ANNEXURE-III

TENDER DOCUMENT FOR

SLICE I: Supply, installation and commissioning of 625 KVA DG SET WITH Acoustic Enclosure, AMF Panel & Exhaust Chimney as per statutory requirements as per attached specs

SLICE II: Supply, installation and commissioning of expansion of existing LT PCC as per attached technical specs

AT

MEDHA DAIRY, HOTWAR, RANCHI, JHARKHAND

A UNIT OF

JHARKHAND STATE CO-OPERATIVE MILK PRODUCERS' FEDERATION LTD., RANCHI

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1.0 INTRODUCTION:

Jharkhand State Co-operative Milk Producers' Federation Limited, Ranchi, managed by National Dairy Development Board, is planning to get:

SLICE I : 625 kVA DG set with acoustic enclosure, AMF panel and exhaust chimney

SLICE II : Expansion of existing LT Power Control Centre to connect the new DG set at Medha Dairy, Hotwar, Ranchi, Jharkhand.

The scope of work includes the design, supply, installation and commissioning of DG set and expansion of existing LT PCC and getting required statutory approvals for the installation. **Necessary cabling between DG set, AMF panel & LT PCC and earthing pits etc. shall be done by Jharkhand Milk Federation.**

The work is to be executed on turnkey basis and handing over after successful commissioning to the JMF in good working condition. The rated capacity / parameters of all supplied equipment should be as per the technical specifications detailed below. The successful bidder shall also be responsible for training of personnel in operation & maintenance of the equipments. Foundation and other civil works shall be provided by the purchaser/owner.

Electrical sub-station along with allied equipment :-

SLICE I :

Part-A : Design & Supply of 625 kVA DG Set with acoustic enclosure and AMF panel cabling etc.
Part-B : Labour charges for installation, testing & commissioning of above DG set with Acoustic Enclosure, AMF panel & Chimney.

SLICE II :

Part-A : Design, fabrication & supply of expansion of existing 430 V LT Power Control Centre
Part-B : Labour charges for installation, testing & commissioning of expansion of existing 430 V LT Power Control Centre

The vendor shall undertake the complete work and there shall not be any exclusion whatsoever of any PART. It is understood that any minor work, which may not be explicitly detailed but is necessary for the proper functioning of the individual equipment or automated plant as a whole, is included in the scope of work without any additional cost.

The general technical specification of the major components and the ancillary items described in the technical section and the equipment, its capacities and quantity proposed by the Purchaser as furnished in the design data and schedule of quantities are for the guidance of the contractor only. However, supplier has been advised to visit the site to get familiarized / acquainted about the nature and the quantum of work involved before submitting without deviating from the basic configuration of the plant.

The quantity of cables, cable trays, earthing, instruments, supporting structure etc. are to be supplied & installed based on the actual requirement at site. The supplier has to work out the exact details based on the system offered by them and submit the same for the approval of the purchaser.

Water for installation shall be provided at one point within the site, free of charge.

Electricity for installation shall be provided (as per the availability of mains power supply) at one point near the substation free of charge.

Completion Period :

SLICE I : 2 (Two) months from the date of work / purchase order.
SLICE II : 2 (Two) months from the date of work / purchase order.

2.0 PROJECT SITE DETAILS:

Name of the Project	100 TLPD Medha Dairy substation at Hotwar, Ranchi, Jharkhand.
Project Authority	The Jharkhand State Co operative Milk Producer's Federation Ltd. (JSCMPF Ltd.), Farmers training centre campus, Sector – 2, HEC, Dhurwa, Ranchi – 834 004
Site Address	Near Birsa Munda Central Jail, Hotwar, Ranchi - 834004
Nearest City / Railway Station / Airport	Ranchi

THE EQUIPMENT TO BE SUPPLIED AND INSTALLED BY THE CONTRACTOR MUST BE SUITABLE FOR CONTINUOUS OPERATION UNDER VARYING CLIMATIC CONDITIONS AT THE PROJECT SITE.

TROPICALISATION:

All equipment supplied against these specifications shall be given tropical treatment in view of the severe climatic conditions prevailing at the site. Tropical protection shall conform to BS: CP: 1014:1963 entitled Protection of Electrical Equipment against Climatic Conditions OR IS: 3202

3.0 SCOPE OF WORK:

The scope of work includes design, fabrication, supply, installation, testing and commissioning of all equipment, cabling and earthing etc. of substation expansion as per the general technical specifications and the schedule of quantities mentioned including necessary approval from the statutory authority viz. **Electrical inspector of Jharkhand, Jharkhand State Electricity Board, Jharkhand Pollution Control Board or any other statutory authority applicable for approval of DG Set and LT PCC expansion and installation**.

The supplier shall be responsible for the Power and Control Wiring etc. to ensure that the system is installed with all safeties and meets all the quality standards as well as to fulfil the design data and technical specifications specified in the bidding document. The work shall be carried out with the best quality materials and in the best workmanship manner, strictly in conformity with the specifications mentioned hereunder.

The system shall be designed, supplied and executed in accordance with prevailing and applicable

- Bureau of Indian Standards
- Indian Electricity Rules
- Indian Electricity Act
- Fire Insurance Regulations
- Indian Factory Act
- Jharkhand State Statutory Requirements
- Jharkhand State Pollution Control Board
- Electrical inspector of Jharkhand, Jharkhand state electricity board.

And any other applicable Indian Act. Wherever Indian Standards are not available/ applicable, the contractor shall follow International Standards. In case of non-availability/ applicability of both the standards mentioned above, DIN, British or American Standards shall be used.

The supplier shall submit all the necessary details, drawings, test certificates, Test reports etc to the Purchaser essential for obtaining required approvals.

The technical specifications for supply and installation of the Sub-station equipment as been specified in respective sections and brief content of each of these is also given under Design Data.

The scope of work includes Design, Fabrication, Supply, Installation, Testing & Commissioning of Equipment for LT PCC expansion and DG Set as mentioned in the schedule of quantities including statutory approvals of **Electrical inspector of Jharkhand, Jharkhand state electricity board**. The Supplier shall ensure that performance tests are carried out in the presence of and to the satisfaction of purchaser. Necessary test kits required if any for performance test shall be arranged by the supplier.

Supplier shall ensure satisfactory performance and after sales service of bought-out items.

The Supplier shall operate and demonstrate the performance of equipment supplied under the scope of work of this contract the same for a period of not less than 3 days from the date of successful commissioning.

The Supplier shall impart necessary training to the plant personnel on operation and maintenance of the equipment.

Detailed Preventive maintenance schedule as well as operational manuals of equipment shall be provided by the Supplier at the time of commissioning.

The manual shall cover the following aspects:-

- Plant startup, commissioning, normal operation, emergency operation.
- Trouble shooting chart covering operational status, reasons (causes) and actions to be taken (remedy)
- As-built drawings of the equipment, electrical schematic, control wiring drawings etc.

Manuals and drawings are to be supplied as follows:

- 4 Sets of drawings and manuals in hard copy
- 3 Sets of drawings and manuals in CD/DVDs (softcopy)

Expansion of LT PCC panel boards etc. are to be fabricated by the panel builder having panel's type testing certificate of CPRI. Necessary proof (short circuit test, temperature rise test and ingress protection test reports) to this effect are to be submitted and NDDB's approval is to be obtained prior to taking up the panel fabrication work.

Equipment Inspection:

All fabricated equipment such as DG Set, AMF Control Panel, LT PCC expansion etc. shall be offered for inspection at manufacturer's works before dispatch to site. Inspection call must be given at least 2 weeks in advance. Equipment shall be dispatched to site only after getting clearance from Purchaser's Inspector.

4.0 SCHEMATIC DIAGRAM & DESCRIPTION OF SUB STATION:

The building plan drawing showing the existing layout of substation equipment and the schematic showing single line diagram of feeder details of LT power side are enclosed. This section provides the conceptual schematic diagram of the complete electrical installation and how the electrical energy is received from Jharkhand State Electricity Board and distributed to the various important sections of the plant. It may be noted that the schematic diagram provided is only for reference to enable the supplier to design and develop their own schematic diagram based on major parameters specified in bidding document/ drawing.

The existing PCC receives back-up power from 1 no. DG set of Capacity of 250 kVA. Necessary protection through relays and mechanical & electrical interlocking are provided in HT Panel & PCC.

LT XLPE insulated, Aluminum conductor armored power cable supply & laying between PCC Panel, new 625 kVA DG Set & AMF panel shall be in the scope of Jharkhand Milk federation.

LIST OF DRAWINGS RELATED TO SUB-STATION:

The followings drawings are enclosed for the guidance of the supplier. However, supplier shall submit the execution drawings for approval of Purchaser before commencing the work.

Sr.	Description
1	GA Drawing and SLD for Substation
2	Substation equipment layout

EQUIPMENT SPECIFICATIONS:

The technical specification of all major equipment required is given in the subsequent pages. It may be noted that general specifications of the equipment are mentioned and the supplier is to design, fabricate, supply & install the complete system to ensure the best performance of the individual equipment as well as the complete system.

5.0 DESIGN DATA:

This section gives brief design data of the electric sub-station such as voltages, capacities and special requirements of important equipment.

5.1 Specific Project Requirement :

Power Supply

Incoming from Electricity Board	11 kV +/- 10 %, 50 HZ, 3 Phase, 3 Wire Earthed System
Incoming from DG SET	415 V, 50 HZ, 3 Phase, 4 Wire
Motive power for project	415 V, 50 HZ, 3 Phase, 4 Wire Earthed System
Lighting power for project	415 V, 50 HZ, 3 Phase, 4 Wire Earthed System

5.2 Equipment Details:

5.3.1 LT Power Control Centre:

P.C.C. Operation	Only from Front
Incoming feeder suitable for receiving power through	XLPE insulated, Al conductor, armoured cables from DG Set
Fault Level of the panel	50 KA
Type	Indoor
Supply Voltage	415 V, 50 Hz, 4 wire
Details of Incoming Feeders	
From Transformer	415 V, 1250 A, 4P ACB – 1 No.
From existing 320 KVA DG Set	415 V, 630 A, 4P, MCCB – 1No.
Details of Outgoing Feeders:	As per Schematic diagram
Incomer from New 625 kVA DG Set	**1250 A ACB, MDO type to be provided under expansion of LT PCC**

5.3.2 **All 3 incomers (one from transformer & two from DG sets shall be mechanically and electrically interlocked with each other by the contractor executing expansion of LT PCC to avoid simultaneous switching "ON" of any two incomers**.

5.3.3 Cables:

LT Power Cable between LT PCC and new 625 kVA DG Set,	1.1 KV grade, XLPE insulated, Armoured cable with Aluminium conductor (**To be arranged by JMF**)
LT Control Cable	1.1 KV grade Armoured copper conductor cable (**To be arranged by JMF**)
Size & no. of runs	Shall be as per the drawing approved by Purchaser

5.3.4 **DG Set:**

New 625 KVA DG Set -1 No. with Acoustic Enclosure, AMF Control Panel and Exhaust chimney as per statutory requirement is to be supplied, installed & commissioned.

5.3.10 Earthing Pits & Earthing strips: **Shall be arranged by JMF**

5.3.11 Electrical Insulating Mats (minimum 3 mm thick & class C :

One Lot as per statutory and site requirement – **To be provided by supplier of LT PCC expansion**

6.0 TECHNICAL SPECIFICATIONS OF EQUIPMENT

6.1 LT POWER CONTROL CENTRE EXTENSION:

One vertical section matching to the existing panel design shall be added for expansion of PCC to accommodate ACB incomer feeder for receiving power supply from the new DG set proposed under SLICE - I of this tender.

The indoor type power control centre in sheet steel enclosure is required to be extended on one end by putting a vertical section to accommodate an ACB to receive LT power supply from the new DG set and supply the same to LT PCC main bus bars to supply power to various motor control centers and distribution boards at 415 volts, 3 phase, 50 Hz. System.

6.1.1 Statutory Requirements

The design and construction manufacture and performance of the PCC extension shall conform to the latest applicable Indian Standards, Indian Electricity Rules, Indian Electricity Act, Fire Insurance Regulations and comply with all currently applicable statutory requirements of concerned State Electricity Inspectorate and safety codes in the locality where the equipment will be installed and as per the detailed specifications mentioned below. The manufacturer of the panel must possess a type test certificate / accreditation from CPRI.

6.1.2 Housing Details:

6.1.2.1 The PCC extension shall be fabricated using pressed and shaped cold rolled sheet steel sections structure of adequate thickness. The cold rolled sheet steel used for panel shall be minimum 14 SWG thick except that the partition plates and inter-panel barriers may be made of 16 SWG. The PCC extension shall be indoor, floor mounted, self-supporting, front open able, cubicle type made up of vertical panels arranged to form a continuous line-up of uniform height. Front doors and rear covers shall be hinged type. As required as per design necessary louvers, cooling fans, filter etc., are to be provided adequately.

Panels at extreme ends shall have openings, which shall be covered with plates screwed to the panel. The switchboard shall be provided with integral base frame. The panel base plate/cable gland plate shall be 3.0 mm thick.

The PCC shall be totally enclosed, dust, weather and vermin proof and shall conform to degree of protection not less than IP 44. Gaskets of durable materials shall be provided all round the perimeter of adjacent panel, panel and base frame, removable covers, doors and cutouts.

6.1.2.2 All hardware shall be zinc plated. All joints and connections shall be made by galvanized zinc passivated or cadmium plated high tensile strength steel bolts, nuts and washers secured against loosening.

6.1.2.3 The height and depth of the panel have to match with that of the existing PCC. The maximum and minimum height of operating handles / push buttons of components shall be approximately 1900 mm & 300 mm respectively with reference to panel base.

6.1.2.4 The bus bars of existing PCC and the extension portion shall be connected together either directly bolted or with tinned copper flexible bus links.

6.1.2.5 Adequate number of slotted cable supports shall be provided in cable alleys for dressing of cables. All doors shall be provided with concealed type hinges and captive screws. Rear doors also shall be openable type.

6.1.2.6 All components shall be front operated. For draw out modules, only handles of switchgears, knobs, cutouts for lamps and meters shall be arranged on the front doors to permit operation without opening the doors. Relays, other than built-in in circuit breakers, shall be mounted on front doors of the ACB compartments. Other accessories of ACB shall be mounted on withdraw able chassis.

6.1.3 Painting

All metal surfaces shall be thoroughly cleaned and degreased to remove all scales, rust, grease and dust. Fabricated structures shall be pickled and treated to remove any trace of acid. The under-surface shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc primer. The under surface shall be made free from all imperfections before undertaking the final coat.

After preparation of the under surfaces, the panel shall be spray painted with final two coats of Siemens Gray shade (RAL 7032) of powder coating paint. Thickness of powder coating shall not be less than 60 microns.

The finished panels shall be dried in stoving ovens in dust free atmosphere. Panel finish shall be free from imperfections like pin holes, orange peels, run off paint etc.

All unpainted steel parts shall be cadmium plated or suitably treated to prevent rust, corrosion, etc.

6.1.4 Nameplates:

Apart from panel nameplate highlighting the operating voltage, the nameplates for all incoming and outgoing feeders shall be provided on doors of each compartment. Nameplates shall be fixed by screws only and not by adhesives. Engraved nameplates shall preferably be of 3-ply (Black-White-Black) acrylic sheets or anodized aluminium Special danger plates shall be provided as per requirement.

Inside the panels, stickers should be provided for all components giving identification number as per detailed wiring diagram.

6.1.5 Bus bar Sizing Connection and Supports:

The bus bars shall be made of high conductivity electrolytic aluminium alloy conforming to grade E91E IS-5082. Buses shall have uniform cross section throughout the length of the panel and up to the incoming feeder terminals. Maximum current density permissible for these bus bars shall be 0.8 A/mm^2 for bus bar area above 500 mm^2 & 1.0 A/mm^2 for bus bar area below 500 mm^2 per phase. A suitable section earthing bus bar (minimum 300 mm^2) of aluminium shall be provided inside the PCC at back bottom through out the length of the PCC. Provision shall be made to connect the earthing bus bar to the plant earthing grid at two ends. All doors shall be earthed using flexible copper connections to the fixed frame of the switchboard.

Maximum current density permissible for Copper bus bars shall be 1.2 Amps/mm^2.

The bus bars shall be provided with heat shrinkable high dielectric PVC insulating sleeves of 1100 V grade. Red, yellow and blue colour shall be used for phase bus bars and black colour shall be used for neutral bus bars. The sleeves should be non-inflammable and self-extinguishing type. All joints in main horizontal bus bars and all tap-off connections from the main horizontal bus bars shall be suitably shrouded. Supports for bus bars shall be made of suitable size non-hygroscopic and non-inflammable epoxy compound SMC / DMC blocks and these should be adequate in number so as to avoid any sag in the bus bars and these shall be capable of withstanding stresses due to short circuit currents of the associated switchgear. Main bus bars shall have rupturing capacity of 50 kA.

Minimum clearance between main bus bars phase-to-phase 25 mm and that between phase to neutral/earth shall be 20 mm.

6.1.6 Power Connection

Interconnections between the main bus bars and individual units shall be made by using copper or aluminium bus bar strips of adequate rating. These interconnections and terminals shall also be shrouded suitably. For current rating 63 A and below copper conductor PVC insulated wires of adequate section with sockets at both ends can be used but their minimum size shall not be less than 4 mm^2. Cable lugs/ sockets of suitable size and type shall be used for all cable terminations.

For all aluminium to copper connections, the copper surface will be silver plated and the aluminium surface will be properly cleaned and supplied with oxide inhibiting grease.

The outgoing power connections from PCC will be through XLPE insulated aluminium conductor armoured cables. The cable entry shall be either from top or bottom as specified in feeder details. Removable gland plates of minimum 3.0 mm thickness shall be provided on bottom/top of panel for cable entries. The cable alleys shall also be totally isolated from switchgears by suitable partition plates.

For outgoing feeders, cable termination directly at switchgear terminals shall not be allowed and hence panel builder should make provision by suitable bus link from switchgear terminals so that required no. of cables could be connected to these links.

To prevent accidental contacts, all junctions of interconnecting cables and bus bars also shall be shrouded suitably using coloured PVC insulation tape. Standard colour code of red, yellow and blue for phases and black for Neutral to be followed for all bus bars/conductors.

6.1.6.1 Auxiliary Wiring

Wiring for all controls, protection, metering, signaling etc. inside the switchboard shall be done with 1100 V grey colour PVC insulated FRLS copper conductors. Minimum size of control wire shall be 1.5 mm^2. However, CT circuit wiring shall be done with 2.5 mm^2. Control wiring to components fixed on doors shall be flexible type.

All control wiring should be provided with necessary sockets / lugs at both the ends. Each termination shall be identified at both the ends by PVC ferrules having numbers corresponding to control circuit diagram.

6.1.7 Electrical Switchgears:

6.1.7.1 Air Circuit Breaker (ACB):

ACB for DG Incoming feeder:

The air circuit breakers (ACBs) shall be suitable for 415 V, 50 Hz. Supply, **4 pole, manually operated fully draw out type with programmable intelligent release suitable for power monitoring and controlling.** The ACB shall have microprocessor based true RMS sensing and programmable protection & control unit shall be self powered and shall have protection & settings for overload, short circuit, instantaneous and earth fault currents with time delay settings, under/over voltage etc. and onscreen LCD display to show various conditions such as Power ON, Overload, Short-circuit, Instantaneous Earth fault, Percentage load, Self Diagnostic Test etc. **The breaking capacity of these ACBs shall be minimum 50 kA. Also, the ACB should also have protection against single phasing. The rating of ACB specified in the data sheet is at an ambient temp of 50^0 C and accordingly necessary derating has to be done if the ACBs rating are specified at lower ambient temperature.**

The release unit shall also have onscreen display of following measurements:

Current : Phase, Line, Average, Max, % loading
Voltage : Phase, Line, Average
Power & Energy : Active, Reactive, Total

Frequency, Power Factor & maximum demand etc

LED indication for different fault & Power ON should be provided on release chassis. Release should be able to perform self test to check healthiness of micro-processor. Release should be provided with test port for testing with test kit.

The make & model of ACB for incoming feeder shall be as under:

L&T U-Power Omega *Series with* ***UW-MTX 3.5 Relay.***

The ACB shall be provided with removable arc chutes and the mechanical spring charging mechanism, stored energy type, with indicators to show 'Open', 'Closed', 'Service' & 'Test' positions. The circuit breaker shall be provided with emergency tripping device. This device shall be available on the front of the panel.

The control supply shall be 240 V AC. 6 NO + 6 NC auxiliary contacts shall be provided.

The interlocks shall be as under:

It shall not be possible to plug in a closed circuit breaker or to draw out a circuit breaker in closed position. It shall not be possible to operate a circuit breaker unless it is in fully plugged-in, test or fully isolated position. In test position, the breaker shall be tested without energizing the power circuit. The ACB feeder cubical door cannot be opened when ACB is "ON". However, it shall be possible to defeat this interlock for inspection purpose. Whenever specified, interlock to prevent paralleling shall be provided. Closing and trip coils shall work under the following voltage variation conditions:

Closing coils - 85 % to 110 % of rated voltage
Trip coils - 50 % to 110 % of rated voltage

The ACB used as incomer shall be provided with under voltage coil and with shunt trip.

Current rating, short circuit current, protection relays etc. shall be as specified in feeder details.

The circuit breaker position shall be indicated electrically. The following indicating colors shall be used:
BREAKER 'CLOSE' - RED
BREAKER 'OPEN' - GREEN
BREAKER 'AUTO TRIP' - AMBER

6.1.8 Interlocking:

Electrical & Mechanical Interlocking shall be provided between 1 No incomer feeder from transformers & 1 No incomer from DG Set. Interlocking logic will be provided to meet operational requirements as following:

Sr	Breaker	Tr-1	DG-1	DG-2
1	SEB Supply ON	ON	OFF	OFF
2	SEB Supply OFF	OFF	ON	OFF
3	SEB Supply OFF	OFF	OFF	ON

- Incoming feeder from new DG set shall be provided with 240 V under voltage coil & shunt trip coils.
- Necessary breaker control (TNC switch) switch and A/M selector switch have to be provided for all the incomer ACBs

The panels shall be designed for proper protection system & 50 kA fault level.

6.1.9 Current Transformers (CTs):

Current transformers shall be cast resin, glass filled polycarbonate type. Primary and secondary terminals shall be marked indelibly. CTs shall preferably be mounted on stationery parts. The short time withstand rating of CTs shall be equal to that of the associated switchgear for one second.

The protection CTs shall be of minimum rating 15 VA, accuracy class 5P and an accuracy limit factor of greater than “10.0”. The instrument CTs shall be of minimum 10 VA, accuracy class “1.0” and an accuracy limit factor less than “5.0”.

Separate CTs to be provided for protection and metering purposes.

6.1.10 Protective Relays:

In case of any protective relays being specified in addition to the built-in relays provided with ACBs & MCCBs, the same shall be mounted on front door of the compartment and accessible for setting and resetting from the front. Hand-reset flag indicators visible from the front shall be provided.

All such protective relays, wherever used, shall be back connected, draw out type suitable for flush mounting and fitted with dust tight covers. Alternatively, plug-in type relays shall also be acceptable. The relay cases shall have provision for installation of test plug at the front for “testing and calibration” using an external power supply without disconnecting permanent wiring. It should be possible to short the CTs through the test plugs.

Auxiliary relays / contactors shall generally be used for interlocking and multiplying contacts. Auxiliary contacts shall be capable of carrying the maximum estimated current. In any case their rating must not be less than 5 A for 240 V, AC at a power factor between 0.3 to 0.1 and 1.5 A for 100 V, DC (inductive load).

Lower voltage contactors with a series resistance will not be acceptable for 220 V DC control supply.

6.1.11 Measuring Instruments:

These shall be of square pattern having approx dimensions 96 mm x 96 mm for digital type, flush mounting type with range as per corresponding feeder. All AC meters shall generally be of Digital type for displaying three phases reading. Suitable selector switch shall be provided if the digital meter does not have provision for simultaneous display of three phase readings.

Ammeters shall always be CT operated. Necessary auxiliary instruments like CTs etc. are also included in the scope of supply.

Voltmeter shall be suitable for direct line connection. Voltmeters shall be connected through fuses only.

The voltmeters and ammeters shall have 3½ digit display whereas the power factor meter shall have 4 digit display.

Intelligent Panel Meter (Load Manager) shall be provided with each of Transformers' and DG Sets' incoming feeders of the PCC (with suitable ratio cast resin CTs) for the local measurement & digital display of Multifunctional Electrical Parameters such as voltage, current, active power, reactive power, frequency, power factor, active energy, reactive energy, etc. on all three phases. Load Manager must have communication port like RS 485 enabling entire data transmission.

6.1.12 Indicating Lamps:
Indicating lamps shall be of LED (cluster of high intensity light emitting diodes) type, suitable for 240 V AC supply. These shall be provided with translucent covers of red, green and amber colours as required. These lamps shall be of minimum 22.5 mm dia. Indication lamps to be provided for all feeders.

6.1.13 Push Buttons:
Push buttons shall be of momentary contact type, rated to carry 10 A, 240 V AC with 2 NO + 2 NC contacts. These should be of size 22.5 mm dia and conform to IP 65 protection to prevent any dust and water ingress.
Colour codes shall be as under:

Start, Close	:	Green
Stop, Open / Emergency	:	Red

6.1.14 Contactors:

All contactors shall be suitable for AC3 duty unless specified otherwise. Contactor coil shall be suitable for 240 Volts, 50 Hz. All contactors shall be supplied with minimum 2 NO + 2 NC auxiliary contacts. Minimum contactor rating for power shall be 16 Amp.

Note :

- The incomer breaker shall be provided with required RYB indicating lamps, ON/OFF/TRIP indicating lamps, breaker ON/OFF switches, auxiliary contactors, protection MCBs etc.

- Further the Incoming feeder shall have 96 x 96 mm size Digital Voltmeter, Ammeter and Multi function meter.

The rating of main Aluminium Bus Bars of LT Power Control Centre extension shall be 1250 A, TPN, 50 KA.

Single line diagram, GA Drawing & Control circuit diagrams must be prepared and submitted for approval to JMF before starting fabrication of PCC extension

6.2 LT POWER & CONTROL CABLES:

6.2.1 LT Power Cables:

Power cabling between new 625 kVA DG set, AMF panel and PCC shall be provided and laid by Jharkhand Milk Federation (JMF).

6.2.2 Schedule of LT XLPE Power Cables:

Sr. No	From	To	Cable Size (Sq.mm)	No. of run	Approx. Length (Mtrs)	Method of laying
1	625 KVA DG Control Panel	PCC	3.5 C X 400 Sq mm	3	As required.	Cable tray/ Masonry trench / Underground

6.2.3 LT Control Cables:

Control cables for use on 415 V systems shall be provided and laid by JMF.

The size of various cables shall be worked out by the contractor and indicated in single line diagram to be submitted with their bids. The minimum conductor diameter shall be 1.5 mm².

6.2.4 Schedule of armoured Copper Control Cables:

1. Control cable required between DG Set Engine & its batteries shall be provided by the DG Set supplier.
2. Any other control cable not covered above but required functionally to meet the contractual obligations under work scope shall be provided by the supplier of LT PCC expansion.

6.3 EARTHING SYSTEM & LIGHTNING ARRESTOR:

The intent of this specification is to define the requirement for the supply, installation, testing and commissioning of the earthing system and lightning arrestor.

6.3.1 Earthing Network: **To be provided by JMF**.

Lightning Arrestor on DG Set chimney including its copper earthing strip up to the nearest earth pit shall be supplied and fixed by DG Set supplier.

6.4 INSULATING MATS:

Elastomer mats, electrical grade, of 3 mm thickness suitable for the applicable voltage grade and conforming to the latest IS: 15652 specifications for DG Set Control Panel and extended portion of LT PCC etc. **shall be provided by the supplier of PCC expansion**

6.5 FIRE EXTINGUISHERS: Shall be arranged by JMF

6.6 CABLE TRAYS: Not applicable

6.7 DIESEL GENERATING SET WITH ACOUSTIC ENCLOSURE, STANDARD AMF CONTROL PANEL AND EXHAUST CHIMNEY AS PER STATUTORY REQUIREMENT AND COMPLETE WITH SUPPORTING STRUCTURE

Capacity: 625 KVA

The diesel generating set of capacity specified in the data sheet and schedule of quantities would be used to generate three phase AC electricity at 415 volts and 50 Hz. The generating set would be used in the plant to operate certain essential motors and lighting load in case there is electric shut down / failure from the main source.

6.7.1 Design Requirements:

6.7.1.1 The diesel generating set shall comprise of diesel engine, alternator, acoustic enclosure, standard control panel, Exhaust Pipe and all standard accessories complete.

6.7.1.2 **Diesel Engine**: The diesel engine of the DG Set shall be skid mounted, multi cylinders, coolant cooled, turbocharged with after cooler suitable for Generating set application and capable of developing required BHP when running at 1500 rpm under NTP conditions. The engine should be built to ISO 3046 / BS: 5514 amended on date and rated for continuous running for 24 hours with an overload capacity of 10 % for a period not exceeding 1 hour in any 12 hours running. The engine instrument panel shall be supplied with:

- Ignition key
- Starting push button
- Coolant water temperature
- Lubricating oil pressure gauge
- Lubricating oil temperature gauge

- ♦ Engine speed - RPM meter (Digital)
- ♦ Engine running hour meter
- ♦ Battery voltage
- ♦ Battery charging ammeter

The diesel engine should be four stroke, multi cylinder and complete with the following:

- Flywheel & flywheel housing to suit alternator
- Engine cooling system with radiator, cooling blower & corrosion inhibitor coolant
- First fill of CAC coolant with coolant recovery bottle
- Dry type replaceable paper element air cleaner with vacuum indicator
- Paper element filters for fuel, lube oil & by-pass
- Fuel oil pump with mechanical/ electronic governor, fuel injectors & fuel hoses
- First fill of lubricating oil
- Lubricating oil cooler
- Spider Flexible coupling
- **Exhaust silencer residential type (Exhaust silencer & exhaust pipe to be insulated with mineral wool & cladded with 22 G aluminium sheets. Exhaust Pipe must be taken out of the building with stainless steel exhaust flexible connection.**
- **Exhaust chimney with proper foundation and supporting structure. The height of chimney shall be as per statutory requirements of Jharkhand State Pollution Control Board).**
- 12 or 24 V self-starting arrangement with suitable rating SMF battery, suitable battery charging arrangement and cables
- Standard set of tools
- Engine protections (Trip) – High water temperature, Low lube oil pressure, Over speed
- Low coolant / oil level alarm
- Holding down bolts & MS combination base frame
- Fuel tank of suitable capacity
- Control panel for engine with engine safety against over speed, high water/ coolant temperature and low lube oil pressure

6.7.1.3 **Alternator**: The engine shall be flexible coupled to one suitable self excited & self regulated (through an AVR) alternator developing required KVA at 0.8 power factor, 3 phase, 415 volts 50 Hz. AC power supply under NTP conditions when running at 1500 RPM. The alternator shall be brushless type, screen protected and fitted with end shield and ball / roller bearings conforming to BS: 5000/ IS: 4722 amended as on date. The winding insulation shall conform to Class "H". The alternator shall be supplied with automatic voltage regulator and band of voltage regulation shall be $\pm$ 2.5% of rated voltage from no load to full load. Alternator of rating 500 KVA and above shall be provided with thermistor winding for protection against overheating. The temperature sensor of thermistor winding shall be connected to DG set control panel. The alternator shall be capable of carrying an unbalanced load of 25% without injurious heating of any part, provided the rated current is not exceeded. The alternator shall withstand a short circuit at its terminals for three seconds with excitation adjusted to develop

rated voltage at no load without any damage. The sub-transient current shall not exceed 15 times the full load current.

6.7.1.4 AMF CONTROL PANEL

The DG Control Panel suitable for AMF shall be supplied as per the specification mentioned below. The incomer of the panel shall be 4 pole ACB of rating 1250 A.

The Control Panel shall be supplied with Microprocessor based, State-of-art technology 'D.G. Set Cummins command control PCC 2100 or equivalent programmed for complete Controls of Engine & Alternator and complete Monitoring, metering & Protection of Engine & Alternator.

The controller shall also have AMF /Manual /Test /Load dependent Start/Stop and Soft load transfer capability with AMF facility.

SEQUENCE OF OPERTAION:

a) IN CASE OF MAINS POWER FAILURE:

"NO" voltage relay shall send command to start the engine. The transformer breaker in the PCC will be open and the DG Set breaker in the PCC shall be closed thus giving the supply to the plant through the DG set.

b) IN CASE OF RESTORATION OF MAINS POWER :

- Relay will sense the voltage and give the command to the transformer breaker in PCC, however, the engine will remain in running position. Synchronizing relay shall sense the phase, voltage, and the frequency of the mains power and DG set. On confirming the required values, shall send the command of load transfer on mains. During this period both the breaker (DG breaker as well as transformer breaker) will remain in ON position and Reverse Power Relay shall not allow flow of the current in reverse direction.

- During this process the load will be transferred from the DG to mains without any break and stops the DG Set after cooling down time and remains ready as Stand-by.

- (The transformer breaker and DG breaker shall be provided in the PCC, however, the supplier shall be responsible for the interlocking with the DG controller with necessary hardwares, control cables etc. as may be necessary for failsafe operation)

c) MANUAL CONTROL:

In manual mode, the starting and stopping of DG Set shall be manual with involvement of operator. Similarly, the transfer of load shall be also manual.

d) TEST FACILITY :

The Panel shall have manual test facility. The DG Set shall be tested manually with the help of Test Push Button.

AMF CONTROL PANEL:

The Panel/s shall be totally enclosed dust tight, vermin-proof, floor mounted, free standing, floor mounted, cubical, compartmentalized type with hinged doors, fabricated from 14 gauge CRCA Sheet Metal having separate compartment. The Panel shall be Powder coated with light Siemens gray shade after the seven-tank process and shall have gland plate at bottom/top for input and outgoing cable terminations. The panel/compartment shall be fitted with following instruments and pre-wired with colour coded flexible copper cable with ferrule numbers for easy identification & maintenance.

The panel shall be installed in the substation building as shown in the drawing.

The Panel / Controller shall have following facility:

Operator Interface & Display

- ✓ Keypad for scrolling display data, configuration & control with Key for Up-Down, Enter, Escape etc.
- ✓ LCD window display for monitoring various parameters & faults as detailed bellow against each control function

Engine Parameter Monitoring:

- ✓ Oil Pressure
- ✓ Water Temperature
- ✓ Battery Voltage
- ✓ RPM (Speed)
- ✓ Engine running hours

Engine Protection:

- ✓ Low Lube Oil Pressure Trip
- ✓ High Water Temperature
- ✓ Low Battery Voltage
- ✓ Over Speed

Electrical (Generator) Parameter Monitoring (Digital):

- ✓ Voltage R, Y, B
- ✓ Ampere R, Y, B
- ✓ Frequency
- ✓ KW
- ✓ KWh
- ✓ PF
- ✓ One running hour meter (Time totalizer)

Electrical (Generator) Protection (Digital):

- ✓ Under Voltage Trip, with adjustable range of Voltage & Time to Trip the generator for persistent under voltage.

- ✓ Over Voltage Trip, with adjustable range of Voltage & Time to Trip the generator for persistent over voltage.
- ✓ Under Frequency Trip, to Trip the generator for persistent under frequency.
- ✓ Over frequency Trip, to Trip the generator for persistent over frequency.
- ✓ Reverse Power Trip, to trip the generator for persistent Reverse Power.
- ✓ 3 Pole Over Current Trip, with IDMT characteristic to trip the generator for Over Current.
- ✓ Loss of Excitation

Power for auto start / Stop (AMF) of D.G. Set:

- ✓ Under Voltage with adjustable range of Voltage & Time to monitor Mains supply to trip Mains breaker & start the DG Set for persistent under voltage.
- ✓ Over Voltage with adjustable range of Voltage & Time to monitor Mains supply to trip Mains breaker & start the DG Set for persistent over voltage.
- ✓ Under Frequency with adjustable range of Frequency & Time to monitor Mains supply to trip Mains breaker & start the DG Set for persistent under Frequency.
- ✓ Over frequency with adjustable range of Frequency & Time to monitor Mains supply to trip Mains breaker & start the DG Set for persistent Over Frequency.

DG SET INCOMER BREAKER:

Incomer 4 pole 1250 A rating ACB with UV coil shall be provided in the AMF panel of the 625 KVA DG Set.

STATIC BATTERY CHARGER:

The Panel shall also be fitted with Manual & Automatic (Constant Voltage type) Static Battery Charger Comprising of:

- ✓ Selector Switch of Auto/Trickle / Boost / Off
- ✓ Transformer / Rectifier
- ✓ Auto Voltage Control Card
- ✓ DC Ammeter (Analog type – 72 sq. mm)
- ✓ DC Voltmeter (Analog type - 72 sq.mm)
- ✓ Annunciations / Indications:
- Set of Indicating Lamps for:
- Mains ON
- Mains ACB Close
- Bus ON
- The fault annunciation for each Engine & Electrical fault shall be displayed in the LCD window of controller.
- 1 No. Hooter with accept & Reset Push Button.

- ✓ Set Of Push Buttons and Selector Switch:
- Emergency trip (Mushroom – lockable type)
- D.G. MCCB Close
- D.G. MCCB Trip

- Engine Start
- Engine Stop
- Speed Raise / Lower
- Voltage Raise / Lower
- Auto / Test / Manual/Off Selector Switch

Miscellaneous:

- ✓ Set of Control Fuses
- ✓ Set of control relay/ aux. connectors.
- ✓ Indicating & Rating Name Plates
- ✓ Mounting Base Channel
- ✓ Set of Control Cable connectors

- One ACB to disconnect power supply in case load of generating set increases beyond permitted limits. The rupturing capacity of the ACB should not be less than 50 kA.
- One set of TPN Bus bar insulated with heat shrinkable PVC sleeves (maximum permissible current density shall be 0.8 amps/mm^2)
- One set indicating lamps and control fuses

The control panel should conform to the Indian Electricity Rules.

6.7.1.5 Base Frame: The above diesel engine and alternator shall be mounted on specially designed combination base frame and MS structure of extremely rigid fabrication. The base frame shall be suitable for mounting the set on AVM pads over the RCC foundation. The DG Set i.e. engine and alternator with closely / flexible coupling assembled completely on base frame shall be supplied to the project site.

6.7.1.6 Fuel Tank: MS fuel tank of suitable capacity shall be provided. The tank shall be complete with suitable mounting brackets, complete with level indicator, fuel inlet and outlet, fuel pipes, air vent and drain plug.

6.7.1.7 Acoustic Enclosure: The acoustic enclosure shall be designed for reducing the noise level and providing ventilation of the DG set to remove the heat fumes dissipated by engine, alternator & its accessories and to provide combustion air. The enclosure shall have access for serviceability.

The acoustic enclosure of DG set shall be of outdoor type, prefabricated, MS modular, free standing, floor mounted sound proof enclosure to meet the most stringent noise levels specified by the Ministry of Environment and Forest (MOEF), Government of India (GOI), as per notification no. GSR 371(E) dated May 17, 2002 and shall be certified for noise control levels of 75 dBA @ 1 meter distance (at 75% load under free field conditions) by the MOEF, GOI appointed nodal agencies.

Enclosure panels shall be filled with suitable insulation material to meet IS 8183 specifications for better sound attenuation and covered with 22 SWG GI perforated sheet. Acoustic canopy shall be 16 SWG CRCA powder coated sheet panels and louvers. The enclosure shall be provided with inlet and outlet specifically designed louvers for ventilation and air movement across the

enclosure. Doors on either sides of the DG set shall be provided for easy access and maintenance of battery, radiator, engine and alternator. All doors shall be provided with stainless steel hinges & suitable locking arrangement.

6.7.1.8 Bidders are requested to quote separate price for set of spares required for 2 years normal operation specifying the quantity, name of spare part and its unit price.

6.7.1.9 The bidders shall quote only for assembled sets. The assembled sets, if required, shall be inspected at the works of supplier at the discretion of the Dairy Board/Client. In case of over dimensions assemblies, the same may be permitted for transportation in knocked down conditions, otherwise the set should be dispatched in assembled conditions only.

6.7.1.10 The foundation details with relevant drawings should also be submitted.

6.7.1.11 Statutory Approvals for DG Set:

All Statutory approvals / NOC required to operate 625 kVA DG Set shall be obtained/arranged as per the requirement by the respective contractor/ supplier from the concerned statutory authorities like Electrical Inspector, Factory inspector, Jharkhand State Pollution Control Board etc. as applicable. All such approvals/ NOC shall be handed over in original to Purchaser/ Project Authority by the contractor.

7.0 LIST OF APPROVED MAKES OF EQUIPMENT & ACCESSORIES:

NAME OF ITEMS	**APPROVED MAKES**
Air Circuit Breaker	L&T – U Power Omega/ SIEMENS 3 WL / SCHNEIDER Master pact NW series
Protection Relays	L&T / SIEMENS / ABB / SCHNEIDER / AREVA T&D
Contactors	L&T / SIEMENS / SCHNEIDER
Timers Electronic	L&T/ SIEMENS / SCHNEIDER/GE
Switch De-connector Fuse Units	L&T / SIEMENS / SCHNEIDER
MCBs	L&T/ SIEMENS / HAGER / LEGRAND
Indicating Lamps	L&T / SIEMENS / SCHNEIDER / TEKNIC
Push Buttons	ESBEE / SIEMENS / SCHNEIDER / VAISHNO / TEKNIC
Multi Function Meter	SIEMENS/ L&T / SCHNEIDER
Digital Ammeter & Voltmeter	SCHNEIDER / SCHNEIDER / L&T / RISHABH
Analog Ammeter & Voltmeter	RISHABH / SCHNEIDER / L&T
Digital Energy / Multi function Meter	L&T / SCHNIEDER / SIEMENS
Power Factor Meter	RISHABH / IMP / MECO / AE/ L&T
Current Transformer	KAPPA / BHARTI/ ASHMORE/ L&T/ RISHABH

NAME OF ITEMS	APPROVED MAKES
LT XLPE Copper Control Cables	LAPP KABEL / SBEE / CCI / KEC / FINOLEX / RR KABELS (UNILAY) /
Signal & Instrument cable	LAPP KABEL / CONCAB / POLYCAB/ FINOLEX
Isolating Switches	SIEMENS / L&T / SCHNEIDER/ ABB
HRC Fuses	L&T / SIEMENS / EE / GE/ ABB
Terminal Blocks	WAGO / LAPP INDIA / CONNECT WELL/ ELMEX
Rotary Selector Switch	KAYCEE /SALZER L&T/SIEMENS /ABB
Cable Glands	COMET / DOWELS / LAPP KABEL
Cable Lugs	DOWELS/ COMET/ LAPP KABEL
Mechanical Interlock	L&T/ SCHNEIDER/ ABB/ GE/ SIEMENS
DG Set Alternator	STAMFORD / KIRLOSKAR ELECTRIC/ LEROY SOMER
DG Set Engine	CUMMINS/ KIRLOSKAR KOEL GREEN / CATER PILLAR

8.0 **BATTERY LIMIT:** Sub- station

This specifies in brief the scope of the contractor and Owner/ Purchaser by specifying the limits at which contractor's scope Starts and Ends.

PURCHASER'S SCOPE	**CONTRACTOR'S SCOPE**
SLICE - I	
Civil Works :	
All civil buildings for the indoor type equipment and RCC foundations / platforms for installation of DG set.	Providing all necessary foundation bolts, foundation plates and templates
RCC hume pipes for crossing roads. Civil works related to laying of underground cables, such as digging of trenches, providing sand and bricks etc.	
Fencing with related civil works for DG yard.	
Civil works related to earth pits such as digging of earth, making watering chambers, earthing plate & earth pit covers etc.	
RCC cable trenches in sub-station building with MS angle nosing for laying cables	Supply and grouting of additional MS angles/channels supports / brackets for installation of equipment inside the building.
Electrical Works :	
Lighting in sub-station building area. Power Cables from DG Set, DG control panel to PCC and all control cables	Scope starts from DG Set & includes installation of exhaust chimney and approval from statutory authority
SLICE - II	
Civil Works :	
All civil buildings for the indoor type equipment and RCC trench	
Civil works related to earth pits such as digging of earth, making watering chambers, earthing plate & earth pit covers etc.	Supply and grouting of additional MS angles/channels supports / brackets for installation of equipment inside the building.
Electrical Works :	
Lighting in sub-station building area. Power Cables from DG Set, DG control panel to PCC and all control cables	Scope starts from PCC including internal wiring for interlocking of feeders

9.0 TECHNICAL DATA TO BE PROVIDED BY THE BIDDER'S:

The information on technical data to be provided by the bidder(s) is as following:

➢ DG Set critical technical data sheet shall be filled–in by the bidders & submitted with all relevant details:

DATA SHEET FOR ENGINE & ALTERNATOR			
S.N	DESCRIPTION		Details to be furnished by the supplier
	ENGINE		
1	Applicable standard	BS/IS	
2	Engine Make		
3	Engine Model		
4	Duty		
5	Rated capacity	KVA	
6	Design Temp.	Deg C	
7	Engine RPM		
8	Engine configuration, Bore x stroke	Mm	
9	Piston Speed	M/sec	
10	Compression ratio		
11	Displacement	Ltrs	
12	Single step block load capability	% of prime	
13	Stroke/ No of Cylinder		
14	Aspiration and cooling		
15	Governor type		
16	Flywheel		
17	Coupling		
18	Fuel Pump		
19	Fuel Filter type		
20	Lube Oil Filter type		
21	Silencer		
22	Method of starting		
23	Radiator Fan power	BHP	
24	Standard Radiator arrangement data: ✓ Air flow (Max.@ rated speed) ✓ Air flow restriction (after radiator)	m^3/min	
25	Battery make, type & rating		
	Exhaust system		
26	Heat rejection to Coolant (Total)	Kcal/hr	
i)	Heat rejected to exhaust	Kcal/hr	
ii)	Exhaust temp.	Deg. C	
iii)	Exhaust gas flow rate	m^3/min	
iv)	Heat rejected from Engine to	Kcal/hr	

	Atm.		
v)	System back pressure (Max. allowable)	mm of H_2O	
27	Exhaust flange size	Mm	
	Cooling System		
28	Engine coolant capacity with radiator	Liters	
29	Coolant pump external resistance	M water	
30	Coolant pump flow at max. allowable resistance	Ltrs/min	
31	Exhaust Pipe Size		
32	Exhaust Pipe Height		
	ALTERNATOR		
31	Alternator Make		
32	Alternator Model		
33	Efficiency of alternator at full load and 0.8 pf	%	
34	Rated Voltage, variation		
35	Rated Frequency, variations		
36	Power factor		
37	Excitation type		
38	AVR type		
39	Regulation		
40	Protection Degree	IP	
41	Insulation class/Temp. rise		
42	Bearing type		
43	Direct axis reactance		
44	Direct axis transient reactance		
45	Direct axis sub transient reactance		
	Performance		
46	Specific fuel consumption	Ltrs/bhp-hr.	
47	Fuel Consumption	Liters/hr.	At 100% Load : At 75% Load : At 50% Load :
48	Energy output		___ KWH/Liter of fuel
49	Permissible overload and duration		10% for 1 Hr in any 12 Hrs operation
50	DG set Loading pattern (No load to full load)	Seconds	Within _____ seconds
	LUBE OIL SYSTEM		
51	Lube Oil Sump capacity	Lit	
	Dimensions and weight (approx.)		
52	Engine Dimension	m x m x m	
53	Engine weight	Kg	

54	Alternator Dimension	m x m x m	
55	Alternator weight	Kg	
56	Overall weight	Kg	
57	Overall dimension	(L x W x H)	

1. **The power & control cabling from the DG Set to its Control Panel and from DG Control Panel to PCC Panel shall be provided by JMF.**

2. **The warrantee for the DG set shall be for one year from the date of successful commissioning or 18 months from the date of dispatch whichever is earlier. The warrantee shall cover all the components including electrical /electronic and rubber parts. During first year the supplier shall provide 5 free services plus any number of breaks down calls.**

3. **Supply & laying of control cables including termination at both ends within the panel shall be responsibility of panel suppliers.**

The supplier has to provide the following for the approval of Purchaser

- Equipment Layout drawing of DG Set, AMF Panel & PCC Extension
- GA drawing of all panels
- Single Line Drawing of all panels
- Control wiring diagram of all panels
- Cable scheduling and route
- Earthing System layout
- DG Set, AMF Panel & PCC Extension etc. critical technical data

10.0 APPLICABLE BIS CODES & STANDARDS:

The switchgear and the mounted equipment shall conform to the latest revision of the following Indian Standards:

IS: 5 Colours for ready mixed (Part-I to Part-5)
IS: 694 PVC insulated cables for working voltages up to and including 1100V
IS: 772 part-I AC Electricity Meters: Part –I general requirements and tests
IS: 1248 Direct acting electrical indicating instruments
IS: 2705 Current transformers
IS: 3156 Voltage transformer
IS: 3231 Electrical relays for power system protection
IS: 3427 Metal enclosed switchgear and control gear for voltages above 1000V but not exceeding 11000 V
IS: 3618 Phosphate treatment of iron and steel for protection against corrosion
IS: 5082 Material data for Aluminium bus bars
IS: 5578 Guide for marking of insulated conductors
IS: 6005 Code of practice for phosphating of iron and steel
IS: 6875 Control switches and push buttons
IS: 9920 Switches and switch isolators for voltages above 1000 V
IS: 9921 AC disconnectors (isolators) and earthing switches for voltage above 1000 V
IS: 9046 AC contactors of voltage above 1000 V up to & including 11000V
IS: 11353 Guide for uniform system of marking and identification of conductors and apparatus terminals
IS: 12729 General requirements for switchgear and control gear for voltages exceeding 1000 V
IS: 13118 General requirements for circuit breakers for voltages exceeding 1000 V
IS: 13703 Low voltage fuses
IS: 13947 part-I LV Switchgear and control gear general rules.