operation on the voltages specified in this specification.

b. The visual annunciation shall be provided by annunciation facia, mounted flush on the top of the control panels.

c. The annunciator facia shall be provided with translucent plastic window for alarm point with approximate size of 35mm x 50mm. The facia plates shall be engraved in black lettering with respective inscriptions. Alarm inscriptions shall be engraved on each window in not more than three lines and size of the lettering shall not be less than 5 mm.

d. Each annunciation window shall be provided with two white lamps in parallel to provide safety against lamp failure. Long life lamps shall be used. The transparency of cover plates and wattage of the lamps provided in the facia windows shall be adequate to ensure clear visibility of the inscriptions in the control room having high illumination intensity (350 Lux), from the location of the operator's desk.

e. AllTripfaciashallhaveredcolourandallNontripfaciashallhavewhitecolour.

f. The audible alarm shall be provided by Buzzer/ Hooter /Bell having different sounds and shall be used as follows. Hooter Alarm Annunciation Bell Annunciation DC failure Buzzer AC supply failure

g. Sequenceofoperationoftheannunciatorshallbeasfollows:

SL.No.	Alarm Condition	Faultcontact	Visual annunciation	Audiable Annunciation (byHooter)
1	Normal	Open	Off	Off
2	Abnormal	Close	Flashing	On
3	Accept pushbutton	Close	Steady on	Off

4	Resetpushbuttonis pressed	Open Close	Steady On	Off Off
5	Lamptestpush button pressed	0pen Open	Off Steady on	off off

h. Audible annunciation for the failure of DC supply to the annunciation system shall be provided and thisannunciation shalloperate on240 Volts ACsupply. On failureof the DC to the annunciation system for more than 2 or 3 seconds. (adjustable setting), a bell shall sound. A separate push button shall be provided for the cancellation of this audible alarm alone but the facia window shall remain steadily lighted till the supply to annunciation system is restored.

i. A separate voltage check relay shall be provided to monitor the failure of supply (240V AC) to the scheme mentioned in Clause above. If the failure of supply exists for more than 2 to 3 seconds. This relay shall initiate visual and audible annunciation. Visual and audible annunciation for the failure of AC supply to the annunciation system shall be provided and this annunciation shall operate on Annunciation DC and buzzer shall sound.

(iv) SWITCHES

a. Control and instrument switches shall be rotary operated type with escutcheon plates clearly marked to show operating position and circuit designation plates and suitable for flush mounting with only switch front plate and operating handle projecting out.

b. Theselectionofoperatinghandlesforthedifferenttypesofswitchesshallbeasfollows:

Breaker,Isolator:Pistolgrip,blackcontrolswitches

Synchronizing:Oval,Black,Keyedhandleswitches(one commonremovable handle fora group of synchronizing switches or locking facility having common key).

Selector switches:Oval or knob, black Instrument switches: Round, knurled, black Protection Transfer: Pistol grip, lockable and switch black.

c. Thecontrolswitchofbreaker and isolatorshall beof spring return to neutraltype. The switch shall have spring return from close and trip positions to "after close" and "after trip" positions respectively.

d. Instrument selection switches shall be of maintained contact (stay put) type. Ammeter selection switches shall have make-before break type contacts so as to prevent open circuiting of CT secondary when changing the position of the switch. Voltmeter transfer switches for AC shall be suitable for reading all line- to-line and line-to-neutral voltages for non effectively earthed systems and for reading all line to line voltages for effectively earthed systems.

e. The contacts of all switches shall preferably open and close with snap action to minimize arcing. Contacts of switches shall be spring assisted and contact faces shall be with rivets ofpure silver or silver alloy. Springs shall not be used as current carrying parts

f. The contact combination and their operation shall be such as to give completeness to the interlock and function of the scheme.

g. Thecontactratingoftheswitches shallbeasfollows:

Description	ContactratingAmps
24vDC	10
Continuouslymake&carry	30
Breakfor: Revisedload	20

(v) INDICATINGLAMPS

a. IndicatinglampsshallbeofmultipleLEDpanelmountingtypewithrearterminalconnections. Lamps shall have translucent lamp covers to diffuse lights coloured red, green, amber, clear whiteor blue as specified. The lamp cover shall be preferablyof screwed type, unbreakable and moulded from heat resisting material.

b. ThewattageofthelampsshallbeSto 10wattsforDCvoltageof24Voltaswellas220VAC.

c. Lamps and its parts shall be interchangeable and easily replaceable from the front of the panel. Tools, if required for replacing the bulbs and lenses shall also be included in the scope of supply.

d. Theindicatinglampsshallwithstand120%ofratedvoltageonacontinuousbasis.

(vi) PositionIndicators

a. Position indicators of "SEMAPHORE" type shall be provided when specified as part of the mimic diagrams on panels for indicating the position of circuit breakers, isolating/earthing switches etc. The indicator shall be suitable for semi-flush mounting with only the front disc projecting out and with terminal connection from the rear. Their strips shall be of the same colour as the associated mimic.

b. Position indicator shall be suitable for DC Voltage as specified. When the supervised object is in the closed position, the pointer ofthe indicator shall take up a position in line with themimic bus bars, and at right angles to them when the object is in the open position. When the supply failure to the indicatoroccurs, the pointer shall takeup an intermediate position to indicate the supply failure.

c. TheratingoftheindicatorshallnotexceedW.

d. Thepositionindicatorsshallwithstand120%ofratedvoltageonacontinuousbasis.

1.12 Relays

(i) All relays shall conform to the requirements of IS:3231/IEC-60255 or other applicable standards. Relays shall be suitable for flush or semi-flush mounting on the front with connections from the rear.

(ii) All protective relays shall be of Numerical type housed in draw out or plug-in type/modular caseswithpropertestingfacilities.Necessarytestplugs/testhandlesshallbesuppliedlooseand shall be included in contractor's scope of supply.

(iii) All AC operated relays shall be suitable for operation at 50 Hz. AC Voltage operated relays shall be suitable for 110 Volts VT secondary and current operated relays for 5 amp CTsecondary. All DCoperatedrelays and timers shall bedesigned for the DCvoltage specified, and shall operate satisfactorily between 80% and 110% of rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation.

(iv) The protective relays shall be suitable for efficient and reliable operation of the protection scheme described in the specification. Numerical relays, if provided, shall be provided with RS 485 port and be compatible for 'MODBUS' protocol. Necessary software for data down loading and analysis of stored data in Numerical relay shall be supplied on 'CD'. Software to be compatible to Windows XP or higher 'OS'.

(v) Necessary auxiliary relays and timers required for interlocking schemes for multiplying of contacts suiting contact duties of protective relays and monitoring of control supplies and circuits, lockout relay monitoring circuits etc. also required for the complete protection schemes described in the specification shall be provided. All protective relays shall be provided withatleasttwopairsofpotentialfreeisolatedoutputcontacts.Auxiliaryrelaysandtimers

shall have pairs of contacts as required to complete the scheme, contacts shall be silver faced with spring action. Relay case shall have adequate number of terminals for making potentialfree external connections to the relay coils and contacts, including spare contacts.

(vi) All protective relays, auxiliary relays and timers except the lock-out relays and interlocking relays specified shall be provided with self-reset type contacts.

(vii) No control relay, which shall trip the power circuit breaker when the relay is de-energized shall be employed in the circuits.

(viii) Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.

(ix) Auxiliary seal-in-units provided on the protective relays shall preferably be of shunt reinforcement type. If series relays are used the following shall be strictly ensured :

(a) The operating time of the series seal-in-unit shall be sufficiently shorter than that of the trip coil or trip relay in series with which it operates to ensure definite operation of the flagindicator of the relay.

(b) Seal-in-unit shall obtain adequate current for operation when one or more relays operate simultaneously.

(c) Impedance of the seal-in-unit shall be small enough to permit satisfactory operation of the trip coil on trip relays when the D.C. Supply Voltage is minimum.

(x) All protective relays and alarm relays shall be provided with one extra isolated pair of contacts wired to terminals exclusively for future use.

(xi) The setting ranges of the relays offered, if different from the ones specified shall also be acceptable if they meet the functional requirements.

(xii) Any alternative/additional protections or relays considered necessary for providing complete effective and reliable protection shall also be offered separately. The acceptance of this alternative/ additional equipment shall lie with the Engr–In-Charge.

(xiii) The contractor shall include in his bid a list of installations where the relays quoted have been in satisfactory operation. All relays and their drawings shall have phase indications as R-Red, Y-yellow, B-blue

PROTECTION:

(a) Overcurrentrelay(twonumber)shall

- have directional IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 50-200% of rated current
- havelowtransient, over reachhighsetinstantaneousunitofcontinuouslyvariablesetting range 500-2000 % of rated current
- haveacharacteristicangleof30/45degreelead
- includehandresetflagindicatorsorLEDs.

(b) Earthfaultrelayshall

- have directional IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 20-80% of rated current
- havelowtransient, over reachhighsetinstantaneousunitofcontinuouslyvariablesetting range 200-800 % of rated current
- haveacharacteristicangleof45/60degreelag
- includehandresetflagindicatorsorLEDs
- include necessary separate interposing voltage transformers or have internal feature in therelay for open delta voltage to the relay

(xiv) TrippingRelay

HighSpeedTrippingRelayshall

(a) beinstantaneous(operatingtimenottoexceed10milli-seconds).

(b) resetwithin20milli seconds

(c) beD.C.operated

(d) have adequate contacts to meet the requirement of scheme, other functions like auto-reclose relay, LBB relay as well as cater to associated equipment like event logger, Disturbance recorder, fault Locator, etc.

(e) beprovidedwithoperationindicatorsforeachelement/coil.

(xv) FlagRelays

Theseshallhave

(a) handresetflagindication

(b) haveminimumtwocontacts(NOorNCorcombinationasrequired)foreachrelay

(xvi) TripCircuitSupervisionRelay

(a) Therelayshallbecapableofmonitoringthehealthinessofeach'phase'trip-coiland associated circuit of circuit breaker during 'ON' and 'OFF' conditions.

(b) Therelayshallhaveadequatecontactsforprovidingconnectiontoalarmandeventlogger.

(c) Therelayshallhavetimedelayondrop-offofnotlessthan200millisecondsandbe provided with operation indications for each phase.

(xvii) DcSupplySuperivisionRelay

(a) Therelayshallbecapableofmonitoringthefailureof D.C.supplytowhich,itis connected.

(b) Itshallhaveadequatepotentialfreecontactstomeettheschemerequirement.

(c) Therelayshallhavea'timedelayondrop-off'ofnotlessthan100millisecondsandbe provided with operation indicator/flag.

(xviii) RELAYTESTKIT

Onerelaytestkitshallcompriseofthefollowingequipmentasdetailedhereunder

1setRelaytools kits.

2nos.Testplugs

1no.Specialtypetestplugsforusingwithmodulartypecases(if applicable)

1.13 COMMON INDICATION&ANUNCIATIONPANEL

(HT SWITCHGEAR DC SUPPLY SYSTEM)

A separate panel shall be provided for duplication of annunciation from 33kV indoor switchgear room. This annunciation shall be suitably wired up and properly integrated into the common annunciation system of the substation. All the annunciations considered important for remote monitoring from C&R room (by operating staff) shall be provided in the panel.

i) Protectiontrip(feederwise)

ii) DCsupplyfailure

iii) LTACsupplyFailure

iv) Healthinessof33KVBUS

Thispanelshallalsohaveindicationlampsfor

i) 33kVBreakerstatus(On/Off)

Furtherthispanelshallalsohavefollowingannunciationfacilityformonitoring110/50VDC system

i) EarthFaultin110VDC-I/II

ii) Chargertrouble110/50V-I/II

1.14 TYPETESTS

(i) Thefollowingtypetestsshallbeconductedontheprotectiverelays,Faultlocatorand, Disturbance recorder.

a) InsulationtestsasperIEC60255-5

b) HighfrequencydisturbancetestasperIEC 60255-4(Appendix-E)-ClassIII(notapplicableforelectromechanicalrelays)

c) FasttransienttestasperIEC1000-4,LevelIII(notapplicableforelectromechanicalrelays)

d) Relaycharacteristics,performanceandaccuracytestasperIEC60255

• SteadystateCharacteristicsandoperatingtime

• DynamicCharacteristicsandoperatingtimefordistanceprotectionrelaysandcurrentdifferential protection relays

e) TestsforthermalandmechanicalrequirementsasperIEC60255-6

f) TestsforratedburdenasperIEC60255-6

g) Contact performance test as per IEC 60255-0- 20 (not applicable for Event logger, Distance to fault locator and Disturbance recorder)

(ii) Steady state & Dynamic characteristics tests on the relays (distance protection relays and current differential protection relays), as type test, shall be carried out based on general guide lines specified in CIGRE Committee 34 report on simulator/ network analyzer/PTL.

1.15 CONFIGURATIONOFC&RPANELS

The following is the general criteria for the selection of the equipments to be provided in each type of panel. The details such as type of panels (Simplex/ Duplex), quantity of each typepanels, number of bays for each voltage level for the purpose of bus bar protection, number of bays to be accommodated in each control panel etc shall be specified elsewhere (i.e. in " BILL OF QUANTITIES").

(i) CONTROLPANEL

Varioustypesofcontrolpanelsshallconsistofthe following

A	Ammeter	1set	foreachbay
B	Wattmeter	1set	foreachline,transformer
C	Var meter	1set	foreachbay, transformer,
D	CBcontrolswitch	1no	foreachbaybreaker
E	IsolatorControlswitch	1no	foreach isolator
F	Semaphore	1no	foreachearth switch
G	Red indicating Lamp	1no	foreachCircuitbreaker
H	Redindicatinglamp	1no	foreach isolator
I	Greenindicatinglamp	1no	foreachCircuitbreaker
J	Greenindicatinglamp	1no	foreach isolator
K	Whiteindicatinglamp	2no	foreach feeder
L	Annunciationwindowswith associatedannunciationrelays	10no	foreach feeder
M	Pushbuttonforalarm Accept/reset/lamptest	3no	foreachcontrol panel

N	MimictorepresentSLD	Lot	Inallcontrolpanel
O	Voltmeterwithselector	1no	Foreachline
P	Cut out, mounting and wiringfor RWTI and selector switch	Lot	

Note:

1 For transformer feeders, all equipments of control panel shall be provided separately for HV and LV sides.

2 The above list of equipments mentioned for control panel is generally applicable unless it is defined elsewhere and in case of bay extension in existing substations, necessary equipments for matching the existing control panel shall be supplied.

3. Commonsynchronizingswitchis also acceptableinSynchronizingtrolley fornew Substations. In this case, individual synchronizing selector switch is not required for each Circuit Breaker in control panel.

4. Each line /HV side of transformer/LV side of transformer/TBC shall be considered as one feeder for above purpose.

(ii) BREAKERRELAYPANEL

ThebreakerrelaypanelshallcompriseofthefollowingWithA/R DC
supply Supervision relay: 2 no.
Tripcircuitsupervisionrelays: 6nos.
Flagrelays,aux.relays,timers, trip
relaysetcasperschemerequirements:Lot
5 Busfrequencymeter(Analog):1no.foreachmainbuswith transducer
6 Busvoltmeter(Digital): 1no.foreachmainbus
7 Busfrequencymeter(Digital): 1no.foreachmainbus
8 Bushealthyindicationlamps: 3nos.foreachbus

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CHAPTER– 18

TECHNICALSPECIFICATIONOFEARTHINGCOILS

(MADEOFHOTDIPGALVANISEDSOFTQUALITY–MILDSTEELWIRE4MMDIA)

1. Earthing coils shall be fabricated from soft GI Wire Hot Dip Galvanized. The Hot dip galvanized wire shall have clean surface and shall be free from paint enamel or any other poor conducting materials. The coil shall be made as per REC constructions standard J-1 (drawing enclosed). The Hot Dip Galvanizing shall conform to IS: 2629/1966, 2633/1972 and 4826/1979 with latest amendments, galvanizing should be heavily coated and should stand for the following tests:-

   I.GalvanizingTest:

   (i) MinimumMassofZinc:-

   (a) ONGIWireused280 gm/m2

   (b) AfterCoiling–266gm/m2.Thecertificatefromrecognizedlaboratoryshouldbesubmitted towards mass of zinc.

   (ii) Diptest:-Shallstand3dipsof1minuteandonedipof½minutebeforecoilingand3 dips of 1 minute after coiling as per IS:4826/ 1979.

2. TheDimensionalrequirement:-

   (a) NominaldiaofGIWire4mm[Tolerance+(-)2.5%]

   (b) Minimumnumberofturns–115nos.

   (c) ExternaldiaofCoil(Min)–50mm,

   (d) LengthofCoil(Min)–460mm

   (e) FreelengthofGIWireatoneendcoil(Min)-2500mm.

3. TheTurnshouldbecloselybound.
4. WeightofonefinishedEarthingcoil(Min) –1.850kg.
5. AdhesionTest:AsperISS4826-1979

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CHAPTER– 19
TECHNICALSPECIFICATIONFOROUTDOORTYPE,OILIMMERSEDDISTRIBUTIONTRANSFORMERS uptoandincluding2500KVA,33KV-Nonesealed type

1.0 SCOPE

This specification provides for the manufacturing, testing and supply ofDistribution Transformer suitable for outdoor application having mandatory BIS certification. Transformers should be of Energy Efficiency Level-2.

2.0 STANDARDS

The transformer shall comply with **the latest revision of IS 1180 (part I): 2014** and with the relevant parts of standards mentioned below;

IS:10561	Applicationguideforpowertransformers
IS-2026	SpecificationforPowerTransformers
IS:10028	Codeofpracticeforselection,installationandmaintenanceof transformers
IS:1866	Codeofpracticeformaintenanceandsupervisionofmineral insulatingoil.
IS:2099	Bushingforalternatingvoltagesabove1000V.
IS-7421	Specificationoflowvoltagebushings
IS-6262	Methodoftestforpowerfactoranddielectricconstantofelectrical insulatingLiquids
IS:335	Newinsulatingoilfor transformers.
IIS: 6600	Guideforloadingofoilimmersedtransformers
IS:3639	Fittingsandaccessoriesforpowertransformers.
IS:2099	BushingsforACvoltageabove1000V
IS:3637	Gasoperatedrelays
CBI&PPublication	ManualonTransformers

The equipment covered under this specification shall comply with all the latest applicable statutory rules, regulations, acts and safety codes in force. Nothing in this specification shall be construed as to relieve the supplier of the responsibility for correctnessof thedesign and constructionoftheequipment.Allthestandardsbeingfollowedshallbelistedoutinthebid. Whereanyotherstandardisbeingfollowed,thecopyofthesameshallbeprovidedwiththe bid.

3.0 SERVICECONDITION

3.1 Ambient Air temperature: Minimum 5^0C to Maximum 55^0C with daily average ambient airtemperature of 50^0 C.

3.2 Altitude:Maximumupto1000metersaboveMSL.

3.3 Humidity:Relativehumiditymaximumupto100%duringrainyseason.

3.4 Location:outdoor.

4.0 DESIGNFEATURES/TECHNICALREQUIREMENTS:

4.1 The design of the transformers and accessories shall be in accordance with the latest standard practiceand shall be such as to facilitate inspection,cleaning, repairs,maintenance and operation and shall ensure safety operations under situation ofsupply voltage fluctuation up to Plus 12.5% to minus 12.5%. These transformers shall able to sustainstarting impact of Induction motors used for Lift Irrigation.

4.2 **TechnicalrequirementsofDistributionTransformers:**

1	RatedKVAofDistributionTransformer(ONANrating)	StdRatings (KVA)	
	a) 33KV/ .433KV	100/160/200/315/400/500/630/ 1000/1250/1600	
	b)6.6KV/ .433KV	100/160/200/250/315/400/ 500/ 630/1000 /1250/1600	
2	No.ofPhases	3	
3	Typeof Installation	Outdoor	
4	Frequency	50HZ(-5%to+3%)	
5	Coolingmedium	Insulatingoil(ONAN)	
6	Typeof mounting	Onwheels,mountedonrails	
7	Ratedvoltage:		
	a) Highvoltagewinding:	33/.433KVTRF	6.6/.433KV
		33KV	6.6KV
	b)Systemvoltage(Max)	36KV	7.2KV
	c)Lowvoltagewinding	.433KV	
8	No.Of windings	TwowindingTransformers	
10	Typeof cooling	ONAN(Oilnatural&airnatural)	
11	KVAratingcorrespondingtoONANcoolingsystem	100%	
12	Methodofconnection		
	HV:	Delta	
	LV:	Star(NeuralBrought out)	
13	Connectionsymbol	Dyn–11	
14	Systemofearthing	NeutralofLVsidetobesolidlyearthed	
15	Percentageimpedanceat75^{0}C	AsperIS1180(Part1):2014	
16	Intendedregularcyclicoverloadingofwindingsof winding	AsperIEC-76-1,Clause4.2	
17	a)Anticipatedunbalancedloading	Around10%	
	b)Anticipatedcontinuousloadingofwindings (HV/LV)	110%ofrated current	
18	Typeoftapchanger	OffLoadType	
	Rangeoftapping	+5%to–20%instepsof5%eachonHV winding, 7 tap positions. Tap No 3 will be the Principal tap position.	
19	Neutralterminaltobebroughtout	OnLV side	
20	Overvoltageoperatingcapabilityandduration	125%ofratedvoltage(Continuous)	
21	MaximumFluxDensityinanypartofthecoreand yoke at rated KVA, rated voltage and 50 HZ.	1.5 Tesla	

22	InsulationlevelsofWindings:-	33KV	6.9KV
	a)1.2/50microsecondwaveshape Impulse withstand(KVP)	170	75
	b)Powerfrequencyvoltagewithstand(KVms)	70	35
23	Typeofwinding Insulation		
	a)HV winding	Uniform	
	b)LV winding	Uniform	
24	Withstandtimeforthreephaseshort circuit	AsperIS	
25	Noiselevelatratedvoltage&frequency	AsperNEMA Publication	
26	PermissibleMaximumtemperatureriseoverambient temperatureof50^{0}C		
	a)Oftopoilmeasuredby thermometer	35^{0}C	
	b)Ofwindingmeasuredbyresistance	40^{0}C	
27	Minimumclearanceinair(mm):-	PhasetoPhase	Phasetoground
	a)HV(For33KVTRF)	400	320
	b)HV(For6.6KV TRF)	280	140
28	Terminals:-		
	a)HVwindinglineend(For33 KV TRF)	36KVoilfilledcommunicating type porcelainbushing(Antifogtype)	
	b)HVwindinglineend(For6.6 KV TRF)	17.5KVporcelaintypeof bushing (Antifogtype)	
29	InsulationlevelofHV bushing:-	33KV TRF	6.6KVTRF
	d)LightingImpulsewithstand(KVP)	170	95
	e)1minutePowerfrequencywithstandvoltage (KV-rms)	70	38
	f) Creepagedistance(mm)(minimum)	900	300
30	MaterialforHV&LVconductor	Electrolyticcopper	
31	MaximumcurrentdensityforHVandLV windingforratedcurrentatnormaltap	2.4A/mm^2	
32	Polarisation Indexi.e. ratio of Megger values at 600 sec.to60secforHVtoearth,L.VtoearthandHVto LV	Shallbegreaterthanorequalto1.5.	
33	CoreAssembly	Boltless	
34	TemperatureIndicator		
	c)Oil	One number	
	d)Winding	One number	
35	Maximumpermissibletotallossesatratedcurrentat normaltapeandat75^{0}C	AsguidedbyIS1180(PartI);2014	

4.3 **MechanicalFeatures**

a) The transformer shall be able to withstand the electro-dynamic stress due to terminal short circuit of the LV side assuming the HV side fed from an infinite bus. All leads, windings in cores shall be properly supported, clamped and tightened after vacuum drying to ensure the short circuit withstand ratings. The short circuit withstand duration shall be minimum 3 sec.

b) Thetransformershallbesodesignedastominimizeanyunduenoiseandvibration.

5.0 CONSTRUCTIONALDETAILS

5.1 Core:

a) The transformer core shall be made of high grade non-ageing grain oriented cold rolled silicon steel lamination having low loss and good grain properties, coated with hot oil poof insulation. Lamination thickness should not be more than 0.23 to 0.27mm.

b) The flux density in any part of cores and yoke at normal voltage and frequency shall not be more than 1.5 Tesla.

c) ForTransformerManufacturer(TM),whohasin-housecore-cuttingfacility,the packed core coils shall be verified at their works as per followings along with witnessing of core-cutting.

1. Invoiceof supplier
2. Testcertificate
3. Packing list
4. Billoflading
5. Billofentrycertificatetocustoms
6. Grossweight
7. Netweight
8. Grade&thicknessofcorematerial

d) Preferablyno bolt shall be used in the cores. Clamping shall be done externally to the limb. The core structure shall be securely grounded to prevent electrostatic potential. Lifting eyes and lugs shall be provided on the limbs and coils assembly.

e) The design of the magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earthed clamping structureand the production of flux component at right angles to the plane of lamination which may cause local heating.

f) Coresand windings shall be capable of withstanding shocks during transport, installation & service and adequate provision shall be made to prevent movement of core and winding relative to tank during these conditions.

g) The manufacturer shall furnish the exact type of core material, its BH curve, design flux density at normal tap and the source of procurement. The bidder should offer the core for stage inspection by the Owner through Third Party and approval during manufacturing stage.

5.2 Tanks:

a) Tanks shall be of welded construction and fabricated from boiler steel plates. The minimum thickness of which shall be 6mm. for the side and 10mm for the bottom & cover for transformers with longer sides having a horizontal length up to but not exceeding 1800mm. For horizontal length above 1800 mm, the minimum side plate thickness shall be 10mm. and the thickness of bottom and cover plate shall be 12mm.

b) All seams and joints those are not required to be opened at site shall be factory welded and wherever possible they shall be double welded.

c) All joints of tank and fittings shall be oil tight and no bulging should occur during service. Inside tank shall be painted with varnish/hot oil resistance paint.

d) Tanksstiffenersshallbeprovidedforgeneralrigidityandtheseshallbedesignedto prevent retention of water.

e) Themainbodyofthetankshallhavesufficientstrengthtowithstandandwithout permanent distortion.

i) Avacuumof760mm.ofmercury.

ii) Continuous internal gas pressure of 0.7 atmospheres above atmosphere pressure with oil at Operating level i.e. the transformer tank should be able to withstand100% vacuum and also one atmosphere pressure above atmosphere internal pressure.

f) Mechanicalshocksduringtransportation

e) The transformer tank and its accessories shall be designed without pockets wherein gas may collect.

f) Adequatespaceshallbeprovidedatthebottomofthetankforsettlementsofsediments.

g) Suitableguidesshallbeprovidedinthetankforpositioningthecoreandcoilassembly.

h) The tank shall be suitable for movement in both directions during shipment. Each tank shall be provided with

1. Liftinglugssuitableforliftingthecompletetransformer
2. Aminimumoffourjackingpadstoberaisedorloweredusinghydraulicorscrewjacks.

i) All bolted connections to the tank shall be fitted with suitable oil tight gaskets of nitrile rubber or equivalent, which shall give satisfactory service under theoperating conditions. Special attentions shall be given to the methods of making the hot oil tight jointsbetween the tank and cover as also between the cover and the bushings and all other outlets to ensure that the joints can be remade satisfactorily and with case, with the help of semi-skilled labor. Gaskets of neoprene and / or any kind of impregnated / bondedcore or cork only which can easily be damaged by over-pressing is not acceptable. Use of hemp as gasket material is also not acceptable.

5.3 CLEANINGANDPAINTING:

a) Before painting or filling with oil, all non galvanized parts shall be completely cleaned, freed from rust, scale and grease and all external surface cavities shall be filled by metal deposition.

b) Interior of all transformer tanks and other oil filled chambers and internal actual works shall be cleaned of all scale and rust by short blasting. In case the process of shot blasting is not adoptedit is to be thoroughly cleaned by chipping, wire brushing and sound reporting etc.These surfaces shall be painted with hot oil resisting varnish or paint.

c) External surface shall be given a priming coat and two finishing coats of durable oil and weather resisting paint or enamel. The colour of the finishing coast shall be dark admirable, gray conforming to no. 632 of ISS colour for ready mixed paints (second revision).

d) The requirement for the dry film thickness (DFT) of paint and the material to be used shall be as given below.

Sl. No	Painttype	Areatobe painted	Noofcoats	DFT(Min)
1	Liquidpaint			
	a)ZincChromate (Primer)	Outside	02	45micron
	b)Polyurethane (Finished coat)	Outside	02	35micron
	c)Hotoil	Inside	01	35micron

5.4 **TANKCOVER**

a) The tank cover shall be sloped to prevent retention of rain water and shall not distort when lifted.

b) At least two adequately sized inspection covers one at each end of the tank shall be provided for easy access to bushings and earth connection. The inspection covers shall have suitable lifting arrangement.

c) Bushings, inspection covers etc. shall be designed to prevent ingress of water into or leakage of oil from the tank.

d) All bolted connectionsshall be fittedwithweatherproofhotoilresistant neoprene gasket in between for complete oil tightness. If gasket is compressible metallic stop shall be provided to prevent over compression.

5.5 **MOUNTINGARRANGEMENT**

a) The transformers shall be provided with two nos. bi-directional skids and pulling eyes integral with the tank body for fixing the transformer tank on foundation.

b) These skids shall be such that the bottom of the tank is at a sufficient height above foundation for cleaning purposes. Each transformer shall be provided with uni-directional, flat rollers of 1000 mm length.

5.6 **CONSERVATORTANK**

a) The conservator tank shall have adequate capacity to accommodate oil preservation system and volumetric expansion of the total cold oil volume in the transformer and radiators for a change in temperature from minimum ambient air temperature of 5^0C to 110^0C.

b) The conservator shall be bolted into position so that it can be removed for cleaning purposes.

c) Theconservatortankshallbefittedwithasilicagelfilterbreather.

d) The conservator shall be fitted with plain oil level gauge. The oil level at 30^0C shall be marked on the gauge.

5.7 **Explosionvent**

i) Thetransformersshallbeprovidedwiththesingletypeofexplosionvent.

ii) An141equalizerpipeshallbeconnectedtoexplosionventfromtheconservator.

5.8 **WINDINGS**

a) Theconductorsshallbeofelectrolyticgradecopperfreefromscalesandburns.

b) Allwindingsshallbefullyinsulated.Nogradedinsulationshallbeaccepted.Useofenamel as a sole conductor insulation is prohibited.

c) The insulation of transformer windings and connections shall be free from insulating compounds which are liable to soften, ooze out, shrink or collapse and be non-catalytic and chemically inert in transformer oil during service.

d) Coil assembly and insulating spacers shall be so arranged as to ensure free circulation of oil and to reduce the hot spot of the winding.

e) Tapings shall be so arranged as to preserve the magnetic balance of transformers at all voltage ratios.

f) Ratedbasicinsulationleveltowhichthetransformersmaybesubjectedareasunder:

Nominalsystemvoltage(kVrms)	Ratedbasicinsulationlevel(KVp)
6.6	60
33	170

Transformer manufacturer may take this aspect into account while designing the transformer for the through fault withstands capability.

g) All bus bars and leads shall be adequately supported in insulated cleats or frames fromthe clamping structure.

h) The studs, set screws or bolts provided for securing cleats or frames shall be effectively locked.

i) Bus bars and leads shall be supported throughout their length to ensure they will notmove under normal service or transport or be forced from the prescribed position duringany short circuit.

j) Theimpedancevaluesshallbe4%to10%.

k) ThewindingshallbeconnectedtoachieveavectorgroupofDY11.

l) ThetransformershallhavetwoorthreewindingasspecifiedintheAnnexure-I.

5.9 **INSULATIONMATERIALS**

a) Class'A'insulating materialsspecifiedin IS:1271orlatestversionshallbeused.Wood insulation, where used, shall be well seasoned and treated.

b) InsulatingOil

i) The new insulating oil supplied with the transformer shall conform to the requirements of IS: 335 tested at bidder's premises. No inhibitors shall be used in the oil.

ii) PriortofillingtheoilinthemaintanksuitablenumberofsamplesshallbetestedforBDV, moisture content, resistivity at 900 C, tan delta at 900 C and interfacial tension. The oil samples taken from the transformer at site shall conform to the requirements of IS: 1866.

iii) The manufacturer shall dispatch the transformer filled with oil. The manufacturer shalltake care of the weight limitation on transport and handling facility at site. Tenpercent(10%)extraoilshallbesuppliedfortoppingup,innonreturnablesealed containers suitable for outdoor storage.

5.10 **EARTHINGTERMINALS**

Two earthing terminals suitable for connecting 50 x 8mm mild steel flat shall be provided at positions close to the two diagonally opposite bottom corners of tank. These grounding terminals shall be suitable for bolted connection.

5.11 **OILPRESERVATIONSYSTEM**

The transformers shall be provided with the conventional conservator preservation system with a single compartment with dry air filling of space above the oil. The top of the conservator shall be connected to the atmosphere through a silica gel filter breather. It shall be so designed that:

i) Passageofairisthroughdustfilterandsilicagel

ii) Moistureabsorptionindicatedbyachangeincolourofthetintedcrystalcaneasily observed from a distance

iii) BreathershallbemountednotlessthanI400mmaboverailtoplevel.

5.12 **TERMINALARRANGEMENT**

a) **PorcelainBushing**

i) Theminimumclearancesinairbetweenthephasesandbetweenthephaseandearth potential of the porcelain bushings shall be in accordance with IS: 2026 - part V, 1994.

ii) Bushing terminals shall be provided with suitable terminal connectors of approved typeand size for ACSR as specified in the annexure.

iii) AlltransformerbushingsshallbeofsolidporcelainwithplainshedsconformingtoIS: 8603.

iv) Theremovalofbushingshallbepossiblewithoutdisturbingthecurrenttransformers, secondary terminals and connectors or pipe work.

b) **CableBoxesandDisconnectingChambers**

i) Wherever cable connections are specified, suitable air insulated type cable boxes of sufficient sizes shall be provided to accommodate cable termination. Cable boxes shall be designed and installed such that it shall be possible to move away the transformer without disturbing the cable termination leaving the cable box on external supports. The support for the cable box shall be of galvanized iron.

ii) Cable boxes shall have terminal connectors of adequate size and bolt holes to receive cable lugs.

iii) Thecontractorshallprovideearthingterminalsonthecableboxtosuit50x8mmGI flat.

iv) Allnecessarycableterminatingaccessoriessuchassupporting brackets,powercablelugs, hard ware etc. shall be provided by the bidder.

v) Cable boxes shall have removable top cover and ample clearance shall be provided to enable either transformer or each cable to be subjected separately to high voltage test.

vi) CableboxesshallhavedegreeofprotectionofIP-52asperIS:2147.

5.13 **TERMINALMARKING**

Theterminalmarkingandtheirphysicalpositionshallbeinaccordancewith IS:2026.

5.14 **TERMINATIONARRANGEMENTFORNEUTRALS**

a) Thetransformershallbesolidlyearthedatthesecondaryneutral.

b) The neutral terminal brought on to a separate neutral bushing shall be connected to associated neutral grounding pit by a copper flat, which shall be supplied and installed bythe bidder.

5.15 **OFFCIRCUITTAPCHANGESWITCH**

a) The tap change switch shall be three phase, hand operated, for simultaneous switching of similar taps on the three phases by operating an-external handle.

b) Arrangement shall be made for securing and pad locking the tap changer in each of the working positions, and it shall not be possible for setting or padlocking in any intermediate position. An indicating device shall be provided to show tap in use.

c) The cranking device for manual operation shall be removable and suitable for operationby a man standing on ground level. The mechanism shall be complete with the following:

i) Mechanicaloperationindicator.

ii) Mechanicaltappositionindicatorwhichshallbeclearlyvisiblefromthetransformer.

iii) Mechanical stops to prevent over cranking of the mechanism beyond extreme tap position.

iv) The manual operating mechanism shall be labelled to show the direction of operation for raising the secondary voltage and vice versa.

v) A warning plate indicating "The switch shall be operated only when the transformer has been de-energized" shall be fitted.

5.16 **coolingtubes**

Thetubesshallbemountedonthetank.

5.17 **BOLTSANDNUTS**

Allboltsandnutsexposedto weathershallbeofhotdipgalvanizedorcadmiumplateorzinc passivated steel. All bolts, nuts and washers in contact with non ferrous part which carry current shall be of phosphor bronze.

5.18 **FITTINGS**

Thefollowingfittingsshallbeprovidedwithallthetransformers:

a) Ratinganddiagramplate.
b) Terminalmarkingplate
c) Twoearthingterminals
d) Liftinglugs
e) Jackinglugs
f) Drainvalvewithplug,50mm size.
g) Dehydratingbreather
h) Plainoillevelindicatorwithminimummarking.
i) Offloadtapchangingswitch
j) Oilfillingholewith cover
k) Conservator
l) Explosionvent
m) Skidsandpullingeyesonbothsides
n) Rollers,Flatunidirectionallimitedto1000 mm
o) H.V.porcelainbushingswithmetalpartsorH.V.cablebox.
p) Filtervalve.
q) Inspectioncover.
r) L.V.cablebox.

5.19 SPAREPARTS:

a) ThesuppliersshallprovidethefollowingmandatorysparesforeachofTransformer supplied at no extra cost.

1. H.V.&L.V.Bushing&Studs–Each2Nos

2. BimetallicconnectorforH.V&L.V.Bushings–Each2sets

b) Any fittings, accessories of apparatus which might not have been mentioned in the specification but which are usual and necessary in the equipment of similar nature and are recommended by the manufacturer for satisfactory operation are to be provided by the contractor without extra cost. All apparatus must be complete in all details whether mentioned in the specification or not.

6.0OperatingConditions

i) The transformers shall be capable of being loaded in accordance with IS: 6600 up to loadof 150%. There shall be no limitation imposed by bushings, tap changer etc.

ii) The transformers shall be capable of being operated continuously without danger on any tapping at the rated KVA with voltagevariation of + 10% corresponding to the voltage of the taping.

iii) For consideration of specific loading the transformer shall be suitable for continuous operation for flux densities specified in the requirement.

b) **FaultConditions**

i) The transformer and all accessories shall be capable for withstanding any external short circuit at bushing terminal without damage for two (2) seconds.

ii) The maximum flux density in any part of the cores and yoke at normal voltage and frequency shall not exceed 1.5 wb/m2.

iii) Manufacturershallalsoindicate150%overvoltagewithstandtime.

7.0INSPECTIONTRANSFORMERASSEMBLYANDTESTS:

a) The following tests shall be carried out in order to determine whether the transformer and its components comply with the specification and to provide necessary data. As many tests in the opinion of the purchaser as are possible shall be arranged by the manufacturer.

b) The transformer shall be completely assembled and tested as per ISS: 2026/1977 and any amendment thereof, at the factory. All the tests are to be carried out in the presence of any authorized representative of the Corporation/Third party as per direction of Engineer of Contract. Test shall be performed in compliancewithstandard practice and relevant ISS. The routine tests shall be carried out on transformer at the manufacturer's cost at their works/other institute of repute, before dispatch.

However it may be noted that no call for final inspection of the transformer shall be entertained if the transformer has not passed the stage inspection or its waival has not been issued by DoWR. The supplier is required to place the call for stage inspection in advance as illustrated in subsequent clauses of technical specification.

c) **ROUTINETESTS:**

Transformer routinetests shall include tests stated in latest issue of IS: 2026 (Part –1). These tests shall also include but shall not be limited to the following:

i) MeasurementofwindingDCresistance.
ii) Measurementofvoltageratingoneachtapping.
iii) Checkforpolarityandvoltagevectorrelationship.
iv) MeasurementofNoLoadlossandcurrentat90%,100%and110%ofratedvoltage.
v) Measurementofpercentageimpedanceonprincipaltapandextremetaps.
vi) Load loss at principal tap measured at rated frequencyby applying an approximately Sinusoidal supply to one winding sufficient to reduce rated current in the winding with the other winding short-circuited.
vii) Measurementofinsulationresistance.
viii) Polarizationindexi.eInsulationResistancefor10minutesandoneminute(R10mt/R 1 mt).
viii) Inducedovervoltagewithstandtest.
ix) Separatesourcevoltagewithstandtest.

x) Dielectric test on transformer oil shall also include testing of oil sample drawn from transformer out of the offered at the suppliers work for BDV of oil (fresh from storage of tank as well as from transformer).

xi) Oilleakagetest.

All tanks and oil filled compartments shall be tested for oil tightness by being completely filled withair/ oilofaviscosity not greater thanthatof insulating oilconformingto IS: 335 at an ambient temperature and subject to pressure equal to 0.7 atmosphere above atmospheric pressure measured at the base of tank. This pressure shall be sustain for a period of not less than 12 Hours for oil and one Hours for air during which time no leakage shall be occur.

d) TYPETEST:

Theofferedequipmentmustbeofprovendesignthroughsuccessfultypetestingparticularly TemperatureriseTest/ShortcircuitTest/LightningimpulsewithstandTest,asperIS:2026or latest amendment thereof (during last 5 years counted from the date of agreement withEPC Developer) at CPRI, Bangalore/Bhopal or NTH, Ghaziabad orERDA, Varodara,. The manufacturer shall carry out type tests in accordance with IS: 2026 on one piece of one rating. Before conducting theTemperature rise Test, short circuit test and Impulse test, the firm willofferforbothstageinspectionsandfinalinspectionofthetransformerby througha 3rd party agency as well as EPC's authorized executives at the manufacturer's works. If the transformer complies with the specification and offered technical parameters, the transformer will be sealed by authorized engineer(s) of EPC Developer and thereafter the transformercanbetransportedtoCPRI/NABLunitforrequiredtypetestsinpresenceofEPC Developer's authorized representative(s) who will verify the seal & allow for conducting the type tests.The type tests shall include:

(2)VacuumTest:

Transformer tank at an internal vacuum limiting to one atmosphere but not more than the pressure of 3.33 KN./Sq.m. (25 mm of Hg.) for one Hour.

The permanent deflection of flat plates after vacuum has been released shall not exceed the value specified below without affecting the performance of the transformer:

HorizontalLengthofflatplate(mm)	Permanentdeflection
Upto&including750	05
751to1250	6.5
1251to1750	08
1751to2000	9.0
2001to2250	11
2251to2500	12.5
2501to3000	16
Above3000	19

(2) PressureTest:

Transformertank togetherwith its radiators, conservators,vessels and other fittings shall be able to with stand a pressure corresponding to 0.7 atmosphere above atmospheric pressure measuredatthebaseofthetankandwillbemaintainedforonehour.Thepermanent

deflection of the flat plate after the excess pressure has been released shall not exceed the figures specified above.

(3) ShortCircuitTest:
AsperISS:2026/1977andlatestamendmentthereof.

(4) IMPULSEVOLTAGEWITHSTANDSTESTLIGHTINGIMPULSETEST:
This test is to be carried out as per IS: 2026/1981(Part-III) Para 13 and latest amendments thereof on all limbs of HV and LV. The tapping position for each limb shall be selected as recommended in clause 6.3 of above IS.

(5) Measurementofacousticnoiselevel.

e) The transformer having passed successfully through the type tests along with verification of losses by test house shall be considered as acceptable design. The physical dimensions ofthis transformer shall formthe guidelines for subsequent supplies. In caseof anyvariation in any dimension incorporated in the approved drawings, shall be finally got approved by the engineer of the Contract taking into consideration, the dimensions offered in GTP/drawings as per test reports and drawings finally approved by CPRI/BHEL/Govt. Test House after conduction of type test.

Incase,itisfoundduringthejointinspectionoftransformers(s)bytheexecutiveofEPC Agencyand/orrepresentativeofthethirdpartyentrustedwiththeworkofinspection and/or representative of the firm that the firm has supplied substandard material then also theabovepenalactionshallbetaken.Iftherepresentativeofthethirdpartyand/orof supplier or both are not present at the time of above joint inspection, then DoWR has righttotakethepenalaction,asmentionedabove.Intheeventofcancellationofordersno compensation shall be given to the firm by EPC Agency with no liability to DOWR.**TOLERANCE:**

However, no negative tolerance on all the parameters including physical of dimensions tank certificated by test house/ laboratories as mentioned in respect of the equipment which has been successfully type tested shall be allowed.

SPECIALTEST:

Measurement of zero sequence impedance test on one transformer. Inspection shall be carried out only after routine test results are submitted to 'Engineer of the Contract' , giving serial number of transformer.

All the original type test reports including verification of load/No. load losses from CPRI/BHEL/Govt. Test House/ERDA Vadodara along with detailed drawing approved by CPRI/BHEL/Govt. Test House as approved by the purchaser shall be submitted after successful "TypeTesting" to prove that the design as successfully type tested.

8.0 INSPECTION & TESTING OF TESTING INSTRUMENTS AND RAW MATERIALS AND STAGE INSPECTION:

The supplier shall offer the core, windings and tank of each transformer for inspection by a 3rd party agency as well as EPC Agency representative(s). During stage Inspection, all the measurements like diameter, window height, leg centre, stack width, stack thickness, thickness of laminations etc. for core assembly, conductor size, Insulation thickness, I.D.,O.D, winding height, major and minor insulations for both H.V and L.V windings, length, breadth,heightandthicknessofplatesofTransformertank,thequalityoffittingsand

accessories will be taken / determined. The supplier can offer for final inspection of the transformers subject to clearance of the stage Inspection report by the DOWR.

All the measuring instruments i.e. Voltmeter, Avometer, CT, PT'S and other instruments used in inspection and testing shall be properly calibrated and sealed once in a year. Calibration Certification when demanded by the inspection officer shall be produced for verification purposes. In case of disputes regarding calibration of instruments, instruments shall be sealed and signed by the representative of suppliers and purchaser and will be sent to institution/lab. of reputes or its own lab. for calibration at the cost of supplier. The result of such testing shall be binding on the supplier.

The purchaser reserves the right to depute his representative/agency for carrying out stage inspections at any stage of manufacturing process for checking qualityof manufacturing and also the raw materials.

The contractor shall offer all reasonable facilities for such inspection. The contractor shall furnish detailed production schedule including different phase of material procurement, manufacture and fabrication to facilitate the purchaser for deputing his representative/agency for carrying out stage inspection.

The contractor shall inform the purchaser likely date of assembly of core and readiness of HT & LT coils enabling the purchaser to depute his officers for stage inspection or issuing waivel of stage inspection.

Records shall be maintained off all the test carried by the supplier on transformer offered for inspection and test shall produce when demanded by the inspection officer to satisfy that the transformer are being offered after carrying all the necessary tests by the supplier.

9.0 DRAWING/INSTRUCTIONSBOOKS/OPERATION&MAINTENANCEMANUALETC:

TheManufacturershallsubmitfollowingdrawings:

a) Outline dimensions drawings of transformers and accessories giving complete details ofmain components parts and transportation details showing dimension and weight of the each package. (Top, Front & side views). Off load tap changer equipment earthing details, top cover/flange fill arrangement.

b) Name plate diagram with tap changing details and guaranteed maximum load and no- Load losses without any plus tolerance.

c) Systematic controlandwiringdiagram of allauxiliaryequipment includingmarshallingBoxes with terminal number of various accessories.

d) Bushing drawing, porcelain portion drawings and terminal connector drawing with their Electrical and mechanical characteristics in tabular form.

e) Drawinggivingtheweightforfoundationoftransformer.

f) Drawing of core and winding (including sectional view) along with the clampingArrangement giving details viz. Core dia, weight, stacking HV/LV winding weight and size/ number of coils/limbs, inner dia, outer dia, axial length, clamping channel, Sizeof the rod dia meter, it's nos. and length etc. Cores steps details to be shown separately and clearly indicating the clearance provided inside and outside the transformer.

The manufacturer shall supply 2 copies of instruction books/operation and maintenance manuals spare parts booklets along with descriptive literature and date of transformer construction, winding, bushing, heat exchanger, tap changing gear etc. to each consignee with each transformer and to DoWR.

All tests and inspection shall be made at the place of manufacturer unless otherwise specificallyagreed upon bythemanufacturerand theengineerof thecontractatthe timeof the purchaser. The manufacturer shall offer the inspecting officer (s). Representing the Engineer of the Contract, all reasonable facilities without charge to satisfy him that the materials are being manufactured in accordance with this specification.

NOTE: Inspection shall be carried out only after routine test results are submitted to Engineer of the contract and Unique number of transformers are given.

SCHEDULEOFGUARANTEEDTECHNICALPARTICULARSFORDISTRIBUTIONTRANSFORMERS

1.	Nameof Manufacturer	
2.	Typeof Transformer	
3.	**Rating**	
a.	Ratedoutput (MVA)	
b.	RatedVoltageofHV&LV (KV)	
c.	RatedCurrentofHV&LV(A)	
d.	NoloadVoltageratio	
e.	No. ofPhases	
f.	Ratedfrequency	
4.	**Connections**	
a.	HighVoltage	
b.	LowVoltage	
c.	VectorGroupSymbol	
5.	**CoolingArrangement**	
a.	Typeof cooling	
b.	NumberofCoolingtubes/finsperradiatorandnumberof radiators	
c.	Sizeofradiator fins	
d.	Thicknessofsheet	
e.	Horizontaldistancebetweenradiators	
f.	VerticaldistancebetweenCorecenterlineandradiatorcenter line	
6.	**Dimensionofinsideoftank (mm)**	
a.	Length	
b.	Breadth	
c.	Height	
d.	Weightoftankwithout fitting	
7.	**ThicknessoftransformertankPlate(mm)**	
a.	Sides	
b.	Bottom	
c.	Cover	
8.	**OverallDimensionofTankwithFittings(mm)**	
a.	Length	
b.	Breadth	

c.	Height	
9.	**DetailsofOil**	
a.	StandardsofOil	
b.	QuantityofOil(Ltr.andKg.)	
C	Quantityofextraoil(LtrandKg)	
10.	**DetailsofCore**	
a.	Materialofcorelamination& Grade	
b.	Thicknessofcoreplates	
c.	InsulationofCore lamination	
d.	Window Height	
e.	LegCenter	
f.	CoreDiameter(approx.)(mm)	
g.	Corecrosssectionalarea(gross)(mm^2)	
h.	Corecrosssectionalarea(net)(mm^2)	
i.	Maximumfluxdensityincoreatnormalvoltage,frequency andratio	
j.	Weightofstampingincoreandyokeseparatelyin Kgs.	
	i)Core	
	ii)Yoke	
i.	SizeandNo.ofclampingchannels	
Ii	Weightofclampingchannelswithstiffeners	
k.	Size&numberoftierod(ifused)	
l.	Size&numberofcore bolt	
(Note:Pleaseenclosedetailsofcore-steps,itsdrawingandfluxdensity,weightofcore, fittings,copper,oil,OffLoadTapChangerseparately).		
11.	**Weightoftransformer**	
a.	Weightofcoreonly	
b.	WeightofcoreassemblyexcludingHV&LVcoils	
c.	Weightofcompletecorecoilassembly	
d.	ValueofTransformerOil	
e.	WeightofTransformer oil	
f.	WeightofinsulatedconductorinHV	
g.	Weightofinsulatedconductorin LV	
h.	WeightofTankandfittings(Kgs.)includingtapchanger.	
i.	Totalweightoftransformerwith oil	
12.	**DetailsofWinding**	**HV/LV**
a.	Typeofwindingand material	
b.	ConductorSize(bare)	
c.	Crosssectionalarea(mm^2)	
i.	Gross	
ii.	Net	
d.	Typeofinsulationofconductor	
e.	Sizeofinsulatedconductor	

f.	Numberofdisc/coilperlimb	
g.	No.ofcoilsper disc	
h.	Internaldiaofcoil	
i.	Outerdiaofcoil	
j.	Axiallength	
k.	Meanlengthofturns(mm)	
l.	No. ofturns	
m.	Interturn insulation	
n.	Endturninsulation	
o.	Typeofaxialcoil supports	
p.	Detailsofendclampingrings	
q.	Whetherwindingsareinterleaved	
r.	Sizeofcoolingducts	
s.	Weightofbareconductorusedinoneleg(kg.)	
t.	Weightofinsulatedconductorusedinoneleg(kg.)(dry)	
u.	I^2Rlossat75^0C(per phase)	
v.	MaximumcurrentdensityinwindingatCMR–Amp./Sq cm.	
W	Polarization index (ratio ofMeggervalues at 600 sec to 60 sec for HV to earth and HV to LV)	Shallbegreater thanorequalto 1.5
u.	Resistanceofwinding(with5%tolerance) a) at20 °C(Ohms) : b) at75 °C (Ohms)	
(Note:Enclosecalculationoflosseswithcompletedetailsoffactorassumed,core& windingdetailsofdrawing)		
13.	Thermaltimeconstants– Hrs.	
14.	TerminalarrangementHVside	
15.	TerminalarrangementLVside	
16.	Regulationatfullloadat 75^0C	
a.	Atunitypower factor	
b.	At0.8powerfactor (lagging)	
17.	**Percentageefficientlyatnormalratio,ratedvoltageandat75^0Caverage windingtemp.**	
		UPF
a.	FullLoad	
b.	3/4FullLoad	
c.	1/2FullLoad	
d.	1/4FullLoad	
18.	Noloadcurrentaspercentageoffullloadcurrentatrated volt.andfrequencyin%	
19.	Powerfactorandnoloadcurrentatnormalvolt.and frequencyin%	

20.	**RMSvalueofsymmetricalshorttimecurrentratingasperISSwhichthe transformercanwithstandanditsduration**	
a.	H.V.Winding	
b.	L.V.Winding	
21.	Maximumoutofbalanceforceinwindingonshortcircuit atthe terminals	
22.	**ClearancebetweenphasesinAir(mm)**	
a.	H.V.Side	
b.	L.V.Side	
c.	L.V.toEarth	
23.	**Clearanceinoil(mm)**	
a.	InternalclearancebetweeninnerwallsofTank&corecoil	
b.	Onlengthside	
c.	OnBreadthSide	
d.	RadialclearancebetweenH.V.&L.V.Winding	
e.	PhaseofphaseclearancebetweenH.V. Limb	
f.	RadialclearanceofL.V.coilfromcore	
g.	MinimumclearancebetweenLVPoleto earth	
h.	HorizontalductbetweenH.T. disc	
i.	EndclearanceofH.T.coilfromYoke(withangleshaped windings)	
j.	Minimumclearancebetweencore&tankbottom	
k.	AngularductsbetweenLT&HTwinding	
24.	**InsulationDetails**	
a.	EndspacingofL.V.	
b.	EndspacingofH.V.	
c.	L.V.windingtocore	
d.	BetweenHV&LVwinding	
e.	Interphasebarrier	
f.	Endphasebarrier	
25.	**InsulationLevel**	**H.V.**
a.	SeparatesourcepowerfrequencyVolt.Withstand–KV.	
b.	Inducedovervoltagewithstand–KV	
c.	1.2/50μsfullwavelightingimpulsewithstandvoltage-KV	
	i) Impulse	
	ii) Powerfrequency(Dry&Wet)	
d.	Voltagetoearth forwhichthestarpointwill beinsulated– KV	
	i) Impulse	
	ii) Powerfrequency(Dry&Wet)	
26.	PerformancereferenceTemp.(Deg. C)	
27.	VoltspercoilofHVwinding(Volts)	
28.	Approx.VoltsperlayerofHVwinding(Volts)	

29.	Impedancevoltageatratedfullloadandtransformation	
30.	PercentagereactanceRatioatratedvoltage&frequency at75^{0}C.	
31.	Percentageresistanceat75^{0}C	
32.	Impendencevoltageatprincipaltappingandat75^{0}C averagewindingtemperatureexpressedaspercentageof ratedvoltagebetweenHV&LVwinding -%	
33.	Permissibledurationofoverloadfollowingcontinuous runningatnormalratedloadinanambientTemp.of50 Deg.C.	
a.	10% overload	
b.	20% overload	
c.	30% overload	
34.	**Maximumtemperatureriseatfullload(abovemax.averageambientTemp. of50 ^{0}C.)**	
a.	OftopoilbythermometerDeg.C.	
b.	OfwindingbyresistancemethodDeg.C.	
c.	ByhotspottemperatureindicatorDeg.C.	
35.	Limitofhotspottemperatureforwhichdesigned –Deg.C.	
36.	TemperatureGradientbetweenwindingandoil–Deg.C.	
37.	Maximum No. load loss at rated voltage on principal tapping at rated frequency (Guaranteed without any plus tolerance)(including25%strayno loadlossforconsidering in-consistenciesofB-Hcharacteristicsofcorematerialand workmanship).	
38.	Maximumloadlossatrated currentonprincipaltappingat 75^{0}C.(Guaranteedwithoutanyplustolerance)including 10%strayloadloss)	
39.	Resistancevoltagedropatratedcurrentforprincipal tappingat75^{0}Caveragewindingtemperatureaspercentof rated voltage - %	
40.	Reactancevoltagedropexpressedaspercentforrated voltage-%	
41.	**Temperatureindictors**	**OilTempInd.**
a.	MakeandType	
b.	Permissiblesettingrangesforalarm&trip.	
c.	No.ofcontacts	
d.	Currentratingofeachcontact.	
42.	Gasandoilactuatedrelaydescriptiondata&rangeof settings,schematicdiagrametc.	
43.	Typeofpressurereliefdevice&pressureatwhichit operates.	
44.	Detailsofmagneticoilgauge	
45.	Weightofsilicagel(Grm.)	

46.	**ParticularofBushings**	**H.V./ LV**
a.	Nameof manufacturer	
b.	Type	
c.	Voltagerating–KV	
d.	Visiblepowerfrequencyvoltagedischargetest–KV	
e.	Drypowerfrequencywithstandvoltageforoneminute	
f.	Wetpowerfrequencywithstandvoltagefor30 minutes	
g.	Drystandardlightningimpulsewithstandvolt-KV	
h.	Creepagedistanceinair(mm)(protectedandtotal)	
i.	RecommendedGapsetting– mm	
j.	Weightofassembledbushing KG	
47.	Freespacerequiredatthetopforremovalofbushing– mm	
48.	Minimumclearanceheightforliftingcore&windingsfrom tank	
Note:TypetestsReportsofbushingsshallbesubmitted		
49.	DetailsofOffloadtapchanger	
a.	Make	
b.	Type	
c.	Rating	
	i)Ratedvoltage	
	ii)Ratedcurrent	
	iii)stepvoltage	
	iv)No.of steps.	
50.	**Shippingdetails**	
a.	Partsdetachedfortransport	
b.	Approx.Weightofheaviestpackage–kg.	
c.	Approx.dimensionoflargespackage-mm	
	i) Length	
	ii) Breadth	
	iii) Height	
51.	**TypeTesting**	
a.	Whetherthetransformeroftheoffereddesignhasbeen type tested during last 5 years from the date of opening of tender?	
b.	Ifyes,whenandwherewasittypetested?	
c.	Isthereanydeviationinthetechnicalspecificationof offeredfor33/6.9KV,powertransformer?	
52.	Detailsoftestreports	

Sl. No.	NameofTest	Dateof Test	Whether test reports enclosedornot (Yes/No)	Ifyesno.of sheets.
1.	TemperatureRiseTest			
2.	VacuumTest			
3.	PressureTest			
4.	ImpulseVoltagewithstandtest (lightningImpulseTest)			
5.	ShortCircuitTest			
6.	ThermalabilityTest			
7.	ZerosequenceImpedanceTest			

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CHAPTER– 20

TECHNICALSPECIFICATIONFOR6kVSURGETYPELIGHTNINGARRESTORS

a) SCOPE

Thisspecificationprovidesforthemanufacturing, testingandsupplyof 6 kV Surge type Lightning Arrestors suitable for outdoor application.

b) STANDARDS

The 6 kV Surge type Lightning Arrestors shall comply with the latest revision of IS: 3070 and with the relevant parts of standards mentioned below;

IS4004:Applicationguidefornonlinearresistortypesurgearrestors. IS

5350:Dimensions for outdoor porcelain post insulators.

The equipment covered under this specification shall comply with all the latest applicable statutory rules, regulations, acts and safety codes in force. Nothing in this specification shall be construed as to relieve the supplier of the responsibility for correctnessof thedesign and constructionoftheequipment.Allthe standardsbeingfollowedshallbelistedoutinthebid. Where any foreign standard is being followed, the copy of the same shall be provided with the bid.

c) DESIGNCRITERIA

The 6 kV Surge type Lightning Arrestors shall be suitable for 6600V (-10% to +10%), 3 phase, 50 Hz (-5% to +3%) power supply. The arrestor shall be suitable for operation in a solid earthed neutral system. The arrestor shall be able to sustain power frequency spark over voltage up to 15 kV. The Lightning Arrestors shall withstand standard impulse withstand voltage of 22.5 kV.

Maximum residual voltage at nominal discharge current shall be 22.5 kV. The nominal discharge current carryingcapacityhas been specifiedin Annexure-Iattheratedvoltage and frequency.

d) CONSTRUCTIONALFEATURES

The lightning arrestor shall be line type and gapless. The arrestors shall be composed ofunits of non-linear resistors made of Zinc oxide.

e) PERFORMANCE

ElectricalFeatures

Thelightningarrestorshallensure:

Ī)Continuousoperationatratedvoltage(6kV&50Hz)whilecarryingouteffectivelyand without damage the automatic extinction of the follow up current.

b) Continuousoperationwithinvariationforvoltagebetween-10%+10%,andfrequency variation between – 5 %, + 3 %.

c) Thearrestorsshalldivertanyswitchingsurgeinexcessofbasicinsulationlevelatthe relevant nominal system voltage and cut off follow-up current of power frequency.

7.0 **TESTCERTIFICATE**

The units shall be Type tested for insulation level, discharge current and residual voltage in accordancewithrelevantcodes.Theresultsofthetestcertificateshallalsoindicatethe

identifications like manufacturer's name and the serial no. of the product which should also appear printed or embossed on the body.

The contractor shall supply at the time of execution the routine test certificates from the manufacturer indicating the type of tests conducted, the test results and the serial nos. of the lightning arrestor.

ANNEXURE–I

TECHNICALPARAMETERSFOR6KVSURGETYPELIGHTNINGARRESTORS

NominalSystemVoltage–6.6kV Rated
Voltage – 6 kV
Powerfrequencysparkovervoltage–15kV
1.2/50Sparkovervoltage2500Amp–22.5kV(peak)
Maximum residual voltage
Atnominaldischargecurrent–22.5kV(peak) Nominal
discharge current – 10 kA
System–3Phase,50C/S,Neutralsolidlyearthed. Type –
Gapless.
Mounting–BracketmountedonstructureOtherrequirements

f) Groundingterminalii)PostinsulatorconformingtoIS:5350.

Line terminals – Each terminal should be suitable to accept ACSR and it should be suitable both for vertical takeoff. Standards to conform – IS: 4004 & IS: 3070.

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CHAPTER– 21
TECHNICALSPECIFICATIONFOR6.6KVINDOORVACUUMCIRCUITBREAKER

1.0 **SCOPE**

Thisspecificationprovidesforthemanufacturing, testingandsupplyof 6.6kVVacuum Circuit Breaker and vacuum contactor panels suitable for indoor application.

6.6 KV switchgear (VCB, CT, PT& Disconnector) must be type tested & the Dimensions ofType Tested equipments from the short listed approved vendors are only be accepted.

2.0 **STANDARDS**

The circuit breaker shall comply with the latest revision of IS: 13118 and with the relevant parts of standards mentioned below;

IS:3156	Voltagetransformers
IS:2705	Currenttransformers
IS:3043	Codeofpracticesforearthing
IS:6875	Controlswitches(switchingdevicesforcontrolandauxiliarycircuits includingcontactorrelays)
IS:10118	Codeofpracticeforselection,installationandmaintenanceof SwitchgearandControl gear
IS:11353	Guideforuniformsystemofmarkingandidentificationofconductors andapparatusterminals
IS:3427	HTindoorswitchgearandcontrolgear

The equipment covered under this specification shall comply with all the latest applicable statutory rules, regulations, acts and safety codes in force. Nothing in this specification shall be construed as to relieve the supplier of the responsibility for correctnessof thedesign and constructionoftheequipment.Allthestandardsbeingfollowedshallbelistedoutinthebid. Whereanyotherstandardisbeingfollowed,thecopyofthesameshallbeprovidedwiththe bid. The equipment shall have Test Certificate for Type test from CPRI, Bangalore.

3.0 **DESIGNCRITERIA**

The Circuit Breaker shall be suitable for 6600V (+/- 10%), 3-phase, 50Hz (+3% to-5%) power supply.

All similar components shall be interchangeable and shall be of same type and rating foreasy maintenance and low spare inventory.

The rated current carrying capacity shall be as specified in annexure-I at the rated voltage andfrequency andthe circuit breakershallcarry ratedcurrent continuouslywhile complying with this specification. The breaking and making capacity of the circuit breaker shall be as specified in annexure-I.

4.0 **CONSTRUCTIONALDETAILS/GENERALTECHNICALREQUIREMENTS**

4.1 Theunitshallcompriseofthepanel,VacuumCircuitBreakerunit(VCB)andVacuumContactor Panels.

4.2 **Panel**

4.2.1 ThepanelsshallconformtoIS: 3427.

4.2.2 ThepanelsshallbeofunitizedconstructionhavingseparatecompartmentsfOr

Circuit breaker, vacuum contactors, bus bars, CT, PT and separate chamber for protective relays, metering and indicating instruments. The panels shall be extensible to form a multi-panel Switchboard.

4.2.3 The panels shall be fabricated from sheet steel of minimum thickness 3mm and 2 mm for load bearing sections and non load bearing sections respectively.

4.2.4 Thepanelsshallhaveaseparatecableboxattherearforoutgoingcables.

4.2.5 Anearthbusofcontinuoustypeshallearthallmetallicnon-currentcarryingpartsinthe panels and the VCB and contactor units.

4.2.6 The panels shall be suitable for ready installation on embedded MS channels flushed withthe floor or for direct installation on a leveled floor through grouting holes.

4.2.7 Thepanelshallbedustandverminproofwithnoaccesstoingressofmoisture.

4.3 **TheVacuumCircuitBreaker unit**

4.3.1 TheBreakerunitshallbeofhorizontalDRAWOUT construction.

4.3.2 TheBreakerunitshallhavetwomaincomponents:

a) Thetrolleyassembly

b) Thecradleassembly

Thetrolleyassemblymadeofsteelplatesshallbemountedonwheels.Thetrolleyassemblyshall be provided with:

- ❖ Thepole assembly
- ❖ Theoperatingmechanism

Thepoleassemblycomponentofthetrolleyassemblyshallhave;

i. Theinterrupterunitshavingvacuumnotlessthan10-5 Torr.
ii. Thetopterminalsforinterrupterunits,separatedbyfireretardanttypebarriers.
iii. Thecontactsofthebreakershallbesilverplatedcopperorsilverplatedcopper-chromium.

Theoperatingmechanismshallconsistof:

- Solenoidoperatingmechanism
- Controldevices

The solenoid mechanism operating on the electro-magnetic principle shall close or open the interrupter. The driving force of the closing electro-magnet shall be imparted to the operating shaft with a trip free link mechanism.

There shall be a heavy duty plug-in type earth contact/change over switch which shall make before the insertion of trolley assembly and break after the withdrawal of the same.

The cradle assembly made of steel plates shall be mounted on chassis and shall accommodate the trolley assembly.

Thecradleassemblyshallconsistof:

a) Copperterminalstoreceivethebreakercontact.

b) Railstoguidethetrolleyassembly.

c) Insulated safety shutter mechanism to make the shutter operation fully automatic depending on circuit breaker position.

4.4 **OperationoftheBreaker**

The breaker shall be electrically operated locally and shall have indicating devices for ON/OFF/TRIP indication and operation counter shall be provided.

Terminal blocks for control cables shall also be provided for interfacing with other breakersif required.

5.0 **PERFORMANCE**

5.1 The design of the circuit breakers and accessories shall be in accordance with the latest standard practice and shall be such as to facilitate Inspection, clearing, repairs, maintenance and operation and shall ensure safety operations under situation of sudden variations of loads and voltages as may be required under local operating conditions.

5.2 **ElectricalFeatures**

Thebreakershallensure:

a) Continuousoperationatratedcurrentatspecifiedambientconditions.

b) Continuousoperationwithinvariationforvoltagebetween-10%+10%,andfrequency variation between +3 to-5% .

c) TemperatureriselimitedtothevaluesgiveninIS:13118fortestcondition.

d) TheinsulationlevelsshallconformtothevaluesgiveninIS:13118.

e) Circuit breaker shall have to withstand apparent short circuit power of 25 kA (rms) for at least 3 second.

5.3 **MechanicalFeatures**

a) The breaker shall be able to withstand the thermal and electromagnetic stress arising out of fault level of 25 kA for 3 second.

b) EarthingofallmetallicpartsoftrolleyandcradlemustbeensuredinISOLATED position.

6.0 **PROTECTIONSANDINTERLOCKS**

6.1 CombinedIDMTtypeoverloadrelay(50%to200%ofC.T.Secondary)and earth fault relay (10% to40% of C.T. Secondary) shall be provided. High set (400% to 1600%) instantaneous element shall also be provided on at least two phases. Protective Class of C.T. with adequate ratio conforming to IS: 2705 shall be incorporated.

6.2 For incoming circuit breakers Overload IDMTover load relay, Earth Fault IDMT relay, Neutral displacement relay, Short circuit protection shall be provided. For outgoing circuit breakers Overload IDMT overload relay, Earth leakage and Short circuit protection shall be provided. For Capacitor control circuit breakers Overload IDMT overload relay, Earth Fault IDMT relay, Earth leakage and Short circuit, Over voltage unbalanced protection and Under voltage protection shall be provided.

6.3 Thetripcircuitshallalsobeoperablefromeachofthefollowing:

A)Buchholz(gasoperated)relayoftransformer

b)TemperaturerelayoftransformerAuxiliarycontactsshallbeprovidedfortheabove.

6.4 Electrical interlock shall be provided to prevent ON/OFF operation with other breakers, if required. Interlocks shall be provided to ensure that the trolley cannot be plugged in or out unless Vacuum Circuit Breaker is in off or open position. Vacuum Circuit Breaker shall not close unless it is fully plugged in.

Interlockshallalsoensureopeningofthedoorwiththebreakerinisolatedpositiononly.

6.5 Protection against earth leakage shall also be provided for operation of the earth leakage relay in the range of 0.5 Amp to 2 Amp. Suitable C.B.C.T. for the same shall be provided.

6.6 Sufficient number of NO + NC auxiliary contacts shall be provided for the protections mentioned in para 6.2, 6.3 & 6.4.

7.0 **METERING&MIMICFACILITY**

7.1 Followingindicationsshallbeprovided:

a) ON/OFF/TRIP

b) Indication(Alarm/Lamp)onTRIPwithresetbutton

7.2 FollowingMimicdisplayshallbeprovided:

a) Triponoverload

b) Triponearth fault

c) Triponshort circuit

d) Tripforhightemperatureintransformer

e) Tripforhighgaspressureintransformer

7.3 Followingmeasuringinstrumentsshallbeprovidedwithallbreakersexceptcouplers:

a) VoltmeterwithSelectorswitch.0-10kVwithmeasuringclassP.T.

b) AmmeterwithSelectorswitchwithmeasuringclassC.T.

c) P.F.meter.

d) Frequencymeter.

e) KWmeter.

f) KWHmeter.0-99999999Units.

7.4 Installation of Circuit Breaker unit and interfacing with other Circuit Breaker unit/Contactor panel shall be in scope of bidder. Suitable class of Current Transformer and Potential Transformer shall be provided.

8.0 **NAMEPLATE**

Thenameplatesofthecircuitbreakeranditsoperatingdeviceshallhavemarkingas: Manufacturer
Typedesignationandserialnumber
Rated voltage
Rated frequency
Ratednormalcurrent
Short circuit withstand capacity
Ratedshortcircuitbreakingcurrent
Rated supply voltage of closing and opening devices
Ratedsupplyfrequencyofclosingandopeningdevices
Tender Document Ref:
Operatingduty
Supply voltage of auxiliary circuits
Supplyfrequencyofauxiliarycircuits
Weights
Ratedoperatingsequence
Year of manufacture

ANNEXURE-I

TECHNICALPARAMETERSOF6.6kVINDOOR VCB

1 Installation:IndoorPanel

2 NumbersofPoles:3

3 ServiceVoltage:6600V(-10%to 10%)

4 Ratedcurrent(A:Asperrequirement
5 Makingcapacity:62kA(peakminimum)
6 Frequency:50Hz(+3%to-5%)
7 Symmetricalbreakingcapacity:25kA(rmsminimum)
8 Shorttimecurrentfor3Second:25kA(rmsminimum)
9 Operatingduty:P1
10 OperatingMechanism:Motoroperatedspringcharged.
Trip free mechanism along with ON/OFF/TRIP Indication.
10.1 Manual/Electricallyoperated:ManualandElectricalwithclosingandshunttripcoil.
11 Trippingarrangement:ACshunttripmechanism.
12 Meterstobeprovidedonallbreakersexcept
Couplers:Ammeter,Voltmeterwithselectorswitches,PFmeter,KWHmeter,KWmeter. 13
Protections to be provided: i) Short circuit
ii) Overload
iii) EarthFault
iv) Earthleakage
v) OverVoltage
iv)Undervoltage
14 IndicationsonControlpanel:ON,OFF,TRIP,LOCKOUT,CONTROLSUPPLY,SPRINGCHARGED.
15 Terminalarrangement:
15.1 Incoming:Conductor:AluminiumType:PVCSWA/PVCDWASize:Suitable size
15.2 Outgoing:
Conductor: Aluminium
Type:PVCSWA/PVCDWA
Size:Suitable size
16 Controlsupply:220VDC.
17 Control wiring: 1.5 mm2, 660 V, PVC, Copper conductor 2.5 mm2, 660 V, PVC, Copper conductor for C.T. secondary connection.
18 CurrentTransformer:Ofadequateclassformeasuringandprotectionwith5Asecondary.
19 Useofbreaker:Incomer/Coupler/TransformerControl/CapacitorBankControl/Spare

CHAPTER– 22

TECHNICALSPECIFICATIONSFOR6.6KVABSWITCH

1.0 SCOPE

(i) This specification covers design, manufacturing, assembly, testing before supply, inspection, packing and delivery and other basic requirements in respect of outdoor type 12 kV rating Air Break Switch (A B Switch) for Distribution Transformer with accessories and auxiliary equipment required for their satisfactory operation.

(ii) The equipment offered shall be complete with all parts necessary for their effective and trouble free operation. Such parts shall be within the scope of supply irrespective ofwhether they are specifically indicated in the Bid Proposal sheet.

(iii) Itisnottheintenttospecify,completelyhereinallthedetailsofdesignandconstruction of the A B Switch. However, the A B Switch shall conform, in all respects to high standard of engineering, design and workmanship as listed in annexure I.

2.0 APPLICABLESTANDARD

(i) The A B Switch shall conform to the latest revisions, available at the time of placement of order of relevant standard, rules and codes listed in annexure-I.

(ii) Equipment meeting with the stipulations of equivalent IEC, ANSI, CSA, DIN standard, which ensure equal or better quality than the standards listed in annexure-I, shall also be acceptable. In such case the contractor should submit along with his offer, two copies ofsuch standards in authentic English translation, if the language of the standard is other than English.

3.0 GENERALTECHNICALREQUIREMENTS

(i) TypeofAB Switch

The A B Switch shall be outdoor type suitable for horizontal mounting on the support structure. The A B switch shall be 3-phase 3-pin type gang operated and of rotating typewith one post insulators per stack and single throw, double break characteristic. It would be complete with arcing horns, down pipe and operating mechanism.

(ii) CurrentDensity

Current density to be adopted for all the parts of A B Switch and terminal connector shallnot exceed the following limits:

a. Hollowtubesection-Copper2.0A/sqmm

b. Flatsection-Copper1.6A/sqmm

c. Terminalconnectors-Alum.1.0A/sqmm

(iii) PostInsulators

a. The Post insulator shall be with solid core insulators. Polycone insulators shall not be acceptable. The post insulator should confirm to IS: 2544 latest issue. Each stack two such insulators placed one over other with original cementing.

b. The insulator shall be provided with completely galvanised steel base design for mounting on the support. The base and mounting arrangement of the insulator shall be such that the insulator shall be rigid and self-supporting and no guying or cross bracing between phases shall be necessary.

c. Insulator shall be made of homogeneous and vitreous porcelain of high mechanical & dielectricstrength.Itshallhavesufficientmechanicalstrengthtosustainelectricaland

mechanical loading on account of wind load, short circuit stresses etc. Glazing of the porcelain shall be uniform brown or dark brown colour with a smooth surface arranges to shed away rain water. Porcelain and metal parts shall be assembled in such a way that any thermal differential expansion between the metal and porcelain through the range of temperaturespecifiedinthisspecification shallnotloosenthepartsorcreateundueinternal stresses which may affect the mechanical or electrical strength or rigidity.

d. Cap of the insulator shall be of high grade malleable steel casting. It shall be machine faced and hot dip galvanized as per IS 3638, IS 2623. The cap shall have four number of tapped holes spaced on a pitch circle of diameter of 76 mm. to accommodate the terminal clamps of Bus bar.

(e) The insulator unit shall be assembled in suitable jig to ensure correct positioning of the top and bottom metal fittings relative to one another.

(iv) OperatingMechanism

a. Manual operating mechanism gang operated through hand-operated lever shall be provided for A B switch.

b. The operating mechanism shall provide quick, simple and effective operation. The design shall be such that one person shall be able to operate the A B Switch without undue efforts. AB Switch operating mechanism should be such that it should not operate by gravity, wind, short circuit, seismic acceleration, vibration, shock, accidental touching.

c. It shall make it possible to effect a smooth and fully controlled movement of the three blades simultaneously throughout the entire cycle of operation. Adjustment step shall be provided at either end and of the mechanism to stop the handle in the "ON" and "OFF" position. Pad locking arrangement for the handle in the "ON" and "OFF" position should be clearly indicated on the stand.

(v) ControlCabinet

(a)The control cabinet of each operating mechanism shall be made out of 12 SWG (2.64 mm thick) sheet steel. Control cabinet shall be provided with hinged door along with padlocking arrangement. 15mm thick neoprene or better type of gaskets shall be provided to ensure degree of protection at least IP55 as per IS 13947.

(vi) GlandPlatesandGlands

A removable gland plate with double compression type brass cable glands shall be provided with each operating mechanism for terminating all cables.

(vii) AuxiliarySwitch

a. Main switch operating mechanism shall be equipped with reliable auxiliary switch with 4 NO & 4 NC contacts exclusively for owner's interlocking and protection scheme.

b. The auxiliary switch and auxiliary shall be capable of carrying of 10 Amp current continuously.

c. Quick make and break (QMB) type auxiliary switch shall have snap action built in within the switch.

d. Auxiliary switches shall be actuated by a cam or similar arrangement directly mounted on the A B Switch shaft without any intermediate levers, linkages etc to ensure fool proof operation.

(viii) TerminalandWiring

A B switch operating mechanism shall be provided with 1100 volt grade stud type terminal. Auxiliaryswitchshallbewireduptotheterminalblock.Thereshallbeatleast20%extra

terminals. All wiring shall be carried out with 1100 V grade PVC insulated 2.5 sq. mm copper conductor maximum conductor temperature shall be as per IS: 3961.

(ix) Accessories

i. Positionindicator

ii. Nameplate(Completedetailsoftheparameter)

iii. Padlockingdevice

iv. StatusoftheABSwitchshallnotshowasclosedtillitscontactsarenotclosedproperly.

v. Status of the A B Switch shall not show as opened till its contacts are not opened at least 80% of the isolating distance.

(x) Earthing

i. Flexible copper braid connections shall be provided between rotating earth blades and the frame which shall have a cross section of at least 50 sqmm and shall be tinned or suitably treated against corrosion.

ii. The frame of each A B Switch shall be provided with two reliable earthing terminals for connectingtoearthmat. The connection shall be such that it can carry specifiedshort circuit current.

(xi) DesignandConstruction

i. Contractorshallhavetogivefulldetailsofdesign,manufacturing,quality controletcofthe equipment offered in respect of the following items.

1. Contactsmaterial,currentdensityetc.

2. Contactsupportandfixingarrangementoninsulator.

3. Bearings,housingofbearings,bushes etc.

4. Baseplates

5. Downpipe,guides joints

6. Operating mechanism, aux switch, size and thickness of box, degree of protection, gland plate, gland etc.

7. Nuts,boltandfasteners

8. Interlockingdevices.

Offerswithouttheaboveinformationorwithincompleteinformationmayberejected.

ii. All live parts shall be designed to have smooth surfaces without any sharp points, edgesand corona producing surfaces so as to eliminate corona at specified extinction voltage or at

1.1xRatedvoltageifextinctionvoltageisnotspecified.

(xii) Fasteners

Nuts,boltsandwashersof5/8"andhighersizeshallbehotdip galvanized.Theboltsusedon tapped holes of insulator cap shall be galvanized by centrifuge process to avoid excess deposition of zinc on threads. Nuts, bolts and washers of less than 5/8" size shall be non-magnetic stainless steel.

(xiii) Contacts

Contacts shall be made out of hard drawn rolled/ extruded electrolytic grade copper. The contact assembly should be so robustly designed that while carrying the rated continuous current the temperature rise does not increase beyond 650C over and average ambient temperature of 400C and peak ambient temperature of 500C. Arcing contacts wherever provided shall close first and open last. The contacts shall be silver plated (10 to15 microns).

(xiv) TerminalPad

It shall be made out of electrolytic copper heavily silver plated (15 microns). The terminal pads shall be suitable for connection to 40x40 mm terminal connector.

(xv) MountingofContacts

Fixed contacts shall be mounted on 6 mm thick 100x50 mm M.S. Galvanized channel welded to 10 mm thick M.S. plate with holes for fixing on insulators. Slots shall be provided for marginal adjustment of height of contacts.

(xvi) MovingBlades

Contact surface of moving blades shall be heavily silver plated to 15 microns thick. The surface shall be wiped during closing and opening operations to remove any oxidedeposition on the contacts. The blades would be made of single length of rolled/extruded electrolyte grade copper of adequate size matching with the current carrying capacity. The blade shall be supported shall be steel angle on MS angle striping of adequate dimensions (40x40x6 mm).

(xvii) FixedContactAssembly

The fixed contact element shall be made of rolled/ extruded electrolyte grade copper flatand reverse loop type. The contact assembly shall be so robustly designed that whilecarrying the rated continuous current the temperature rise does not increase beyond 650C over and average ambient temperature of 400C. The fixed contact assembly shall be spring-loaded and of high pressure and self aligned type, head guide shall be provided so that properratingofcontactelementsanddetailedevenwhenthebladeisoutofalignmentby¼ inch. It should be of robust design. The fixed contact assembly shall be designed in such that the passage of short circuit current for a period one second shall not cause any annealing of the contact. The various parts should be finished to ensure inter-changeability of similar component.

(xviii) Bearings

Rotating insulator shall be mounted on housing with bearings. Two numbers of bearingswith at least 50 mm ID and 80 mm distance between the bearings shall be provided. The bearings shall be of reputed make and lubricated for lifetime. Other parts like bushes, joints springs etc shall be so designed that no lubrication shall be required during the service.

(xix) DownPipe

The down pipes of A B Switch shall be of at 1.25% I.P.S. G.I. pipe and its length would besuch that when the blades of the switch are at height of 20 ft, the operating handle is 3.5 ft from the ground level. Suitable guides shall be provided for intermediate positions of the down pipe.

(xx) Base

Each base of A B Switch shall be provided with a base fabricated from steel sections. The base shall be suitable for mounting on support structures. Fabrication, welding etc shall be done by suitable jig; templates and devices used for production of the base shall befurnished with the contractor.

(xxi) SupportingStructures/ArcingHorns/Phase Coupling Bar

a. The contractor shall quote unit prices for support structure for the A B Switch offered. Thesesupportstructuresshallbefabricatedoutofgalvanizedsteelsectionsconformingto IS 1239.

b. The support structure shall be suitable for mounting operating mechanism and guides. It shall be designed to withstand short circuit forces, wind pressure, seismic forces etc. along with the operating forces, vibrations, shocks etc. at actual site conditions with adequate factor of safety.

c. The arcing horn shall be of 8 mm galvanized steel rod. One end of each arcing horn shallbe soundly wielded to a 25x6 mm steel flat which in turn shall be fitted to the switch usingto 5/16 inch dia galvanized bolts and nuts. Arcing horn shall be fitted against one another.

d. The phase coupling bar: The bar required for coupling the rotation of all the three phase would on1 inch I.P.S. steelpipe in 9 ft length. The fixing arrangement for the phase coupling bar to the cranks and the rotating insulator stacks shall be such as to permit a smooth movement of coupling bar on operation of the switches without and bending/looseness.

(xxii) Terminals&Connectors

a. Terminal: The terminal shall be made of rolled/ extruded electrolytic grade copper flat having cross section area equal to that of the blade. It shall be so constructed that an intimate contact with the contact element is ensured and provision ismade to bolt with two numbers of 3/8 inch dia galvanized bolts and nuts, a cast aluminium connector suitable to take conductors up to the size of ACSR 150 mm2 using number 3/8 inch dia bolts and nuts. The terminal shall be silver coated.

b. Connectors: The cast aluminium connectors shall be smooth and supplied for the eachend of each phase of the switch. The design of the connector shall be such that at no place it's crosssectionalarea is less thanthetwice the cross sectionalareaofthecopper blade. All the bolts should be galvanized.

(xxiii) Assembly

i. The disconnectorshall befully assembled at the works of the contractor and alloperations of the fully assembled disconnector shall be checked at the manufacturer's works

(xxiv) Painting,GalvanizingandClimateProofing

a. Allinteriorsandexteriorsofenclosures,cabinetsandothermetalpartsshallbe thoroughly cleaned to remove all rust, scales, corrosion, grease and other foreign materials. After cleaning two coats ofzinc oxide primer shall be given by suitable stoving and air drying etc. Colour of the final paint shall be epoxy light gray.

b. Paint inside themetallichousing shall be of anti condensation type and the paint on outer surfaces shall be suitable for out door condition.

c. Galvanization shall be done after completion of the fabrication and should be capable of preventing corrosion in view of severe climatic conditions.

d. All ferrous part of the switch shall be hot dip galvanized as IS: 2629-1969 (as amended up to date). The steel pipe used shall be galvanized in accordance with IS: 4786-1968 (as amended up to date). **ANNEXURE-I**

(xxv) Tests

Type Tests: The A B Switch shall be typetested as perIS:1818-1972 (as amendedup to date) for the following, for which the contractor shall submit the type test report along with the bid.

a. Impulsevoltagedrytest

b. Temperaturerisetestofthemaincontact.

c. Measurementofresistanceofmaincontactinclosureposition.

d. Test to prove the capability of carrying the rated full load current continuously and short circuit for some second.

e. Mechanicalendurancetests.

RoutineTests&AcceptanceTest:

a. All acceptance and routine tests as stipulated in the relevant standards shall be carriedout by the supplier/contractor in presence of owner representative.

b. Mechanicaloperationtest(Routinetest)shallbeconductedonthecompleteABswitch.

c. Immediately after finalization of the Programme of type/acceptance/routine testing, the supplier/ contractor shall give three weeks advance intimation to the owner, to enable him to depute his representative for witnessing the tests.

(xxvi) Inspection

a. The owner may carry out the inspection at any stage of manufacture. The contractor shall grant free access to owner's representative at Ī reasonable time when the work is in progress.

b. The owner reserves the right to insist for witnessing the acceptance / routine testing of the bought out times.

c. Inspection and acceptance of any equipment under this specification by the owner shall not relieve the supplier/contractor of his obligation of supplying equipments in accordance with the specification.

Annexure-I

Listoftherelevant standards:

a. IndianStandards:1818,9921,2544,13947,4691,325,
4722,2629,4759,2633,1573,3033,2016,3961,5561,1554,5578,11353,9920

b. IEC:129, 168,

c. IndianElectricityRules1956

Onlythelatestversionsofallthesestandardsshallbefollowed. Technical parameters:

Sl.No	Parameter	Unit	Requirement
1	Ratedfrequency	HZ	50
2	SystemneutralEarthing		Effectivelyearthed
3	Noof phases	No	3
4	Tem.Rise	Deg.c	As per Standards IS/IEC
5	Safedurationofoverload		
	a)150%ofratedcurrent		
	b)12%ofrated current		
6	Ratedvoltage	Kvrms	12
7	Typeof ABswitch		DBCR
8	Rated normalcurrent	Amps	400
9	Ratedshorttimewithstandcurrent ofMS for3 sec	KA rms	25
10	Ratedshortcircuitmakecurrent	KA peak	63
11	BasicInsulationLevel		
	1)Lightingimpulsewithstand	KV peak	

	voltage		
	a)Poletoearth&between poles		75
	b)Acrossisolatingdistance		85
	2)Rated power frequency withstandvoltage	KV rms	
	c)Poletoearth&between poles		28
	d)Acrossisolatingdistance		32
12	Minimumcreepagedistance	mm	300

MaterialDetails:

Sl.No	Description	Material	Size
1	Basechannel	MS Galvanized	75x40x6mm
2	Basesupportchannel	MS Galvanized	75x40x6mm
3	Basefor4 th bearing	MS Galvanized	75x40x6mm
4	Tandem pipe	GIPipe	25NB,ClassB 3200mmlong
5	DownPipe	GIPipe	50NB,ClassB, 1900mmlong
6	EarthingTerminal		M16,BoltswithNut
7	Supportstructure	MSGalvanisedPipe	114mmCDx12SWG

Note: Thedimensions/datashownaboveagainstmaterialdetailsarefor referenceofthecontractor and indicative only.

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CHAPTER– 23

TECHNICALSPECIFICATIONFORCROSS-ARMS (6.6 kV OVERHEAD LINES)

j) V'shapeM.S.crossarmwithclamps

(ii)X-armsshallbemadeasperGAD – 001.

k) Thecrossarmshallbehotdippedgalvanizedgenerallyconformingto IS– 2633/72.

(iv) TheX-armshouldnotbewelded/jointedatanyplaceexceptasspecified.

(v) The clampsfortheX-armshallbeofG.I.&shallbehotdippedgalvanizedgenerallyconformingto IS – 2633/72.

(vi) Theclampsshallbedesignedtofitforthespecified PSCpoles.

G.I.X-Armfor90degreescut points

(i) Itshallcompriseof75 x40x6mm3.2mtr.LongISMCchannelsto beprovidedonpolesfor90 degrees cut points.

(ii) TheX-armshallbehotdippedgalvanizedgenerallyconformingtoIS– 2633/72.

l) Theclampsshallbedesignedtofitforthespecified PSCpoles.

m) TheholesfortheG.I.pinshallbespacedasperthe relevantI.S.specificationsfor 11kV and LT circuits.

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CHAPTER– 24
TECHNICALSPECIFICATIONFORSTAYSET

SCOPE:

Thisspecificationprovidesformanufacturing,testing,dispatch,supplyanddeliveryofStaySetfor 6.6kV.Thestaysetwillconsistofthefollowingitems:

a. Stay wire
b. StayInsulator
c. TurnBuckle
d. Clamps
e. Anchorrod&plate
f. Staypitanchorassembly

GISTAYWIRE

ThespecificationfortheGIstaywireshallbeas follows.

(i) **APPLICABLESTANDARDS**

Exceptwhentheyconflictwiththespecificrequirementsofthisspecification,theG.I.Stay Stranded Wires shall comply with the specific requirements of IS: 2141-1979. IS: 4826-1979 & IS: 6594-1974 or the latest versions thereof.

(ii) **APPLICATIONANDSIZES**

a) The G.I. stranded wires covered in this Specification are intended for use on the overhead power line poles, distribution transformer structures etc.

b) The G.I. stranded wires shall be of 7/12SWG (7/2.5 mm) (11kV lines) and 7/14 SWG (7/2 mm) (LT lines) standard sizes.

(iii) **MATERIAL**

The wires shall be drawn from steel made by the open hearth basic oxygen or electric furnace process and of such quality that when drawn to the size of wire specified and coated with zinc, the finished strand and the individual wires shall be of uniform quality and have the properties and characteristics as specified in this specification. The wires shall not contain sulphur and phosphorus exceeding 0.060% each.

(iv) **TENSILEGRADE**

The wires shall be of tensile grade 4, having minimum tensile strength of 700 N/mm2 conforming to IS: 2141.

(v) **GENERALREQUIREMENTS**

a. Theouterwireofstrandsshallhaveright-handlay.
b. Thelaylengthofwirestrandsshallbe12to18timesthestranddiameter.

(vi) **MINIMUMBREAKINGLOAD**

Theminimum-breakingloadofthewiresbeforeandafterstrandingshallbeasfollows:

No.ofwires&const	Wiredia (mm)	Min.breakingloadofthe standardwire(KN)before standing (KN)	Min.breakingloadof singe wire
7(6/1)	2.0	2.20	13.70
7(6/1)	2.5	3.44	21.4
7(6/1)	3.15	5.46	34.0
7(6/1)	4.0	8.8	54.9

(VII)**CONSTRUCTION**

a. The galvanized stay wire shall be of 7-wire construction. The wires shall be so stranded together that when an evenly distributed pull is applied at the ends of completed strand, each wire shall take an equal share of the pull.

b. Joints are permitted in the individual wires during stranding but such joints shall not be less than 15 meters apart in the finished strands.

c. The wire shall be circular and free from scale, irregularities, imperfection, flaws, splits and other defects.

(viii) **TOLERANCES**

Atoleranceof(±)2.5%onthediameterofwiresbeforestrandingshallbepermitted.

(ix) **SAMPLINGCRITERIA**

ThesamplingcriteriashallbeinaccordancewithIS:2141.

(x) **TESTSONWIRESBEFOREMANUFACTURE**

ThewiresshallbesubjectedtothefollowingtestsinaccordancewithIS:2141.

i) DuctilityTest

ii) ToleranceonWireDiameter

(xi) **TESTSONCOMPLETEDSTRAND**

Thecompletedstrandshallbetestedforthefollowingtestsinaccordancewith IS: 2141.

a) Tensile and Elongation Test: the percentage elongation of the stranded wire shall not be less than 6%.

b) Chemicalanalysis

c) GalvanizingTest:

TheZincCoatingshallconformto"HeavyCoating"aslaiddowninIS:4826

(xii) **MARKING**

Eachcoilshallcarryametallictag,securelyattachedtotheinnerpartofthecoil,bearingthe following information:

a) Manufacturers'nameortrademark

b) Lotnumberandcoilnumber

c) Size

d) Construction

e) TensileDesignation

f) Lay

g) Coating

h) Length
i) Mass
j) ISIcertificationmark,if any

(xiii) **PACKING**

The wires shall be supplied in 75-100 Kg. coils. The packing should be done in accordance with theprovisions of IS: 6594

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CHAPTER – 25

DANGERNOTICEPLATES

1. SCOPE

ThisSpecificationcoversDangerNoticePlatesto bedisplayedinaccordancewithruleNo.35 of Indian Electricity Rules, 1956.

2. APPLICABLESTANDARDS

Unless otherwise modified in this specification, the Danger Notice Plates shall comply withIS: 2551-1982 or the latest version thereof.

3. DIMENSIONS

I. Fordisplayat33KVinstallations -250x200mm
II. Thecornersoftheplateshallberoundedoff.
III. Thelocationoffixingholes:-thatsuittherequirementsofthe installations.

4. LETTERINGS

All letterings shall be centrally spaced. The size of letters in the words in each language and spacing between them shall be sochosen that these be uniformly written in the space earmarked for them.

5. LANGUAGES

5.1 Under Rule No. 35 of Indian Electricity Rules, 1956, the owner of every medium, high and extra high voltage installation is required to affix permanently in a conspicuous position a danger notice in Hindi or English and, in addition, in the local language(Odiya), with the sign of skull and bones.

5.2 In the specimen danger notice plate, adequate space has been provided for having the letterings in local language for the equivalent of' Danger', '33000' and 'Volts'.

6. MATERIALANDFINISH

Theplate shall be made from mild steel sheet of at least 1.6mm thick and vitreousenameled white, with letters, figures and the conventional skull and cross-bones in signalred colour (refer IS:5-1978) on the frontside.The rearside of the plate shall also be enameled.

7. TESTS

Thefollowingtestsshallbecarriedout:

i) VisualexaminationasperIS:2551-1982
ii) DimensionalcheckasperIS:2551-1982
i) TestforweatherproofingasperIS:8709-1977(oritslatestversion)

Chapter-26
TECHNICAL SPECIFICATIONS FOR 415/240 V. PORCELAININSULATORSANDINSULATORFITTINGS

1.0 SCOPE:

This specification covers design, engineering, manufacture, assembly, stage testing, inspection& testing before supply and delivery at site of LT pin insulator, LT shackle insulators andinsulator fittings for use on 415/240 V over head power lines to be constructed under this specification.

2.0 APPLICATIONSTANDARDS:

The insulators shall comply with IS: 1445-1977 and fittings with IS: 7935-1975 or the latest revisions thereof. In the event of the supply of insulators and fittings confirming to standards other than specified, the Contractor shall confirm in his bid that these standards are equivalent to those specified. In case of award, salient features of comparisation between the standards proposed by the contractor and those specified in this document will be provided by the contactor to establish their equivalence.

3.0 PORCELINEINSULATORS:

(i) Generalrequirements:

a. The porcelain shall be sound, free from defects, thoroughly verified and smoothly gazed.
b. The glaze, unless otherwise specified, shall be brown in colour. Except for the screw threads and parts on which the porcelain is supported during the firing, which may be left unglazed.
c. The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to its deterioration.
d. Theinsulatorshallbeinone piece.

(ii) Typeof insulators

a. Pin insulator: Pin insulator is an insulator consisting of single piece of porcelain and indented to be mounted rigidly on a supporting structure by a pin, which passes up inside the insulator. The pin type insulator shall have a top grooveand shall be threaded to take mild steel pin. The dimensions of pin insulator shall be as per REC standards.

(iii) Basicinsulationlevel:Thetestvoltagesoftheinsulatorsshallbeasunder:

Typeof Insulator	Wet One minute Power frequencywithstandvoltage [KV(rms)]	Power Frequency Puncture withstand voltage[KV (rms)]
Pin	10	60
Shackle	10	60

Thewithstandvoltageincolumn2aboveisreferredtothe“ReferenceAtmospheric Conditions” as per IS: 1445.

(iv) MechanicalLoad:Theinsulatorsshallbesuitableforminimumfailingloadspecifiedas under:

PininsulatorKN	Shackleinsulator KN
3.5	11.5(Type1)
-	16.0(Type2)

(v) Test:TheinsulatorsshallcomplywiththefollowingtestsasperIS: 1445.

a. Typetest:Thefollowingtestsshallconstitutethetypetests;
   a) Visualexamination
   b) Verificationofdimensions
   c) Wetpower-frequencyvoltagewithstandtest
   d) Temperaturecycletest
   e) Mechanicalfailingloadtest
   f) Power-frequencypuncturewithstandtest
   g) Porositytest

b. Acceptancetest:Thetestsamplesshallbesubjectedtothefollowingacceptance tests in the order indicated below;
   a) Verificationofdimensions
   b) Temperaturecycletest
   c) Mechanicalfailingloadtest
   d) Porositytest

c. Routine test: The visual examination shall be carried out on each insulator. Any other test not mentioned above but included in the latest version of IS:1445 shall also be construed to be included in the above list of type, acceptance & routine tests.

(vi) Marking:

a) Eachinsulatorshallbelegiblyandindeliblymarkedtoshowthefollowings:
   - Nameofthetrademarkofthemanufacturer
   - Yearof manufacture
   - ISIcertificationmark

(vii) Packing: All insulators shall be packed in basket, crates or boxes as per manufacturer's standard practice but suitable to rough handling.

4.0 INSULATORFITTINGS:

I. Pins

Generalrequirements

a. The pin shall be obtained by process of forging. They shall be good finish, free from flows and other defects. The finish of collar shall be such that sharp angle between the collar and the shackle is avoided.

b. All ferrous pins, nuts and washers except those made of stainless steel, shall be galvanized.The threads of nuts shall be cut aftergalvanizing and shall be well oiled or greased.

c. Dimensions: Pin shall have a stalk length of 135 mm, stalk length of 125 mm and minimum failing load of 2.9 KN. Dimensions shall be as per REC standards.

II. ShackleinsulatorFittings

a. All parts shall be of good finish and free from flaws and other defects. The edges on the outside of the fittings, such as holes etc. shall be rounded.
b. All ferrous fittings and the parts other than those of stainless steel shall be galvanized.Smallfittings likespring washers,nutsetc.maybeelectro-plated with zinc.

III. Straptypefittingsshallconsistoffollowings:
a. ApairofMS Strap
b. 2nosMSboltswithhexagonalheadandnuts
c. 2nos.springwashers
d. Helically formed conductor dead-end fittings made of aluminum alloy or aluminum-clad steel conforming to the requirement specification No.25/1983.

IV. UClampsfittingsshallberequired.Thesewouldconsistof:
a. MS“U” Clamps
b. 1.No.MSboltsandnut
c. 1Nospring washer
d. Helically formed distribution side tie made of aluminum alloy or aluminum- cladsteel conforming to requirements of RE Specification No. 25/1983. [Note: “U”Clamp fittings are intended only for use on tangent locations]

V. Tests:InsulatorfittingsshallcomplywithfollowingtestsasperIS:7935.
a. Typetest:thefollowingshallconstitutethetypetest:
a) Visualexamination
b) Verificationofdimensions
c) Checkingofthreadsonhead
d) Galvanizing/electroplatingtest
e) Mechanicalstrengthtest(forpininsulatorfittingonly)
b. Acceptancetests:Thefollowingshallconstitutetheacceptancetests;
- Checkingofthreadsontheheads
- Galvanizingtest

c. Routine Tests: Visual examination test shall be carried out as routine tests. Any other test not mentioned above but included in the latest version of IS: 7935 shall also be construed to be included in the above list of type, acceptance & routine tests.
d. Packing: Forpackingof insulatorpin& shackle fittings,double gunny bags or wooden cases, if deemed necessary, shall be employed. Helically formed fittings shall be packed in card board/wooden boxes. The gross wt of each packing shall not normally exceed 50 KG. All nuts shall be hand tightened over the bolts and screwed up to furthest point.

VI. GUARANTEED TECHNICAL PARTICULARS: The bidders shall furnish this document with his bid.

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