ENGINEERING PROJECTS (INDIA) LIMITED

Coal Handling Plant Package for
Pakri Barwadih Coal Mining Project of NTPC

PACKAGE No. : ENGG/PA/344/E/3

LT POWER & CONTROL CABLES

VOLUME –2

VOLUME – 2 A : GENERAL TECHNICAL REQUIREMENT
VOLUME – 2B : TECHNICAL SPECIFICATIONS
# GENERAL TECHNICAL REQUIREMENT

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GENERAL TECHNICAL REQUIREMENTS

1.00.00 INTRODUCTION
This part covers technical requirements, which will form an integral part of the specifications. The following provisions shall supplement all the detailed technical requirements brought out in the Technical Specifications and the Technical Data Sheets.

2.00.00 BASE OFFER
Vendor’s proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognized that the Vendor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein.

3.00.00 COMPLETENESS OF FACILITIES
3.01.00 Vendor may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant/equipment shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure that a completely engineered plant/equipment is provided.

3.02.00 All equipments furnished by the Vendor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation & maintenance of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions. All similar standard components/ parts of similar standard equipment provided, shall be interchangeable with one another.

4.00.00 CODES & STANDARDS
4.01.00 In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following:

(a.) Bureau of Indian Standards (BIS)
(b.) Indian electricity act
(c.) Indian electricity rules
(d.) Indian Explosives Act
(e.) Indian Factories Act and State Factories Act
(f.) Indian Boiler Regulations (IBR)
(g.) Regulations of the Central Pollution Control Board, India
(h.) Regulations of the Ministry of Environment & Forest (MoEF), Government of India
(i.) Pollution Control Regulations of Department of Environment, Government of India
(j.) State Pollution Control Board.
(k.) Rules for Electrical installation by Tariff Advisory Committee (TAC).
(l.) Any other statutory codes / standards / regulations, as may be applicable.
4.02.00 The codes, and/or standards referred to in these specifications shall govern, in all the cases wherever such references are made for design of various equipments/system etc. Latest edition shall be followed by the Vendor for all the codes and/or Standards. In case of a conflict between such codes and/or standards and the specifications, the latter shall govern such codes and/or standard referred to shall mean the latest revision, amendments/changes adopted and published by the relevant agencies. In case of any further conflict in this matter the same shall be referred to the Employer whose decision shall be final and binding.

4.03.00 Other internationally acceptable standards which ensure equal or higher performance than those specified shall also be accepted subject to the EPI / Employer's approval, for which the Vendor shall furnish, adequate information to justify that these standards are equivalent or superior to the standards referred. In all such cases the Vendor shall furnish specifically the variations and deviations from the standards mentioned else where in the specification together with the complete word to word translation of the standard that is normally not published in English.

4.04.00 In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the EPI/Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Vendor to bring to the notice of the Employer such changes and advise EPI/Employer of the resulting effect.

5.00.00 EQUIPMENT FUNCTIONAL GUARANTEE

5.01.00 The functional guarantees of the equipment under the scope of the Contract is given elsewhere in the technical specification. These guarantees shall supplement the general functional guarantee provisions covered under General Conditions of Contract.

5.02.00 Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Vendor as specified elsewhere in this specification.

6.00.00 DESIGN OF FACILITIES/MAINTENANCE & AVAILABILITY CONSIDERATIONS

6.01.00 Design of Facilities

All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere.

Vendor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit.

6.02.00 Maintenance and Availability Considerations

Equipment/facilities offered shall be designed for high availability, low maintenance and ease of maintenance. Vendor shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance.

Lifting devices i.e. hoists and chain pulley jacks, etc. shall be specified separately by the Vendor for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities.

Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist / crane shall be provided by the Vendor for lifting the equipment and accessories covered under the specification during erection & commissioning.
All the valves and other equipments shall be provided with operating platforms, ladders, lifting lugs etc as required by Employer and such appurtenances if required during /after commissioning of the plant shall be provided by the Vendor at plant within the contract price.

7.00.00 DOCUMENTS, DATA DRAWINGS AND ENGINEERING CO-ORDINATION PROCEDURE.

7.01.00 Vendor may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required ensuring a completely engineered plant shall be provided in respect of mechanical, electrical, control & instrumentation, civil & structural works as per the scope.

Vendor shall furnish engineering data/drawings and manuals in accordance with the schedule of information as specified in Technical Specification and data sheets.

7.02.00 The number of copies/prints/floppy discs/CD-ROMs/manuals to be furnished for various types of documents is given in Annexure-I of this Section. In addition to numbers indicated, 2 sets of each of drawings & 1 set CD/Floppies shall also be furnished.

7.03.00 The documentation that shall be provided by the Vendor is indicated in the various sections of specification. This documentation shall in general include (whichever applicable for the package) but not be limited to the following as mentioned below.

7.03.01 Detailed Engineering Documents
   i) General layout
   ii) Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant.
   iv) Piping isometric /composite layout and fabrication drawings.
   v) Piping engineering diagrams, pipe and fittings schedules, valve schedules, hanger and support schedules, insulation schedules.
   vi) Technical data sheets for all bought out and manufactured items. Vendor shall use the technical specifications as a base for placement of orders on their sub-vendors.
   vii) Detailed design calculations for components, system, piping etc., wherever applicable.
   viii) Transient, hydraulic and thermal stress analysis of piping and system wherever applicable & input and output data alongwith stress analysis isometrics showing nodes.
   ix) Characteristic Curves/ Performance Correction Curves applicable for various equipments.
   x) Comprehensive list of all terminal points which interface with Employer's facilities. giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc.
   xi) Power supply single line diagram, block logics, control schematics, electrical schematics, etc.
   xii) Protection system diagrams and settings.
   xiii) Cables schedules and interconnection diagrams.
   xiv) Cable routing plan.
   xv) Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc.
   xvi) Alarm and annunciation/ Sequence of Event (SOE) list and alarms & trip set points.
xvii) Sequence and protection interlock schemes.
xviii) Type test reports.
xix) Control system configuration diagrams and card circuit diagrams and maintenance details.
xx) Detailed software manuals & source software listing.
xxi) Detailed flow chart for digital control system.
xxii) Mimic diagram layout.
xxiii) Civil drawings for architectural works, foundations and super-structural works, civil calculation sheets including structural analysis and design along with output results.
xxiv) Underground facilities, levelling, sanitary, landscaping drawings.
xxv) Geo-technical investigation and site survey reports (as applicable).
xxvi) Model study reports wherever applicable.
xxvii) Functional & guarantee test procedures and test reports.
xxviii) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.

Vendor's while submitting the above documents/drawings for approval/reference as the case may be, shall mark on each copy of submission the reference letter along with the date vide which the submissions are made.

7.03.02 Instruction Manuals

Vendor shall submit to EPI, draft Instruction Manuals for all the equipments and as well as for the complete system covered under the Contract within the time agreed upon between EPI and the Vendor. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project.

The Instruction Manuals of plant/equipment/system shall comprise of the following:

i) Erection Manuals

The erection manuals shall be submitted at least three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum.

a) Erection strategy.
b) Sequence of erection.
c) Erection instructions.
d) Critical checks and permissible deviation/tolerances.
e) List of tool, tackles, heavy equipments like cranes, dozers, etc.
f) Bill of Materials
g) Procedure for erection.
h) General safety procedures to followed during erection/installation.
i) Procedure for initial checking after erection.
j) Procedure for testing and acceptance norms.
k) Procedure/Check list for pre-commissioning activities.
l) Procedure/Check list for commissioning of the system.
m) Safety precautions to be followed in erection all equipments and electrical supply distribution during erection.

ii) Operation & Maintenance (O & M) Manuals

a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume/Book number. Each section of the manual shall be divided by a stiff divider of the same
size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side.

b) The arrangement and contents of O & M manuals shall be as follows:

1) Chapter 1 - Plant Description: To contain the following sections specific to the equipment/system supplied

(a) Description of operating principle of equipment / system with schematic drawing / layouts.
(b) Functional description of associated accessories / controls. Control interlock protection writeup.
(c) Integrated operation of the equipment along with the intended system. (The is to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers).
(d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment along with its accessories and auxiliaries.
(e) Design data against which the plant performance will be compared.
(f) Master list of equipments, Technical specification of the equipment/system and approved data sheets.
(g) Identification system adopted for the various components, (it will be of a simple process linked tagging system).
(h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume).

2) Chapter 2.0 - Plant Operation: To contain the following sections specific to the equipment supplied

(a) Protection logics provided for the equipment along with brief philosophy behind the logic, Drawings etc.
(b) Limiting values of all protection settings.
(c) Various settings of annunciation/interlocks provided.
(d) Startup and shut down procedure for equipment along with the associated systems in step mode.
(e) Do's and Don'ts related to operation of the equipment.
(f) Safety precautions to be take during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions.
(g) Parameters to be monitored with normal value and limiting values.
(h) Equipment isolating procedures.
(i) Trouble shooting with causes and remedial measures.
(j) Routine testing procedure to ascertain healthiness of the safety devices along with schedule of testing.
(k) Routine Operational Checks, Recommended Logs and Records
(l) Change over schedule if more than one auxiliary for the same purpose is given.
(m) Preservation procedure on long shut down.
(n) System/plant commissioning procedure.

3) Chapter 3.0 - Plant Maintenance: To contain the following sections specific to the equipment supplied.

(a) Exploded view of each of the equipments. Drawings along with bill of materials including name, code no. & population.
(b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment.
(c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc.
(d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc.
(e) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out.
(f) Overhauling schedules linked with running hours/calendar period alongwith checks to be done.
(g) Long term maintenance schedules
(h) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling.
(i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation and quantity required for complete replacement.
(j) Tolerance for fitment of various components.
(k) Details of sub vendors with their part no. in case of bought out items.
(l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares.
(m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares.
(n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares.
(o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied.

7.03.03 After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-I. The Contract shall not be considered to be completed for purposes of taking over until the final Instruction manuals (both erection and O & M manuals have been supplied to EPI / Employer.

If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O &M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Vendor to the EPI/Employer for records and number of copies shall be as mentioned in Annexure-1.

7.03.04 Project Completion Report.

Vendor shall submit a Project Completion Report at the time of handing over the plant/equipment.

7.04.00 Engineering Data / Drawings

7.04.01 All data/ information furnished by Vendor in the form of drawings/documents/catalogues or in any other form for NTPC's information/ interface and or review and approval are referred by the general term "drawings".

7.04.02 All documents submitted by the Vendor for EPI/Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per Annexure-I. The soft copies to be supplied shall be either in CDs, Floppies or through direct transfer via E-mail, etc. depending upon the nature/volume/size of the document. The drawings submitted for approval shall be in the Image form / Autocad drawing format / pdf format readable through Acrobat Reader as mutually agreed to between Vendor and EPI before award of Contract. All documents/text /calculations etc
information shall be in MS Office application such as MS – WORD or MS-Excel as the case may be.

7.04.03 All drawings submitted by the Vendor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.

7.04.04 Each drawing submitted by the Vendor (including those of sub-vendors of Vendor) shall bear a title block at the right hand bottom corner with clear mention of the name of EPI & Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units. A sample of ‘TITLE’ Block shall be furnished to the successful vendor.

7.04.05 The drawings submitted by the Vendor (or their sub-vendors) shall bear Employer’s drawing number wherever available in addition to Vendor’s (their sub-vendor’s) own drawing number. Employer’s drawing numbering system shall be made available to the successful Vendor so as to enable him to assign Employer’s drawing numbers to the drawings to be submitted by him during the course of execution of the Contract.

7.04.06 Vendor shall also furnish a “Master Drawing List” which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to EPI along with the schedule of submission of each drawing/document. Such list should clearly indicate the purpose of submission of these drawings i.e. “FOR APPROVAL” or “FOR INFORMATION ONLY”.

7.04.07 The review of these drawings by EPI/Employer will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under specifications, external connections, and of the dimensions which might affect plant layout. This review by EPI/Employer may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Employer shall not be relieve the Vendor of any of his responsibilities and liabilities under this Contract.

7.04.08 After the approval of the drawings, further work by the Vendor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of EPI/Employer.

7.04.09 All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Vendor’s risk.

7.04.10 Vendor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, vendor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification.

7.04.11 Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/approval of Employer prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority / representative of Employer based on requirements of such piping indicated in approved / finalized Flow Scheme / Process & Instrumentation Diagrams and/or the requirements cropping up for draining
& venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package.

7.04.12 Assessing & anticipating the requirement and supply of all piping and equipment hall be done by the contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining venting arrangement as per site suitability.

7.04.13 Final copies of the approved drawings shall be submitted in vector form on CD-ROM long with the requisite number of hard copies as per Annexure-I.

7.04.14 As Built Drawings
After final acceptance of individual equipment / system by the Employer at the plant/site, the Vendor will update all original drawings and documents for the equipment / system to “as built” conditions.

7.04.15 All engineering data submitted by the Vendor after final process including review and approval by the Employer/Project Manager shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Employer / Project Manager in writing.

7.05.00 Engineering Information Submission Schedule
Prior to the award of Contract, a Detailed Engineering Information Submission Schedule shall be tied up with EPI. For this, Vender shall furnish a detailed list of engineering information along with the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorised into the following parts. (a) Information that shall be submitted to EPI for the approval of the Employer before proceeding further, and (b) Information that would be submitted to EPI for Employer’s information only.

The schedule should allow adequate time for proper review and incorporation of changes/ modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.

7.06.00 Engineering Co-ordination Procedure

7.06.01 The following coordinators will be identified by respective organizations at time of award of contract:

NTPC Engineering Coordinator (NTPC FC):
Name :
Designation :
Address :
a) Postal :
b) Telegraphic / e-Mail :
c) FAX : TELEPHONE :

EPI's Engineering Coordinator:
Name :
Designation :
Address :
a) Postal :
b) Telegraphic / e-Mail :
c) FAX : TELEPHONE :
Vendor’s Engineering Coordinator (VENDOR EC):
Name  :
Designation  :
Address  :
a) Postal  :
b) Telegraphic / e-Mail  :
c) FAX  :  TELEPHONE

7.06.02 All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations.

7.06.03 Vendor’s Drawing Submission and Approval Procedure:

a) All data/information furnished by vendor in the form of drawings/documents/catalogues or in any other form for EPI/NTPC’s information/interface and or review and approval are referred by the general term “drawings”.

b) The ‘Master drawings list’ indicating titles, Drawing Number, Date of submission and approval etc. shall be finalised mutually between Vendor, EPI and Employer before the award of contract. This list shall be updated if required at suitable interval during detailed engineering.

c) All drawings (including those of sub-vendor’s) shall bear at the right hand bottom corner the ‘title plate’ with all relevant information duly filled in. Vendor shall furnish this format to his sub-vendor along with his purchase order for sub-vendor’s compliance.

d) Employer, EPI and Vendor shall follow their own numbering systems for the drawings. However, EPI shall intimate to the Vendor, NTPC drawing number on receipt of the first submission of each drawing. Vendor, thereafter, shall indicate NTPC’s drawing number in subsequent Submission, in the space provided for this purpose in title plate, in addition to his own drawing number.

e) Vendor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data/drawings at site which are needed as an input to the engineering. Vendor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer’s scope and submit all necessary drawings/documents for the same.

f) **Drawings must be checked by the Vendor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Vendor, the same shall not be reviewed and returned to the Vendor for re-submission.**

g) Vendor shall submit to EPI, adequate prints of drawing/data/document for Employer’s review and approval. The drawings submitted by the vendor shall be reviewed by EPI/NTPC and their comments shall be forwarded within four (4) weeks of receipt of drawings. Upon review of each drawing, depending on the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories:

CATEGORY- I  :  Approved

CATEGORY- II  :  Approved, subject to incorporation of comments/modification as noted. Resubmit revised drawing incorporating the comments.
CATEGORY – III : Not approved. Resubmit revised drawings for approval after incorporating comments/ modification as noted.

CATEGORY – IV : For information and records.

h) Vendor shall resubmit the drawings approved under Category II, III & IV within two (2) weeks or earlier of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision Number enclosed in a triangle (eg. 1, 2, 3 etc). Vendor shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the Vendor shall resubmit the drawing identifying the changes for EPI/Employer’s review and approval. **Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and EPI/Employer shall review only such revised portion of documents.**

i) In case, the Vendor does not agree with any specific comment, he shall furnish the explanation for the same to EPI/NTPC for consideration. In all such cases the Vendor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.

j) It is responsibility of the Vendor to get all the drawings approved in the Category I & IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.

k) If Vendor fails to resubmit the drawings as per the schedule, construction work at site will not be held up and work will be carried out on the basis of comments furnished on previous issues of the drawing.

l) These comments will be taken care by the Vendor while submitting the revised drawing.

m) Vendor shall use a single transmittal for drawings submission. This shall include transmittal numbers and date, number of copies being sent, names of the agencies to whom copies being sent, drawing number and titles, remarks or special notes if any etc.

7.06.04 Engineering Progress Reporting /Exception Report

Vendor shall prepare every calendar month, at his own cost progress reports describing the engineering activities in the reporting month, in a form and size acceptable to the Engineering coordinator. The progress report shall be in three sections.

In the first, all major engineering activities that took place during the reporting month shall be clearly described, indicating major delays the agency responsible and any corrective actions taken.

The second section shall show an exception report showing the list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of submission.

The third shall comprise drawings. Submission and approval status, listed separately (i.e.), for drawings submitted during the reporting month and drawings commented and approved during the reporting month.
Lastly the fourth section shall contain the ordering status of bought out items. The formats for ‘Drawing submission and approval Status’ and ‘Bought out’ items ordering status shall be furnished to the Vendor for his compliance, at the time of award of contract.

7.06.05 Technical Co-Ordination Meeting

a) Vendor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings(TCMs) with EPI/Employer/Employer’s representatives and other Vendors of EPI/ Employer during the period of contract. Vendor shall attend such meetings at his own cost at NEW DELHI / NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.

b) Vendor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, Vendor shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Vendor will be reviewed by EPI/ Employer as far as practicable within four (4) weeks from the date of receipt of the drawing. The comments of EPI/Employer shall then be discussed across the table during the above Technical Co-ordination Meeting(s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.

c) Vendor shall ensure availability of the concerned experts / consultants/ personnel/sub-vendor who are empowered to take necessary decisions during these meetings. Vendor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.

d) Should any drawing remain unapproved for more than six (6) weeks after its first submission, this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.

e) Any delays arising out of failure by the Vendor to incorporate Employer’s comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Vendor to alter the Contract completion date.

7.07.00 Design Improvements

The Employer/ EPI may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.

If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Vendor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

7.08.00 Equipment Bases

A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by EPI/ Employer. Each base plate which support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.
8.00.00 PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.

9.00.00 LUBRICANTS, SERVO FLUIDS AND CHEMICALS

9.01.00 Vendor’s scope includes all the first fill and one year’s topping, requirements of consumables such as oils, lubricants including grease, servo fluids, gases and essential chemicals etc. Consumption of all these consumables during the initial operation and final filling after the initial operation shall also be included in the scope of the Vendor. Vendor shall also supply a quantity not less than 10% of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc. used which is expected to be utilised during the first year of operation. This additional quantity shall be supplied in separate Containers.

9.02.00 As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible. Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Employer alongwith lubrication requirements.

9.03.00 Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.

10.00.00 MATERIAL OF CONSTRUCTION

All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilised for various components shall be those which have established themselves for use in such applications.

11.00.00 RATING PLATES, NAME PLATES & LABELS

a) Each main and auxiliary item of plant including instruments shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer’s name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.

b) Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by EPI/Employer or as detailed in appropriate section of the technical specifications.

c) Such nameplates or labels shall be of white nonhygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back. The name plates shall be suitably fixed on both front and rear sides.

d) Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.

e) Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall
also have stamped upon it the designed hot and cold load which it is intended to support. Suitable scale shall also be provided to indicate load on support/hanger.

f) Valves, steam traps and strainers shall be identified by Employer’s tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.

g) Safety and relief valves shall be provided with Manufacturer’s identification, Nominal inlet and outlet sizes in mm, Set pressure in Kg/cm2 (abs), Blow down and accumulation as percentage of set pressure and Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.

h) All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

i) All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system

12.00.00 TOOLS AND TACKLES

Vendor shall supply with the equipment one complete set of all special tools and tackles and other instruments required for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Vendor alongwith the offer.

The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. Vendor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period Vendor should bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to the Employer.

13.00.00 WELDING

If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be performed by others the requirements shall be submitted to EPI/ Employer in advance of commencement of erection work.

14.00.00 COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES

All equipment/ piping/ pipe services are to be painted by the Vendor in accordance with Employer’s standard colour coding scheme, which will be furnished to the Vendor during detailed engineering stage.

15.00.00 PROTECTION AND PRESERVATIVE SHOP COATING PROTECTION

15.01.00 All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or overground environment as the case may be.
15.02.00 Preservative Shop Coating

15.02.01 All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer unless otherwise mentioned in the technical specification.

15.02.02 Transformers and other electrical equipments if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date.

15.02.03 Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Vendor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.

15.02.04 All other steel surfaces which are not to be painted shall be coated with suitable rust preventive compound subject to the approval of the Employer.

15.02.05 All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled.

15.02.06 Painting for Civil structures shall be done as per relevant part of technical specification

16.00.00 QUALITY ASSURANCE PROGRAMME

16.01.00 Vendor shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Vendor’s works or at his sub-Vendor’s premises or at the Employer’s site or at any other place of work are in accordance with the specifications. Such programmes shall be outlined by the Vendor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with IS/ISO-9001. A quality assurance programme of the Vendor shall generally cover the following:

a) His organisation structure for the management and implementation of the proposed quality assurance programme

b) Quality System Manual

c) Design Control System

d) Documentation and Data Control System

e) Qualification data for Vendor’s key personnel.

f) The procedure for purchase of materials, parts, components and selection of sub-Vendor’s services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.

g) System for shop manufacturing and site erection controls including process, fabrication and assembly.

h) Control of non-conforming items and system for corrective actions and resolution of deviations.

i) Inspection and test procedure both for manufacture and field activities.
j) Control of calibration and testing of measuring testing equipment.

k) System for Quality Audits.

l) System for identification and appraisal of inspection status.

m) System for authorising release of manufactured product to the Employer.

n) System for handling, storage and delivery.

o) System for maintenance of records, and

p) Quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component.

16.02.00 General Conditions - Quality Assurance

16.02.01 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Vendor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the Vendor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Vendor and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award. Monthly progress reports on Manufacturing Quality Plan (MQP)/ Field Quality Plan (FQP) submission/approval shall be furnished on enclosed format No. QS-01-QAI-P-02/F1.

16.02.02 MQP will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Vendor’s/ Sub- Vendor’s/ sub-supplier’s Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. floppy or E-mail in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM.

16.02.03 FQPs will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Vendor’s “Site Quality Control Organisation”, during various stages of site activities starting from receipt of materials/equipment at site.

16.02.04 Vendor shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer’s approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer’s Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.

16.02.05 No material shall be despatched from the manufacturer’s works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Employer’s Project Manager/Authorised representative.
and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).

16.02.06 All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.

16.02.07 Vendor shall submit to the Employer Field Welding Schedule for field welding activities in the enclosed format No.: QS-01-QAI-P-02/F3. The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.

16.02.08 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer.

16.02.09 All welding/brazing procedures shall be submitted to the Employer or its authorized representative for approval prior to carrying out the welding/brazing.

16.02.10 All brazers, welders and welding operators employed on any part of the contract either in Vendor’s/sub- Vendor’s works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.

16.02.11 Welding procedure qualification & Welder qualification test results shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.

16.02.12 For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.

16.02.13 Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.

16.02.14 No welding shall be carried out on cast iron components for repair.

16.02.15 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

16.02.16 All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of correlation of the test report with the job.

All plates of thickness above 40mm & all bar stock/Forging above 40mm dia shall be ultrasonically tested. For pressure parts, plate of thickness equal to or above 25mm shall be ultrasonically tested.

16.02.17 Vendor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub- Vendor (BOI). All the sub Vendor proposed by the Vendor for procurement of major bought out items including castings, forging, semi-finished and finished components/ equipment etc., list of which shall be drawn up by the Vendor and finalised with the Employer, shall be subject to Employer's approval.
The Vendor’s proposal shall include vendor’s facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-Vendor enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in “DR” category prior to any procurement. Monthly progress reports on sub-Vendor detail submission / approval shall be furnished on enclosed on format no. QS-01-QAI-P-02/F2. Such vendor approval shall not relieve the Vendor from any obligation, duty or responsibility under the contract.

16.02.18 For components/equipment procured by the Vendor for the purpose of the contract, after obtaining the written approval of the Employer, the Vendor’s purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-Vendor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor’s quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Vendor and sub-Vendor. With in three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Vendor along with a report of the Purchase Order placed so far for the contract.

16.02.19 Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Vendor’s or their sub-Vendor’s quality management and control activities. Vendor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.

16.02.20 Vendor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-Vendor’s and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Vendor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.

16.02.21 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Vendor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.

16.02.22 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

16.02.23 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/authorised representative.

16.02.24 Burn in and Elevated Temperature Test Requirement for Electronics Solid State Equipment All solid state electronic systems/equipment shall be tested as a complete system/equipment with all devices connected for a minimum of 168 hours (7 Days) continuously under energized conditions prior to shipment from manufacturing works, as per the following cycle.

  a) Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours of the total 168 hours of testing, the ambient temperature shall be maintained at 50 deg.C. The equipment
shall be interconnected with devices which will cause it to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components/modules shall be monitored. The temperature rise inside the cubicle should not exceed 10 deg.C above the ambient temp. at 50 deg.C.

b) Burn in Test Cycle

The 48 hours elevated temperature test shall be followed by 120 hours of burn in test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems, the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

In case Vendor /sub-Vendor is having any alternate established procedure of eliminating infant mortile components, the detail procedures followed by the Vendor/sub- Vendor along with the statistical figures to validate the alternate procedure to be forwarded.

Vendor/Sub- Vendor shall carry out routine test on 100% item at Vendor /sub-Vendor’s works. The quantum of check/test for routine & acceptance test by employer shall be generally as per criteria/sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check/test for routine / acceptance test shall be as agreed during detailed engineering stage.

16.03.00 QA DOCUMENTATION PACKAGE

16.03.01 Vendor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (#) mark.

16.03.02 Each QA Documentation shall have a project specific Cover Sheet bearing name &identification number of equipment and including an index of its contents with page control on each document.

The QA Documentation file shall be progressively completed by the Supplier’s subsupplier to allow regular reviews by all parties during the manufacturing.

The final quality document will be compiled and issued at the final assembly place of equipment before dispatch. However CD-Rom may be issued not later than three weeks.

16.03.03 Typical contents of QA Documentation is as below:-

a) Quality Plan

b) Material mill test reports on components as specified by the specification and approved Quality Plans.

c) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.

d) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

e) Heat Treatment Certificate/Record (Time- temperature Chart).
f) All the accepted Non-conformance Reports (Major/Minor)/ deviation, including complete technical details/repair procedure.

g) CHP / Inspection reports duly signed by the Inspector of the Employer and Vendor for the agreed Customer Hold Points.

h) Certificate of Conformance (COC) wherever applicable.

i) MDCC

16.03.04 Similarly, Vendor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

16.03.05 Before Dispatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.

If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.

If a decision is made Dispatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time. The supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the Dispatch of equipment.

16.03.06 Transmission of QA Documentation

On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer.

For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment.

16.04.00 Project Manager’s Supervision

16.04.01 To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of ‘Arbitration’ clause in Section GCC of Vol.I, Vendor shall proceed to comply with the Project Manager's decision.

16.04.02 The work shall be performed under the supervision of the Project Manager. The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:

a) Interpretation of all the terms and conditions of these documents and specifications:

b) Review and interpretation of all Vendor’s drawing, engineering data, etc:
c) Witness or his authorised representative to witness tests and trials either at the manufacturer’s works or at site, or at any place where work is performed under the contract:
d) Inspect, accept or reject any equipment, material and work under the contract:
e) Issue certificate of acceptance and/or progressive payment and final payment certificates
f) Review and suggest modifications and improvement in completion schedules from time to time, and
g) Supervise Quality Assurance Programme implementation at all stages of the works.

16.05.00 Inspection, Testing And Inspection Certificates

16.05.01 The word ‘Inspector’ shall mean the Project Manager and/or his authorized representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.

16.05.02 The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Vendor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Vendor’s own premises or works.

16.05.03 Vendor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Vendor’s account except for the expenses of the Inspector’s. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which Vendor may proceed with test which shall be deemed to have been made in the inspector’s presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.

16.05.04 The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Vendor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. Vendor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.

16.05.05 When the factory tests have been completed at the Vendor’s or sub-Vendor’s works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Vendor’s test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Vendor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.

16.05.06 In all cases where the contract provides for tests whether at the premises or works of the Vendor or any sub-Vendor, the Vendor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the
equipment in accordance with the Vendor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.

16.05.07 The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Vendor in respect of the agreed Quality Assurance Programme forming a part of the contract.

16.05.08 To facilitate advance planning of inspection in addition to giving inspection notice as specified above the Vendor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

16.05.09 All inspection, measuring and test equipment used by Vendor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. Vendor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, Vendor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.

16.06.00 Associated Document For Quality Assurance Programme:

a) List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0 (Annexure-II).
b) Status of items requiring Quality Plan and sub supplier approval. Format No.: QS-01-QAI-P-02/F1-R0 (Annexure-III).
c) Field Welding Schedule Format No.: QS-01-QAI-P-02/F2-R0 (Annexure-IV).
d) Manufacturing Quality Plan Format No.: QS-01-QAI-P-09/F1-R0 (Annexure-V).
e) Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R0 (Annexure-VI).

17.00.00 PRE-COMMISSIONING AND COMMISSIONING FACILITIES

a) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Employer and the Vendor for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Vendor’s quality assurance programme as well as those included elsewhere in the Technical Specifications.

b) Vendor’s pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipments shall be operated integral with sub-systems and supporting equipment as a complete plant.

c) All piping system shall be flushed, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be submitted for approval to the Employer six months prior to the respective implementations. The Employer will approve final verification of cleanliness.

d) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.
e) The check outs during the pre-commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Employer's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed commissioning documentation [SLs (Standard Check List) / TS (Testing Schedule) / CS (Commissioning Schedule)] approved by the Employer.

f) Vendor during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.

g) Vendor shall furnish the commissioning organization chart for review & acceptance of employer at least eighteen months prior to the schedule date of synchronization of 1st unit. The chart should contain:
   i) Biodata including experience of the Commissioning Engineers.
   ii) Role and responsibilities of the Commissioning Organisation members.
   iii) Expected duration of posting of the above Commissioning Engineers at site.

18.00.00 Initial Operation

(a) On completion of all pre-commissioning activities / tests and as a part of commissioning the complete facilities shall be put on Initial Operation during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests.

(b) The duration of Initial Operation of the complete equipment shall be fourteen (14) days out of which at least seventy two (72) hours shall be continuous operation on full load or any other duration as may be agreed to between the Engineer and the Vendor.

(c) The Initial Operation shall be considered successful provided that each item of the equipment can operate continuously at the specified operating characteristics, for the period of Initial Operation. For the period of Initial Operation, the time of operation with any load shall be counted. Minor interruptions not exceeding four (4) hours at a time caused during the continuous operation shall not affect the total duration of trial Operation. However if in the opinion of the Engineer the interruption is long, the initial operation shall be prolonged for the period of interruption.

(d) A Initial Operation report comprising observations and recordings of various parameters to be measured in respect of the above initial operation shall be prepared by the Vendor. This report, besides recording the details of the various observations during initial run shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repair done during the Initial Operation. Based on the observations, necessary modifications/ repair to the plant shall be carried out by the Vendor to the full satisfaction of the Engineer to enable to the latter to accord permission to carry out Performance and Guarantee Tests on the Plant. However, minor defects, which do not endanger the safe operation of the equipment, shall not be considered as reasons for with holding the aforesaid permission.

19.00.00 GUARANTEE TESTS

(a) The final tests as to the guarantees shall be conducted at Site, by the Vendor. Vendor's Commissioning and start-up Engineers shall make the unit ready for such tests. Such test will be commenced, within a period of three (3) months after the
successful completion of Trial Operation. Any extension of time beyond the above three months shall be subject to Employer's approval.

(b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the performance guarantee.

(c) The Project Manager will apply proper corrections in calculations as elaborated in Appendix-8, Section-VII of the specification to take into account conditions which do not correspond to the specified cycle.

(d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Vendor, free of cost.

(e) The guarantee figures and design/performance parameters of the equipment shall be proved by Vendor during these Guarantee Tests/ and or during the ‘Trial operation’ as detailed out elsewhere. Should the results of these tests show any deterioration from the guaranteed values, the Vendor shall modify the equipment as required to enable it to meet the guarantees. In such case, the Guarantee Tests shall be repeated and all cost for modifications including labour, materials and the cost of additional testing to prove that the equipment meets the guarantees, shall be borne by the Vendor.

(f) The specific tests to be conducted on equipment have been brought out in Appendix-8 (enclosed in Volume-I of the specifications) read in conjunction with the technical specification.

20.00.00 TAKING OVER

Upon successful completion of Initial Operations and all the tests conducted to the Employer's satisfaction, the Employer shall issue to the Vendor a Taking over Certificate as a proof of the final acceptance of the equipment.

Such certificate shall not unreasonably be withheld nor will the Employer delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Vendor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.

21.00.00 TRAINING OF EMPLOYER'S PERSONNEL

21.01.00 The scope of service under training of Employer’s engineers (min. 3 nos.) shall include a training module in the areas of Operation & Maintenance.

Such training should cover the following areas as a minimum in order to enable these personnel to individually take the responsibility of operating and maintaining the power station in a manner acceptable to the Employer:

21.02.00 The scope of services under training shall also necessarily include training of Employer's Engineering personnel covering a training module of upto 15 man days. This shall cover all disciplines viz, Mechanical, Electrical, C&I, & QA etc. and shall include all the related areas like Design familiarization, training on product design features and product design softwares of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits, exposure to various kinds of problems which may be encountered in fabrication, manufacturing, erection, welding etc.

21.03.00 Vendor shall furnish in his offer, details of training module(s) covering above requirements which shall be subject to Employer's approval. Consolidated training period included above is indicative only.
21.04.00 Exact details, extent of training and the training schedule shall be finalised based on the Vendor proposal within two (2) months from placement of award.

21.05.00 Wherever the training of Employer's personnel is arranged at the works of the manufacturer's it shall be noted that the lodging and boarding of the Employer's personnel shall be borne by the Employer.

22.00.00 SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION

In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover:

a) Working platforms should be fenced and shall have means of access.

b) Ladders in accordance with Employer’s safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.

23.00.00 NOISE LEVEL

The equivalent 'A' weighted sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) metre horizontally from the nearest surface of any equipment / machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA.

24.00.00 PACKAGING AND TRANSPORTATION

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. Vendor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Vendor shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting despatch of equipment. Before despatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shops before despatch of materials for transportation.

25.00.00 ELECTRICAL ENCLOSURE

All electrical equipments and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specification.

26.00.00 INSTRUMENTATION AND CONTROL

26.01.00 All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.

26.02.00 All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale. All scales and charts shall be calibrated and printed in Metric Units as follows:

a) Temperature - Degree centigrade (deg C)

b) Pressure - Kilograms per square centimetre (Kg/cm2). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.

c) Draught - Millimetres of water column (mm wc).
d) Vacuum - Millimeters of mercury column (mm Hg) or water column (mm Wcl).
e) Flow (Gas) - Tonnes/ hour
f) Flow (Steam) - Tonnes/ hour
g) Flow (Liquid) - Tonnes / hour
h) Flow base - 760 mm Hg, 15 deg.C
i) Density - Grams per cubic centimetre.

26.03.00 All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plug-in connection at rear.

26.04.00 All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalised & components shall be of industrial grade or better.

27.00.00 ELECTRICAL NOISE CONTROL

The equipment furnished by the Vendor shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Vendor's equipment which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-801-2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems.

28.00.00 INSTRUMENT AIR SYSTEM

The instrument air supply system as supplied by the Vendor for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc. shall be as per the details furnished elsewhere. Each pneumatic instrument shall have an individual air shut - off valve. The pressure regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built-in filter housing blow down valve.

29.00.00 TAPPING POINTS FOR MEASUREMENTS

Tapping points shall include probes, wherever applicable, for analytical measurements and sampling.

For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. Vendor will be intimated about thread standard to be adopted.

The following shall be provided on equipment by Vendor. The standard which is to be adopted, will be intimated to the Vendor.

a) Temperature test pockets with stub and thermowell
b) Pressure test pockets

30.00.00 ELECTRONIC MODULE/COMPONENT DETAILS

Vendor shall have to furnish all technical details including circuit diagrams, specifications of components, etc., in respect of each and every electronic card/module as employed on the various solid state as well as microprocessor based systems and equipment including conventional instruments, peripherals etc. It is mandatory for the Vendor to identify clearly the custom built ICs used in the package. The Vendor shall also furnish the details of any equivalents of the same.
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description of Documents</th>
<th>No of Prints (Sets)</th>
<th>NO. OF CD-ROMs/ Floppy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Drawings for Initial Submission (Either &quot;FOR APPROVAL&quot; or &quot;FOR INFORMATION Category) and re-submissions after review by NTPC (including Data sheets/ Calculations, all Equipment/instrument schedule, BOM etc)</td>
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<td>1 Soft Copy (through 2 sets of Floppy or 1 no of CD-Rom or through E-Mail)</td>
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<td>2</td>
<td>Final Approved Drawings (Cat-I &amp; Cat- IV Approved) (As referred in Sl no: 1 above)</td>
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<td>3</td>
<td>Documents / Drawings &quot;AS BUILT &quot;</td>
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<td>4 CD-Roms</td>
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<td>6</td>
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<td>Progress Reports</td>
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<td>QA programme including Organisation for implementation and QA system manual (with revision-servicing)</td>
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<td>19</td>
<td>Vendor details in respect of proposed vendors including vendor’s evaluation report.</td>
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<td>1 CD –ROM</td>
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<tr>
<td>20</td>
<td>Manufacturing QPs, Field QPs, Field welding schedules and their reference documents like test procedures, WPS, POR etc</td>
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<td>21</td>
<td>i) For review/comment</td>
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<td>(ii) For final approval 1 set floppies</td>
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<td>2 CD ROMS</td>
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<td>QA Documentation Package for items / equipment manufactured and dispatched to site</td>
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<tr>
<td>24</td>
<td>QA Documentation Package for field activities on equipment / systems at site</td>
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Note: 2 copies of drawings / document and 1 copy of CD shall be considered in addition to above for EPI.
## LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL

<table>
<thead>
<tr>
<th>S. N.</th>
<th>Item</th>
<th>QP/ Insp. Cat.</th>
<th>QP No.</th>
<th>QP Sub. Schedule</th>
<th>QP approval schedule</th>
<th>Proposed sub-supplier</th>
<th>Place</th>
<th>Sub-suppliers approval status/category</th>
<th>Sub-supplier Details submission schedule</th>
<th>Remark</th>
</tr>
</thead>
</table>

### LEGENDS

**SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY NTPC)**

- **A** – For these items proposed vendor is acceptable to NTPC. To be indicated with letter “A” in the list along with the condition of approval, if any.
- **DR** – For these items “Detailed required” for NTPC review. To be identified with letter “DR” in the list.
- **NOTED** – For these items vendors are approved by Main Supplier and accepted by NTPC without specific vendor approval from NTPC. To be identified with “NOTED.”

**QP/INSPN CATEGORY:**

- **CAT-I** : For these items Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC.
- **CAT-II** : For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved QP.
- **CAT-III** : For these items Main Supplier approves the Quality Plans. The final acceptance by NTPC shall be on the basis certificate of conformance by the main supplier.

**UNITS/WORKS** : Place of manufacturing Place of Main Supplier of multi units/works.

### FORMAT NO.: QS-01-QAI-P-1/F3-R0

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Engg. Div. / QA&I
### Status of Item Requiring QP & Sub-Supplier Approval

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<th>QP/ Cat.</th>
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<th>Date of commit Appl.</th>
<th>Status Code</th>
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**Format No.: QS-01-QAI-P-02/F1-R0**

1/1

**Engg. Div. / QA&I**
### FIELD WELDING SCHEDULE
(To be raised by the contractor)

**Welding Code:**

|---------|-------------------------------------------------|--------------------------------|------------|------------|-------------------|--------------|----------------------|----------|-----------------|---------------------------|----------------|-------------|--------------|--------|

**NOTES:**

**SIGNATURE**

FORMAT NO.: QS-01-QAI-P-02/F2-R0

1/1

Engg. Div. / QA&I
## MANUFACTURING QUALITY PLAN

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<th>ITEM</th>
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<th>REV. NO.</th>
<th>DATE</th>
<th>PAGE: .... OF....</th>
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<tr>
<td>SUB-SYSTEM:</td>
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### MANUFACTURER'S NAME AND ADDRESS

- **MFGR.'s LOGO**
- **MANUFACTURER'S NAME AND ADDRESS**

### PROJECT

- **PROJECT:**
- **PACKAGE:**
- **CONTRACT NO.:**
- **MAIN-SUPPLIER:**

### PACKAGE

- **PACKAGE:**

### CONTRACT NO.

- **CONTRACT NO.:**

### MAIN-SUPPLIER

- **MAIN-SUPPLIER:**

### MANUFACTURER/ SUB-SUPPLIER

- **MANUFACTURER/ SUB-SUPPLIER:**
- **MAIN-SUPPLIER**

### SIGNATURE

- **SIGNATURE**

### LEGEND

- **RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.**
- **M: MANUFACTURER/SUB-SUPPLIER**
- **C: SUPPLIER/NOMINATED INSPECTION AGENCY, N: NTPC**
- **P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE, CHP: NTPC SHALL IDENTIFIED IN COLUMN “N”**

### ACCEPTANCE NORMS

- **ACCEPTANCE NORMS**
- **FORMAT OF RECORD**
- **AGENCY**
- **REMARKS**

### COMPONENT & OPERATIONS

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<tr>
<th>SL. NO</th>
<th>COMPONENT &amp; OPERATIONS</th>
<th>CHARACTERISTICS</th>
<th>CLASS</th>
<th>TYPE OF CHECK</th>
<th>QUANTUM OF CHECK</th>
<th>REFERENCE DOCUMENT</th>
<th>ACCEPTANCE NORMS</th>
<th>FORMAT OF RECORD</th>
<th>AGENCY</th>
<th>REMARKS</th>
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### DOCUMENT NUMBER

- **DOC. NO.:**
- **REV...... CAT.....**

### APPROVAL

- **APPROVED BY**
- **APPROVAL SEAL**
### Annexure-VI of GTR

**FIELD QUALITY PLAN**

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<th>CHARACTERISTICS / INSTRUMENTS</th>
<th>CLASS# OF CHECK</th>
<th>TYPE OF CHECK</th>
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<th>REFERENCE DOCUMENT</th>
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**LEGEND:** *

Records, indentified with “tick” (√) shall be essentially included by supplier in QA documentation.

**LEGEND TO BE USED:** CLASS # : A = CRITICAL, B=MAJOR, C=MINOR; ‘A’ shall be witnessed by NTPC FQA, ‘B’ shall be witnessed by NTPC erection / construction deptt. and ‘C’ shall be witnessed by erection supplier (A & B check shall be NTPC CHP stage)

**FOR NTPC USE**

**REVIEWED BY**

**APPROVED BY**

**APPROVAL SEAL**

Format No.: QS-01-QAI-P-09/F2-R0

1/1

Engg. Div./QA&I

---

**PAKRI BARWA DiH COAL MING PROJECT**

**COAL HANDLING PLANT**

**TECHNICAL SPECIFICATIONS**

Annexure of GTR

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TECHNICAL SPECIFICATIONS

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<th>Description</th>
<th>Page Nos</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Cover page</td>
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</tr>
<tr>
<td>2</td>
<td>Documents/information to be furnished alongwith offer</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Project Synopsis</td>
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<td>4</td>
<td>Scope of Supply</td>
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<td>5</td>
<td>Technical specification LT Power Cables</td>
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<td>6</td>
<td>Technical specification LT Control Cables</td>
<td>11</td>
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<tr>
<td>7</td>
<td>Data sheet (To be filled up by manufacturer)</td>
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Enquiry Technical Specifications
For
LT POWER & CONTROL CABLES

Package No.  ENGG/PA/344/E/3

Total no. of pages – 14
1. Clear Scope of supply.

2. Exclusions, if any.

3. Type and quantity of oil, lubricants & consumables for initial fill till successful commissioning of equipment.

4. List of Commissioning spares and start-up spares with unit rates (cost to be included in equipment supply price).

5. List with price of special tools and tackles, if any required (cost to be included in equipment supply price).

6. Price Schedule for equipment & mandatory spares as per Format enclosed.

7. List of Recommended spares for 3 years trouble free operation and maintenance alongwith unit rates as per format enclosed in price schedule.

8. Technical Data sheets duly filled by the vendor (blank data sheets enclosed).

9. Weight of the equipment in Kgs.

10. Catalogues/ Leaflets and O&M Manuals.


12. Reference list of your Customers for the similar supply of items.

PROJECT SYNOPSIS

1.00.00 BACKGROUND
1.01.00 Pakri Barwadih Block is located in North Karanpura Coalfields in Hazaribagh district of Jharkhand state, India. The block has been allotted to NTPC Limited by Ministry of Coal, Government of India.

2.00.00 Location and Approach
2.01.01 The Pakri-Barwadih block is located in the north eastern part of North Karanpura Coal Field. It is bounded by longitudes 85°10’ to 85° 15’E and latitude 23°51’30” to 23°55’30” North and is covered by the Survey of India Topo-sheet no. 73E/1 (R.F 1: 50000) and special sheets no. 21, 23 & 24 (R.F. 1:10000).

2.01.02 The entire block falls in the Hazaribagh district of Jharkhand State. The nearest township is Hazaribagh located at a distance of around 25 kms from Barkagaon in the southern part of the block. Ranchi, which is the state capital of Jharkhand, is around 120-130 kms from the block.

2.01.03 The Hazaribagh – Khelari – Ranchi State highway passes through the eastern part of the block touching Barkagaon and Tandwa Villages. This locality is connected from Hazaribagh by an all weather 24 Km metalled road which has been extended along the northern & western part of the coalfield touching Kerendari and Tandwa. This can serve as a useful road link from Pakri-Barwadih to Tandwa where a proposed Super Thermal Power Station of NTPC is also considered to be located.

2.01.04 The nearest rail stations are Ranchi Road and Chitarpur on the Gomoh Barkakana – Dehri-on-Sone loop lines of South East Railway both around 70-75 kms from the block.

2.01.05 The coalfield is likely to be connected by a new railway network under initial phases of execution as described in clause no. 3.01.07 of this chapter.

2.01.06 Further to the information given in this sub-section, Vendors are also advised visit the project site and collect data on local site conditions.

2.01.07 Information on existing/ planned Indian Railway line in the area:
The existing nearest Railway line to the Pakri – Barwadih coal block is the Barkakana loop popularly known as the CIC loop running between Gomoh – Barkakana – Garhwa Road. Pakri Barwadih Mine block is situated to the North of this railway line. The Railway’s Grand Chord i.e. Gomoh-Koderma-Gaya-Dehri-on-Sone line lies on the North of the said mine. Two new railway links are also under construction around the Pakri-Barwadih and Amrapali Coal Block in North Karanpura area. One rail link is from existing Koderma station on the Grand Chord. It would connect Barkakana station on the CIC section in the South and will extend up to Ranchi. In between Koderma and Barkakana a
new junction station viz Hazaribagh would be created. This new rail link from Koderma will also connect Rajgir and Tilaya station in the North. The entire link is the project of East Central Railway. The other rail link will take off from the new Hazaribagh Jn and would connect Tori station on CIC line in the South. This second rail link is being constructed at the cost of Central Coalfield Limited (CCL) to facilitate coal loading from North Karanpura mine area. Shivpur will be an important station over this link to provide rail access to mining area. The Pakri- Barwadih mine block lies in between the above two Rail links i.e. from Hazaribagh to Shivpur and Hazaribagh to Barkakana. The nearest station under construction over the two sections is Banadag station about 7.5 km from Hazaribagh station on Hazaribagh-Shivpur line – proposed formation level at Banadag is about 627 M above MSL. Banadag station is being planned as a 3 lines station over Hazaribagh – Shivpur single line section (about 7 km from Hazaribagh).

2.01.08 Location of Mine Block
Location of Pakri Barwadih Mine Block
a) Longitude : 85\degree 09' to 85\degree 15' E
b) Latitude : 23\degree 51' to 23\degree 55' 30'' N

2.01.09 Meteorological Data: The Pakri Barwadih block being a virgin block has no rain gauging station, The nearest station is at Barkagaon block office, situated in Barkagaon village in the south eastern corner of eastern sector, where daily rain fall is recorded. The rainfall data for the period from 1979-2004 were collected and enclosed at Annex. I.

2.01.10 Water Source: There is no perennial source of water in the area. Thus ground water needs to be tapped for industrial and domestic use.

2.01.11 Criteria for Wind Resistant Design of Structures and Equipment All structures and equipment of the coal handling plant including all plant auxiliary structures and equipment, shall be designed for wind forces as given in Civil Specifications.

2.01.12 Criteria for Earthquake Resistant Design of Structures and Equipment All coal handling plant structures and equipment, including auxiliary structures and equipment shall be designed for relevant seismic forces.
1.0 The scope of the work includes Design, engineering, manufacture, shop fabrication assembly, testing and inspection at manufacturer’s works, packing, despatch, transportation, transit insurance, delivery to site as per specifications and scope defined in tender documents complete with all accessories and electricals, which are not mentioned specifically but are required for the efficient and trouble free operation of the equipment/system.

Following items are also included in vendor’s scope.

1.1 Complete equipment as per the details given in the specifications.
1.2 Consumables etc. for the initial operation of the equipment till handing over.
1.3 Commissioning spares and start-up spare parts.
1.4 Special tools & tackles, if any required.
1.5 Mandatory spares as per the list enclosed in Price schedule.
1.6 Recommended spare parts for 3 years trouble free operation and maintenance.
1.7 All drawings / documents along with operation and maintenance manuals as per requirement mentioned elsewhere in the tender document.
1.8 Approval of design/drawings and any other design calculation related to the equipment from EPI / NTPC.
1.00.00 CODES & STANDARDS

1.01.00 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 of opening of bid. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

- IS :1554 - I PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.
- IS : 3961 Recommended current ratings for cables
- IS : 3975 Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.
- IS : 5831 PVC insulation and sheath of electrical cables.
- IS:7098 (Part -I) Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.
- IS : 8130 Conductors for insulated electrical cables and flexible cords.
- IS : 10418 Specification for drums for electric cables.
- IS : 10810 Methods of tests for cables.
- ASTM-D -2843 Standard test method for density of smoke from the burning or decomposition of plastics.
- IEC-754(Part-I) Tests on gases evolved during combustion of electric cables.
- IEC-332 Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).

2.00.00 TECHNICAL REQUIREMENTS

2.01.00 The cables shall be suitable for laying on racks, in ducts, trenches, conduits or under ground buried installation with chances of flooding by water.

2.02.00 Cables shall be armoured, flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.

2.03.00 Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be stranded.

2.04.00 XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg C. PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.

2.05.00 The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS : 5831.

2.06.00 For single core armoured cables, armouring shall be of aluminium wires/ formed wires. For multicore armoured cables, armouring shall be of galvanised steel as follows:

- Calculated nominal dia. of cable under armour
- Size and Type of armour
- Upto 13 mm 1.4mm dia GS wire
- Above 13 & upto 25mm 0.8 mm thick GS formed wire / 1.6 mm dia GS wire
- Above 25 & upto 40 mm 0.8mm thick GS formed wire / 2.0mm dia GS wire
- Above 40 & upto 55mm 1.4 mm thick GS formed wire /2.5mm dia GS wire
- Above 55 & upto 70 mm 1.4mm thick GS formed wire / 3.15mm dia GS wire
- Above 70mm 1.4 mm thick GS formed wire / 4.0 mm dia GS wire
2.06.01 The aluminium used for armouring shall be of H4 grade as per IS: 8130 with maximum resistivity of 0.028264 ohm mm2 per meter at 20 deg C. The sizes of aluminium armouring shall be same as indicated above for galvanized steel.

2.06.02 The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of G.S. wire/ formed wire.

2.07.00 Outer sheath shall be of PVC as per IS: 5831 & black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties.

(a.) Oxygen index of min. 29 (as per IS 10810 Part-58).
(b.) Acid gas emission of max. 20% (as per IEC-754-I).
(c.) Smoke density rating shall not be more than 60 % (as per ASTMD-2843).

2.08.00 Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted:
1 core - Red, Black, Yellow or Blue
2 core - Red & Black
3 core - Red, Yellow & Blue
4 core - Red, Yellow, Blue and Black

2.09.00 For reduced neutral conductors, the core shall be black.

2.10.00 In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath.

(a.) Cable size and voltage grade - To be embossed
(b.) Word 'FRLS' at every 5 metre - To be embossed
(c.) Sequential marking of length of the cable in metres at every one metre –To be embossed / printed The embossing shall be progressive, automatic, in line and marking shall be legible and indelible.

2.11.00 All cables shall meet the fire resistance requirement as per Category-B of IEC 332 Part-3.

2.12.00 Allowable tolerances on the overall diameter of the cables shall be ±-2 mm maximum, over the declared value in the technical data sheets.

2.13.00 In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.

2.14.01 Cables shall be sized based on the following considerations:
(a) Rated current of the equipment
(b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage
(c) Short circuit withstand capability This will depend on the feeder type. For a fuse protected
circuit, cable should be sized to withstand the letout energy of the fuse. For breaker controlled
feeder, cable shall be capable of withstanding the system fault current level for total breaker
tripping time inclusive of relay pickup time.

2.14.02 Derating Factors
Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes:

a) Variation in ambient temperature for cables laid in air
b) Grouping of cables
c) Variation in ground temperature and soil resistivity for buried cables.

2.14.03 Cable lengths shall be considered in such a way that straight through cable joints are avoided.

2.14.04 All LT power cables of sizes more than 120 sq.mm. shall be XLPE insulated and preferable sizes are 1Cx150, 1Cx300, 1Cx630, 3Cx150 & 3Cx240 sq.mm.

3.00.00 CONSTRUCTIONAL FEATURES

(a.) 1.1 KV grade XLPE power cables shall have compacted aluminium conductor, XLPE insulated, PVC inner sheathed armoured, FRLS PVC outer sheathed conforming to IS:7098. (Part-I).
(b.)  **1.1KV grade PVC power cables** shall have aluminium conductor (compacted type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed, armoured, FRLS PVC outer sheathed conforming to IS:1554 (Part-I).

(c.)  **1.1 KV grade Trailing cables** shall have tinned copper(class 5)conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber(EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968.

### 4.00.00 CABLE DRUMS

(a)  Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.

(b)  Each drum shall carry manufacturer's name, purchaser’s name, address and contract number, item number and type, size and length of cable and net gross weight stencilled on both sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

(c)  The standard drum length for power cables shall not be less than 500 meters. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. The Employer shall have the option of rejecting cable drum with shorter lengths. For each size, the variance of total quantity, adding all the supplied drum lengths, from the ordered quantity, shall not exceed +/- 2%.

### 5.00.00 TESTS

(a)  All equipments to be supplied shall be of type tested quality. The Contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

(b)  In case the Contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract, free of cost to the Owner and submit the reports for approval.

(c)  All acceptance and routine tests as specified below and in relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

5.01.00  Type Tests

5.01.01 The reports for the following type tests shall be submitted for one size each of LT XLPE/PVC Power cables:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Type test Remarks</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Resistance test</td>
<td>For Conductor</td>
</tr>
<tr>
<td>2.</td>
<td>Measurement of Dimensions</td>
<td>For Armour Wires/ Formed Wires</td>
</tr>
<tr>
<td>3.</td>
<td>Tensile Test</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Elongation test</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Torsion test For round wires only</td>
<td></td>
</tr>
</tbody>
</table>
5. Wrapping test For aluminium wires / formed wires only.
7. Resistance test
8(a) Mass of zinc coating test For GS Formed wires/wires only
8(b) Uniformity of zinc coating For GS Formed wires/wires only
9. Adhesion test For GS Formed wires/wires only
   For PVC/XLPE insulation & PVC Sheath
10. Test for thickness
11. Tensile strength & elongation tests before ageing and after ageing
12. Ageing in air oven
13. Loss of mass test For PVC insulation and sheath only
14. Hot deformation test For PVC insulation and sheath only
15. Heat shock test For PVC insulation and sheath only
16. Shrinkage test
17. Thermal stability test For PVC insulation and sheath only
18. Hot set test For XLPE insulation only
19. Water absorption test For XLPE insulation only
20. Oxygen index test For outer sheath only
21. Smoke density test For outer sheath only
22. Acid gas generation test For outer sheath only

For completed cables
23. Insulation resistance test
   (Volume resistivity method)
24. High voltage test
25. Flammability test as per IEC-332 Part-3 (Category-B)

5.02.00 Indicative list of tests/checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of LT power cables.
CONTROL CABLES

1.00.00  CODES & STANDARDS
1.01.00  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 of opening of bid. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS :1554 - 1 PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.
IS : 3961 Recommended current ratings for cables
IS : 3975 Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.
IS : 5831 PVC insulation and sheath of electrical cables.
IS : 8130 Conductors for insulated electrical cables and flexible cords.
IS : 10418 Specification for drums for electric cables.
IS : 10810 Methods of tests for cables.
ASTM-D –2843 Standard test method for density of smoke from the burning or decomposition of plastics.
IEC-754 (Part-I) Tests on gases evolved during combustion of electric cables.
IEC-332 Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).

2.00.00  TECHNICAL REQUIREMENTS
2.01.00  The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.
2.02.00  Cables shall be Armoured, flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.
2.03.00  Conductor of control cables shall be made of stranded, plain annealed copper.
2.04.00  PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg C.
2.05.00  The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS: 5831.
2.06.00  For multicore armour ed cables, the armouring shall be of galvanised steel as follows:
Calculated nominal dia of cable under armour Size and Type of armour Upto 13 mm 1.4mm dia GS wire Above 13 upto 25 mm 0.8 mm thick GS formed wire / 1.6 mm dia GS wire Above 25 upto 40 mm 0.8mm thick GS formed wire / 2.0mm dia GS wire Above 40 upto 55mm 1.4 mm thick GS formed wire/2.5mm dia GS wire Above 55 upto 70 mm 1.4mm thick GS formed wire / 3.15mm dia GS wire Above 70mm 1.4 mm thick GS formed wire / 4.0 mm dia GS wire The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface.
2.07.00  Outer sheath shall be of PVC as per IS: 5831 and grey in colour. In addition to meeting all the requirements of Indian Standards referred to, outer sheath of all the cables shall have the following FRLS properties.
(a.) Oxygen index of min. 29. (As per IS 10810 Part-58)
(b.) Acid gas emission of max. 20% (As per IEC-754-I)
(c.) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTM-D-2843.
2.08.00  Cores of the cables of upto 5 cores shall be identified by colouring of insulation. Following colour scheme shall be adopted.
1 core - Red, Black, Yellow or Blue
2 core - Red & Black
3 core - Red, Yellow & Blue
4 core - Red, Yellow, Blue and Black
5 core - Red, Yellow, Blue, Black and Grey

2.09.00 For cables having more than 5 cores, core identification shall be done by numbering the insulation of cores sequentially, starting by number 1 in the inner layer (e.g. say for 10 core cable, core numbering shall be from 1 to 10). The number shall be printed in Hindu-Arabic numerals on the outer surfaces of the cores. All the numbers shall be of the same colour, which shall contrast with the colour of insulation. The colour of insulation for all the cores shall be grey only. The numerals shall be legible and indelible. The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. When the number is a single numeral, a dash shall be placed underneath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing between consecutive numbers shall not exceed 50 mm.

2.10.00 In addition to manufacturer’s identification on cables as per IS, following marking shall also be provided over outer sheath:
(a.) Cable size and voltage grade - To be embossed
(b.) Word 'FRLS' at every 5 metre - To be embossed
(c.) Sequential marking of length of the cable in metres at every one metre - To be embossed / printed.
   The embossing / printing shall be progressive, automatic, in line and marking shall be legible and indelible.

2.11.00 All cables shall meet the fire resistance requirement as per Category-B of IEC-332 Part-3.
2.12.00 Allowable tolerances on the overall diameter of the cables shall be +\(-2\) mm maximum over the declared value in the technical data sheets.
2.13.00 In plant repairs to the cables shall not be accepted. Pimples, fish eye, blowholes etc. are not acceptable.
2.14.00 Cable selection & sizing Control cables shall be sized based on the following considerations:
(a) The minimum conductor cross-section shall be 1.5 sq.mm.
(b) The minimum number of spare cores in control cables shall be as follows: No. of cores in cable Min. No. of spare cores 2C, 3C NIL 5C 1 7C-12C 2 14C & above 3
2.14.01 Cable lengths shall be considered in such a way that straight through cable joints are avoided.

3.00.00 CONSTRUCTIONAL FEATURES

3.01.00 1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC insulated, PVC inner sheathed armoured FRLS, PVC outer sheathed conforming to IS: 1554. (Part-I).

4.00.00 CABLE DRUMS
(a.) Cables shall be supplied in non-returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.
(b.) Each drum shall carry manufacturer’s name, purchaser’s name, address and contract number, item number and type, size and length of cable and net gross weight stenciled on both the sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.
(c.) The standard drum length for control cables shall not be less than 1000 metres. The length per drum shall be subjected to a maximum tolerance of +/\(-5\)\% of the standard drum length. The Employer shall have the option of rejecting cable drums with shorter lengths. For each size, the variance of total quantity, adding all the supplied drum lengths, from the ordered quantity, shall not exceed +/\(-2\)%.

5.00.00 TESTS
(a) All equipments to be supplied shall be of type tested quality. The Contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out
within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

(b) In case the Contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.

(c) All acceptance and routine tests as specified below and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

5.01.00 TYPE TESTS
5.01.01 The reports for the following type tests shall be submitted for one size of control cables:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Type Test Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>For Conductor</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Resistance test</td>
</tr>
<tr>
<td>2.</td>
<td>Measurement of Dimensions</td>
</tr>
<tr>
<td>3.</td>
<td>Tensile Test</td>
</tr>
<tr>
<td>4.</td>
<td>Elongation test</td>
</tr>
<tr>
<td>5.</td>
<td>Torsion test For round wire only</td>
</tr>
<tr>
<td>6.</td>
<td>Wrapping test For aluminium wires/formed wires only</td>
</tr>
<tr>
<td>7.</td>
<td>Resistance test</td>
</tr>
<tr>
<td>8(a).</td>
<td>Mass of zinc Coating test For GS wires/formed wires only</td>
</tr>
<tr>
<td>8(b).</td>
<td>Uniformity of zinc coating For GS wires/formed wires only</td>
</tr>
<tr>
<td>9.</td>
<td>Adhesion test For GS wires/formed wires only For PVC insulation &amp; PVC Sheath</td>
</tr>
<tr>
<td>10.</td>
<td>Test for thickness</td>
</tr>
<tr>
<td>11.</td>
<td>Tensile strength and elongation test before ageing and after ageing</td>
</tr>
<tr>
<td>12.</td>
<td>Ageing in air oven</td>
</tr>
<tr>
<td>13.</td>
<td>Loss of mass test For PVC insulation and sheath only</td>
</tr>
<tr>
<td>14.</td>
<td>Hot deformation test For PVC insulation and sheath only</td>
</tr>
<tr>
<td>15.</td>
<td>Heat shock test For PVC insulation and sheath only</td>
</tr>
<tr>
<td>16.</td>
<td>Shrinkage test</td>
</tr>
<tr>
<td>17.</td>
<td>Thermal stability test For PVC insulation and sheath only</td>
</tr>
<tr>
<td>18.</td>
<td>Oxygen index test For outer sheath only</td>
</tr>
<tr>
<td>19.</td>
<td>Smoke density test For outer sheath only</td>
</tr>
<tr>
<td>20.</td>
<td>Acid gas generation test For outer sheath only</td>
</tr>
<tr>
<td>For completed cables</td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>Insulation resistance test (Volume resistivity method)</td>
</tr>
<tr>
<td>22.</td>
<td>High voltage test</td>
</tr>
<tr>
<td>23.</td>
<td>Flammability test as per IEC-332 Part-3 (Category-B)</td>
</tr>
</tbody>
</table>

5.02.00 Indicative list of tests/checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of Control Cables.

6.00.00 Design Parameter:

The parameter for electrical power distribution system shall be as follows:

(i) 33 KV System : ± 6% , 25 KA rms for 1 sec.
(ii) 6.6 KV System : ± 6% , 40 KA rms for 1 sec.
(iii) 415/240 V System : ± 10% (Solidly grounded) – 45 KA for 1 sec.
(iv) 110 V DC System : Isolated type. (95V DC – 115V DC).
(v) Frequency : 50 Hz,+ 3%,-5% and 10%combined variation Of voltage and frequency.
POWER CABLES
(Use separate sheet for each type and size of cables)

1.01.00 Make & Type
1.02.00 Country of Manufacture
1.03.00 Type & Designation
1.04.00 Applicable standard
1.05.00 Cable size and no. of cores
1.06.00 Rated voltage
1.07.00 Catalogue attached Yes/No
1.08.00 Conductor
   a) Material
   b) Nominal cross section area in sq. mm
1.09.00 Insulation
   a) Material
   b) Nominal Thickness (in mm)
   c) Type of Curing (for XLPE)
1.10.00 Metallic Screen (wherever applicable)
   a) Material
   b) Type
   c) Rating KA sec.
1.11.00 Type of inner sheath
1.12.00 Armour material
1.13.00 Outer sheath material
1.14.00 Over all dia cable (in mm)
1.15.00 Guarantee value of minimum oxygen index of outer sheath
1.16.00 Maximum acid-gas generation by weight (% of outer sheath)
1.17.00 Average light transmission