

VOLUME-2
PART- I
Section-10
415 V Switchgear

Contents

10. 415 V Switchgear	1
10.1 Intent of Specifications	1
10.2 Scope of Supply	1
10.2.1 Station Service board	1
10.2.2 Barrage Auxiliary Board (BAB)	2
10.2.3 Miscellaneous Equipment	2
10.2.4 Services	2
10.3 Specific Parameters and Layout Conditions	3
10.3.1 Layout and General Arrangement	3
10.3.2 Description of the 415 V Scheme	3
10.3.3 General Arrangement of Station Service Board	3
10.3.4 General Arrangement of Barrage Auxiliary Board (BAB)	4
10.4 Performance Guarantee	4
10.5 Integration with SCADA System	4
10.6 Design and Construction	4
10.6.1 Standards	4
10.6.2 415 V switchgear	5
10.7 Details of the Equipment	7
10.7.1 Air Circuit Breakers	7
10.7.2 Moulded Case Circuit Breakers	11
10.7.3 Current Transformers	11
10.7.4 Potential Transformers	12
10.7.5 Controls	12
10.7.6 Metering	12
10.8 Auto Changeover Supply Scheme	12
10.9 Tests	13
10.10 Drawings, Documents and Design Calculations	13
10.10.1 Design memorandum	13
10.10.2 Drawings and documents	13
10.10.3 To be enclosed with the Bid	14
10.10.4 To be submitted after award of contract	14
10.10.5 Design calculation	14
10.11 Spare Parts	15
10.12 Special Tools	15
10.13 Quality Assurance and Testing	15
10.14 Guaranteed and Technical Particulars	16
10.15 Completeness of Equipment	16
10.16 Deviation from Specifications	16

10. 415 V Switchgear

10.1 Intent of Specifications

The intent of these specifications is to define the scope of work under this section which covers the provision of labour, tools, plants, materials and performance of work necessary for the design, manufacture, quality assurance, quality control, shop assembly, shop testing, delivery at site, storage at site, erection, acceptance testing, commissioning, performance testing, handing over to Purchaser and guarantee for trouble free operation of 415 V Switchgear for Keyi Hydro Electric Project, Arunachal Pradesh as per the specifications hereunder, complete with all auxiliaries, accessories, spare parts and warranting a trouble free safe operation of the installation.

It is not the intention to specify the minute details/smallest items to deliver a functional system or to define the standard manufacturing practice but to outline the performance, constructional, operational and guaranteed requirements. It is the responsibility of the contractor to ensure these requirements.

10.2 Scope of Supply

10.2.1 Station Service board

One (1) no.415 volts, 800 Amperes, A.C. Station Service Board having short time rating of 31.5 kA for one second, totally enclosed complete with bus bars, bus bar chambers, supports, small wiring terminal blocks, fuses, labels, interlocks etc. comprising of the circuit breakers with protection equipment as under:

- Two (2) nos. 3-pole air circuit breakers rated 415 volts, three phase, 800 amperes and having breaking capacity of 31.5 kA suitable for both electrical and manual operations, draw-out type with motor operated, spring charged mechanism (two for the incoming circuit from the station service transformers) with necessary protections.
- One (1) nos. 3-pole air circuit breakers rated 415 volts, three phase, 800 amperes and having breaking capacity of 31.5 kA suitable for both electrical and manual operations, draw-out type with motor operated, spring charged mechanism for bus coupler with necessary protections.
- One (1) no. air circuit breakers rated 415 volts three phase, 4-pole 800 amperes and having breaking capacity of 31.5 kA suitable for both electrical and manual operations, draw out type with motor operated spring charged mechanism with adjustable thermal and instantaneous trip units for supply from one no. DG set.
- Necessary moulded case circuit breakers (MCCB) rated 415 volts, three phase, suitable current rating, 31.5 kA short circuit current rating and suitable number miniature circuit breaker (MCB) rated 230/415V, 10 kA short circuit current rating for outgoing feeders from station service board to the A.C. switchyard auxiliary distribution board, EOT Crane, Powerhouse lighting, governor, cooling water pumps, Dewatering and Drainage pumps, fire pumps, AC Panel, 110 V chargers.
- The following items shall be provided as per requirement for the Unit-Station Service Board:
 - Control switches / push buttons
 - Set of current transformers for phase and neutral ends

- Sets of potential transformers
- Under voltage relays for the station service bus for interlocking.
- Timers with the above under voltage relay
- Multifunction meter
- Sets of necessary cable sealing ends
- Auxiliary relays as required
- Indicating lamps as required
- All necessary auxiliaries for control and supervisory circuits, and other relays as required,
- All secondary wiring, terminal blocks, labelling and nameplates, sockets etc.,
- Cubicle lighting including lighting fixtures and power and communication sockets,
- Cubicles heating including heating elements.

10.2.2 Barrage Auxiliary Board (BAB)

One (1) no.415 volts, 200 Amperes, Barrage Auxiliary Board having short time rating of 16kA for one second, totally enclosed complete with bus bars, bus bar chambers, supports, small wiring terminal blocks, fuses, labels, interlocks etc. comprising of protection equipment as under:

- One (1) no. MCCB rated 415 volts, three phase, 200 amperes and having breaking capacity of 16 kA suitable for both electrical and manual operations with thermal and instantaneous overload release and indicating lamp for incomer supply feeder from Transformer.
- One (1) no. MCCB rated 415 volts, three phase, 200 amperes and having breaking capacity of 16 kA suitable for both electrical and manual operations, draw-out type with motor operated, spring charge mechanism for supply from barrage DG set.
- Fifteen (15) no. MCCBs/MCBs having appropriate continuous current and 10 kA short circuit current rating and suitable for manual operation complete with thermal and instantaneous overload releases and indicating lamps for different outgoing feeders.

10.2.3 Miscellaneous Equipment

Coordination and provision of necessary contacts and/or ports for integration with plant SCADA system are to be provided.

Spare parts shall be discussed separately.

Special tools and instruments, if required.

10.2.4 Services

- Transportation and delivery to site including all logistics and proper site storage and preservation as per manufacturer's recommendation.
- Cable schedule
- Site installation and commissioning

- Field / touch-up painting including all painting materials
- Performance and field acceptance testing as per the relevant clause of this section and submission of report
- Training of Purchaser's personnel
- All the technical documentation including preparation and submission of O & M manuals

10.3 Specific Parameters and Layout Conditions

10.3.1 Layout and General Arrangement

The single line diagram giving arrangement and interconnection of 415 V system is shown in tender drawing.

The LT switchgear system is solidly grounded, 3 phases + neutral.

BAB shall be installed in barrage control & switchgear room.

10.3.2 Description of the 415 V Scheme

The generating units 1,2 are connected to 11 kV bus through respective 11 kV generator circuit breakers.

The power requirements for station auxiliaries are met from 11 kV bus which is fed directly from generating units and /or from 132 kV bus through back charge from 11 kV side of generator transformers. For feeding the station and unit auxiliaries two nos. 11/ 0.433 kV, 500 kVA station auxiliary transformers feeders are taken from 11kV bus. The 433V side of station auxiliary transformer feeders is connected to 415 V bus of unit-station service board.

When none of the units are in operation or power to the station service board is not available due to failure of station auxiliary transformers, the power at the unit-station service board shall be met by starting one DG set of 375 kVA rating connected to station service board. The DG set shall start automatically with AMF panel when there is no power from normal sources.

The power requirements for unit auxiliaries are met by taking feeders from unit-station service board.

10.3.3 General Arrangement of Station Service Board

The Contractor shall provide one indoor type 415 V Station Service Board for supplying the power for station auxiliary requirements as well as for unit auxiliaries before start of machines or after stop of machines.

The 11 kV sides of SATs shall be connected to 11 kV indoor switchgear through XLPE cable and 433 V side of SAT shall be connected to unit-station service board through XLPE cables.

The station service board shall draw supply independently from two 11kV / 0.433 kV Station Auxiliary Transformers (SAT) with bus coupler open. In case of failure of one station Auxiliary transformer, the supply shall be drawn from other SAT by closure of bus coupler breaker through automated electrical

interlocking. On failure of supply from both the station auxiliary transformers, the supply to station service board shall be resumed from DG set after satisfying necessary interlocking conditions as defined in the specification.

For black start, the station service board shall be charged from DG set.

10.3.4 General Arrangement of Barrage Auxiliary Board (BAB)

The supply to the Barrage Auxiliary board will be through 100 kVA, 11/0.433 kV auxiliary Transformer. The 11 kV side of the transformer will be connected through overhead line from 11 kV Switchgear feeder. The 11 kV overhead line / XLPE cable connection up to the HV side of the Transformer shall be in the scope of Employer.

In case of failure of the transformer, supply shall be resumed from DG set connected to the BAB bus.

It shall be the responsibility of the Contractor to complete the work in all respect and to make the scheme functional.

10.4 Performance Guarantee

The 415 V switchgear along with all auxiliaries and accessories shall be capable of performing intended duties under specified conditions. The Contractor shall guarantee the reliability and performance of the individual equipment as well as of the complete system.

10.5 Integration with SCADA System

The powerhouse 415 V switchgear shall be suitable for co-ordination and integration with SCADA System and necessary contacts and/or ports for the purpose shall be provided.

10.6 Design and Construction

10.6.1 Standards

The system and equipment shall be designed, built, tested and installed to the latest revisions of the following applicable standards. In the event of other standards being applicable they will be compared for specific requirement and specifically approved during detailed engineering for the purpose:

Standards	Description
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 60439	Low-voltage switchgear and control gear assemblies
IEC 60364	Electrical installations of buildings
IEC 60947	Low-voltage switchgear and control gear
IEC 60044-1	Instrument transformers - Part 1 : Current transformers

IEC 60044-2	Instrument transformers - Part 2 : Inductive voltage transformers
IEC 60044-6	Instrument transformers - Part 6 : Requirements for protective current transformers for transient performance
IS: 2705 (Part I to IV)	Current Transformers
IS: 3156 (Part I to III)	Voltage Transformers
IS: 13947	Low voltage switchgear and control gear

10.6.2 415 V switchgear

10.6.2.1 General

The 415 V switchgear shall be metal enclosed indoor cubicle free floor standing type.

The cubicle assemblies shall be designed in accordance with the recommendations of IEC Publication 60439-1 with protection class IP 42 according to IEC Publication 60529. The assemblies must be built to suit the equipment shown on the single line diagram. Hinged doors and removable covers shall be provided wherever necessary to allow access to all equipment. The frame of the cubicles shall be sufficiently sturdy and the metal sheeting of sufficient thickness to ensure safe transport, mounting and operation without deformation or bulging. Natural ventilation as required shall be provided. Provision for future expansion of cubicles shall be made in end cubicles.

Continuous lifting angle or lifting hooks shall be provided to facilitate the installation of the cubicles.

10.6.2.2 Compartments

Cubicle shall be divided into sections, or compartments, housing the incoming, interconnecting or outgoing feeder air circuit breaker units and moulded case circuit breaker units respectively.

Each ACB and MCCB unit above 400A current rating shall be mounted on a carriage assembly, constructed so that the unit can be removed and replaced while the buses are energized. The carriage shall have self-engaging definite position stops for disconnected, test and connected positions. All necessary means shall be provided for easy removal and handling of the unit. MCCBs/MCB of current rating less or equal to 400A current rating shall be fixed type.

10.6.2.3 Cable compartments

All feeders to and from the cubicle assemblies will be cables. The assemblies shall be accessible for the cables from bottom to each feeder circuit breaker via separate cable compartment. Solderless connectors shall be furnished for each power conductor entering the equipment. Provisions shall be made to clamp and fasten cables in the cable compartment. Terminals for cable connection will be suitable for Aluminium cables.

10.6.2.4 Name plates

Each feeder shall be clearly identified with suitably located nameplate(s). Nameplates shall be furnished for all instruments, control switches, etc. Each section of an assembly shall have an identifying name plate placed near the top edge.

10.6.2.5 Wiring

Current transformer secondary leads shall not be less than 4.0 mm² and all secondary and control wiring shall be done with stranded copper wires of size 1.5 mm of size 1.5 mm². All control wiring within the assembly housing shall be installed at the manufacturer's premises.

All connections shall be made with solderless lugs. All wires and connections to remote equipment shall be wired to terminal blocks.

10.6.2.6 Bus bars

Bus bars shall be of high conductivity Aluminium, supported on insulators made of non-hygroscopic, non-inflammable material having high insulation resistance, high rigidity at elevated temperature and high tracking resistance. The main bus bars shall have uniform current ratings through their length. The current rating of the neutral shall be half that of the phase bus bars throughout the length.

As most of the connected loads shall be of load of induction motors, due consideration shall be given to momentary overloads at the starting of various motors for bus bar sizing of the panels. A comprehensive study shall have to be done by the successful bidder for load flow in the LTAC system in computer software as well as supporting design calculation to be submitted to the purchaser for approval.

The bus bar and supports shall be capable of withstanding the short circuit current of 31.5 kA for 1 sec. Only zinc passivated or cadmium plated high tensile strength steel bolts, nuts and washers shall be used for the bus bar joints and supports.

The bus bars shall be further insulated by heat shrunk PVC sleeve to provide additional protection against accidental contact and to prevent failure in the presence of foreign matter. The sleeves used shall be capable of withstanding the temperature attained by bus bars during normal operation.

The temperature rise of the horizontal and vertical bus bars and main bus links including all power draw out contacts when carrying the rated current along the full run shall in no case exceed 55 deg. C with silver plate joints and 40 deg. C with all other types of joints over an ambient of 40 deg. C.

The successful contractor shall have to furnish detailed design calculation in support of selection of bus bar cross section.

All bus bars shall be colour coded by means of identifying colour rings at every power tap off point. Red, yellow and blue colour shall be used for phase bus bars and black colour shall be used for neutral bus bars.

Interconnections between the main bus bars and individual units shall be made by using vertical Aluminium bus bars of adequate rating. These interconnections and the vertical bus bars shall be further insulated by heat shrink PVC sleeve. Vertical bus bars for circuit breaker cubicles shall be sized depending upon the rating and number of breakers per vertical cubicle.

Phase arrangements shall be R-Y-B from top to bottom, from back to front and from left to right when facing the front of the equipment. All bus bars shall be clearly marked by engraved letters.

Adequate provisions must be made for the expansion and contraction of the bus bars and other bus bar connections with variation in temperature. Bus bars shall be so arranged that they can be extended in length without difficulty.

All field connections shall be bolted. The connections shall be kept as short and straight as possible. Bus bars, connections and their insulating supports shall be of approved construction, mechanically strong and shall withstand all the stresses, which may be imposed upon them under ordinary working conditions due to vibration, temperature fluctuations, short circuit or other reasonable causes.

10.6.2.7 Instruments

Control switches and instruments shall be mounted on the circuit breaker compartment doors / front side of the panel.

10.6.2.8 Space Heaters

All the switchgear panels shall be provided with space heaters to prevent moisture condensation. The space heater shall be located at the bottom of the switchboard and shall be supplied from 240V AC supply obtained by tapping between a phase and neutral. The space heater shall be provided with Miniature Circuit Breaker and shall be controlled through a thermostat. A separate space heater shall be provided for each vertical panel.

10.6.2.9 Painting

All metal surfaces shall be thoroughly cleaned and degreased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under surface shall be prepared by applying a coat of phosphate paint and coat of yellow zinc chromate primer. The under surface shall be made free from all imperfections before undertaking the finishing coat.

After preparation of the under surface, the switchboard shall be spray painted with two coats of final paint. Colour shade of final paint for interior shall be glossy white & exterior shall be shade No: 631 as per IS: 5. The finished cubicles shall be dried in stoving ovens in dust free atmosphere. Cubicle finish shall be free from imperfections like pinholes, orange peels, runoff paint, etc. All unpainted steel parts shall be cadmium plated or suitably treated to prevent rust formation. If these parts are moving elements then they shall be greased.

10.7 Details of the Equipment

10.7.1 Air Circuit Breakers

Type and Rating

The 415 V circuit breakers shall have the following rating:

i)	No. of poles	3/4
ii)	Service voltage	415 V
iii)	Normal current	As indicated in clause 18.2 above
iv)	Frequency	50 Hz
v)	Symmetrical breaking current capacity	31.5 kA
vi)	Making capacity	80 kA
vii)	Short time rating for 1 sec.	31.5 kA for 1 sec. (rms)
viii)	Control circuit voltage	110 V DC, + 10, - 15%

@ DG set air circuit breaker shall be 4 poles.

Assembly-

The air circuit breakers shall be designed in accordance with the recommendations of IEC Publications 60947-1 and 60947-2. All air circuit breakers shall be of the draw out type and MCCB/MCB below and including 400A current rating shall be fixed type, housed in metal-enclosed compartments. Each air circuit breaker shall be mounted on a carriage assembly with wheels running on tracks secured to the inside of the compartment. The carriage shall have self-engaging definite position stops for disconnected, test and connected position. Means shall be provided for easy removal and handling of the breakers.

The frame of the air circuit breakers shall be solidly grounded in both test and connected positions. In the test position, it shall be possible to operate the breaker and perform complete functional tests.

The air circuit breaker shall be equipped with shutters, which automatically cover live parts when the breaker is withdrawn. Provision shall be made for padlocking the circuit breaker in the disconnected and test position.

The air circuit breakers shall be three-pole electrically operated with motor driven stored-energy operating mechanism.

Operating Mechanism-

Electrical power operating mechanism shall be motor operated spring charged energy type. However, manual operating mechanism may be of the spring charging stored energy type or the spring assisted type. For circuit breakers with electrical power operating mechanism, provision shall be made for manual spring charging. Closing time of circuit breakers with manual operating mechanism shall be independent of the speed of the operating handle.

All stored energy operating mechanisms shall be equipped with following features:

- Failure of springs, vibrations or shocks shall not cause unintended operation of breaker or prevent intended tripping operation.
- Closing of circuit breaker shall be prevented unless the spring is fully charged.
- All electrical power operating mechanisms shall be suitable for remote operation and shall be equipped with following features:

- Provided with universal motor operating on AC and DC control supplies designed to operate satisfactorily from 85% to 110% of rated voltage.
- The motor shall be suitable to charge the spring from fully discharged to fully charged condition in not more than 8 sec. The spring once fully charged shall be capable of trip, close and trip operations successfully.
- Provided with emergency manual charging facility. The motor shall be automatically, (mechanically) delinked once the manual charging handle is inserted.
- Closing operation of circuit breaker shall automatically initiate charging of the spring for the next closing operation.
- One complete closing operation shall be completed once the closing impulse is given and the first device in the control scheme has responded even though the control switch / push button is released provided no counter trip impulse is present.

Circuit breaker trip and closing coils in case of electrically operated breakers and trip coil in case of mechanically operated breakers and circuit breaker indications shall be suitable for satisfactory operation on a control supply system.

Circuit breaker trip and closing coils shall be rated for satisfactory operation under the following conditions of supply voltage variation:

- Trip coil: 70% to 110% of rated voltage
- Closing coil: 85% to 110% of rated voltage

The circuit breaker closing time shall be approximately 80 milliseconds and the tripping time shall not exceed 40 milliseconds.

The circuit breakers shall be provided with an anti-pumping feature. If an electrical relay is used for this feature, the relay shall be located on the breaker chassis. The anti-pumping feature shall be maintained even if the bus voltage disappears during a fault.

The breakers shall be trip free. If available as a manufacturer's standard feature, the breakers shall be provided with a release to trip the breakers instantaneously if closed on to a fault.

Releases-

The releases shall have the following features:

- The overload release / relay shall be provided with a setting of 70% to 110% of the breaker rated current.
- The short circuit release / relay shall be provided with minimum two settings corresponding to 750% to 1000% of the rated current and shall be provided with adjustable time delay range of 25 milliseconds and 350 milliseconds.

Contacts-

The main circuit breaker contacts shall be of the self-cleaning type, made from an arc resisting material and provided with auxiliary arcing contacts as a protection against burning during the operating of the breaker. All contacts shall be self-aligning, and shall be readily replaceable.

Main and secondary disconnecting contacts shall be silver plated with springs, which will ensure high-pressure contacts. Secondary contacts shall be engaged both in connected and test position.

Auxiliary contacts for position indication, control, interlocks, etc., showing whether the breaker is in open, closed or tripped position and whether the operating spring is locked, shall be provided and wired to terminals. Mechanical position indicators, visible from the outside without opening the circuit breaker compartment door, shall also be provided. At least 2 NO and 2 NC auxiliary contacts shall be provided for each breaker as spares after utilization of contacts in interlocking & operation scheme.

Interlocks-

Following safety interlocks shall be provided:

- A mechanical interlock shall prevent moving of the air circuit breaker from the connected position, while the breaker is closed, and prevent the access door being opened unless the circuit breaker is in test or withdrawn position. However, it shall be possible to bypass or defeat this interlock for inspection purposes.
- It shall be possible to operate a circuit breaker only in the defined "Service" and "Test" position inside the cubicle. It shall not be possible to operate the breaker in intermediate positions while inserting or withdrawing a circuit breaker or while in "Isolated" position inside the cubicle.
- Interlocks shall be provided to prevent paralleling of supplies during auto change-over operation of breakers associated with the supply scheme.

Protection

The air circuit breakers shall be equipped with adjustable magnetic short circuit over current and instantaneous trip mechanism/ relay, with auxiliary magnetic short circuit contacts for indication of tripped condition. The protection equipment shall be interchangeable.

Operational Requirements

The following air circuit breakers shall be suitable for electrical as well as manual operation and shall be draw out type with motor operated spring charged mechanism. The provision for remote electrical operation of the air circuit breakers shall also be made. These breakers are identified as below:

- All the incoming breakers to the unit-station service boards.
- Incomer Breaker to unit-station service board from DG Set

Incoming Circuit breakers shall be air break, draw out type. The normal current ratings shall be as per requirement of the scheme.

The circuit breaker shall be provided with series trip releases for overload and short circuit protection. Alternatively, electromagnetic or static relays may be offered for foregoing protections.

The circuit breakers shall be provided with mechanically operated emergency tripping device. This device shall be available on the front of the cubicle. If available as a manufacturer's standard design, mechanically operated "closing" device shall be provided for all breakers.

The circuit breakers shall be provided with minimum 6 nos. normally open and 6 nos. normally close spare auxiliary contacts, wired and available for Purchaser's use. If spare auxiliary contacts are not available, an auxiliary relay shall be used to multiply the available spare auxiliary contact.

10.7.2 Moulded Case Circuit Breakers

Assembly-

The MCCBs shall be designed in accordance with the IEC Publications 60947-1 and 60947-2. All MCCBs shall be manually operated and shunt trip type, if required.

All MCCB with current rating more than 400A shall be of draw out type mounted on draw out chassis and MCCB with current rating less than and equal to 400A shall be fixed type, housed in individual metal-enclosed compartments. Means shall be provided for easy removal and handling of the units. ON, OFF TRIP position of MCCBs should be indicated.

Contacts-

The MCCB contacts shall be of the self-cleaning type, made from an approved arc resisting material. All contacts shall be self-aligning, and shall be readily replaceable.

Main and secondary disconnecting contacts shall be silver plated, with spring, which will ensure high-pressure contact. Secondary contacts shall be engaged both in connected and test position.

10.7.3 Current Transformers

The current transformer shall be single phase, multi /single core inductive type. It shall be mounted within the cubicles and shall comply with the requirements of relevant IEC 60044-1. It shall be used for protection and metering as per single line diagram.

The ratings of current transformers for each main air circuit breaker incomers from SATs, shall be as per relevant clause of this section.

Other air circuit breakers connected to LTAC panel shall have single core CTs of suitable rating (based on capacity of breaker) for metering of 0.5 class

The secondary windings of all current transformers shall be grounded at one point only and means shall be provided to facilitate the secondary windings to be short-circuited.

• Burden and Connections

The burden rating of all current transformers shall not be less than 200% of the overall computed burden of apparatuses connected to each transformer.

10.7.4 Potential Transformers

Required no. of potential transformer shall be provided for metering and interlock as per single line diagram. Accuracy class for voltage transformer should be as following

Protection cores	3P
Metering	0.5

The Contractor shall use single-phase 240V supply available in switchgear for metering and indication.

10.7.5 Controls

10.7.5.1 General

Each air circuit breaker shall be equipped with facilities for remote operation. Each air circuit breaker unit shall be equipped with a manual / auto selection switch, local start-stop push button and an indicator showing the position of the breaker in the control room. The air circuit breaker shall be operable with the breaker in test position. Auxiliary contactors with an alarm contact for remote indication of tripped condition shall be provided for protection of the control circuits.

Auxiliary contacts for the following remote indications of the circuit breakers shall be wired to terminal blocks:

- Main contact position,
- Test and connected /service position,
- Trip condition,
- Fault condition.

10.7.6 Metering

All instruments, relays and control switches mounted in the switchgear shall be in accordance with "Section 8 - Supervisory Control and Data Acquisition System (SCADA) System" and "Section 9 - Protection System". Instruments shall be furnished with all necessary resistors, shunts etc.

Each incoming feeder containing current transformers and voltage transformer shall have energy meter, ampere meters and ammeter selector switches, voltmeters and voltmeter switches located in the respective feeder compartment doors.

All metering circuits shall be terminated in terminal blocks for remote metering purposes.

10.8 Auto Changeover Supply Scheme

The details of electrical connections for 415V AC switchgear are indicated in the drawing. For station & unit auxiliaries, two no. 500 kVA, 11/0.433 kV station auxiliary transformers shall take off from 11 kV switchgear and shall be connected to station service board through controlling breakers.

The 375 kVA powerhouse DG set shall be connected to station service board through its controlling breaker.

The auto changeover supply scheme shall be so designed that there is no paralleling of supplies from different sources.

The station service board shall draw supply independently from two 11kV / 0.433 kV Station Auxiliary Transformers (SAT) with bus coupler open. In case of failure of one station Auxiliary transformer, the supply shall be drawn from other SAT by closure of bus coupler through automated electrical interlocking. On failure of supply from both the station auxiliary transformers, the supply to unit-station service board shall be resumed from DG set after satisfying necessary interlocking conditions as defined in the specification.

For black start, the unit-station service board shall be charged from DG set.

10.9 Tests

The station service board, unit auxiliary boards and motor starter panels shall be assembled in the factory of the manufacturer, with complete apparatus, instruments and meter connected and shall be tested in accordance with requirements of relevant Indian / International Standards. Each circuit breaker shall also be subjected to routine tests in accordance with the latest issue of IS: 13947 or relevant IEC, in presence of the purchaser's representative.

Design of all the equipment/apparatus such as circuit breaker, MCCBs, CT, PT, meters etc must be got type tested as per IS or IEC. The copies of test report for type tests already conducted on similar equipment, specifically temperature rise test on similar rating of bus bar & degree of protection of panels and are not older than seven years from signing of the contract, shall be furnished along with the tender and shall be subjected to the approval of Owner.

All the routine test reports shall be submitted and got approved from the purchaser prior to despatch of the equipment.

10.10 Drawings, Documents and Design Calculations

10.10.1 Design memorandum

The Contractor shall submit to Purchaser a design memorandum prepared in accordance with clause 1.2 of "Section 1-General Technical Specifications of the proposed equipment /system fulfilling the contract specification/requirement for approval prior to submission of drawings and documents. The design memorandum shall include the design philosophy, methodology, system description, input parameters for design, standards and codes, design & selection criteria, equipment data, material specification, major technical features, basic arrangement / layout etc.

10.10.2 Drawings and documents

The Contractor shall submit all the drawings and documents in accordance with requirements stipulated in clause 1.2.2 "Section 1 - Technical Documents" of "General Technical Specification (GTS)". The drawings and documents shall include at least the following:

10.10.3 To be enclosed with the Bid

The following drawings and data in addition to those mentioned elsewhere in the specification shall be submitted with each copy of the offer:

- Single line diagram of LT Scheme offered

The tenderer shall furnish all the data/information especially guaranteed and other technical particulars called for.

10.10.4 To be submitted after award of contract

After award of the contract, a comprehensive list of drawings/documents planned to be submitted for reference/approval along with time schedule shall be furnished by the contractor for approval of the purchaser. All the drawings shall be prepared in AUTOCAD & same shall be in SCALE. The contractor shall supply following drawings, but not limited to, for purchaser's approval:

- Detailed quality assurance plan giving complete specification of the materials and specifications relating to inspection and testing of materials and finished components.
- Drawings listed above.
- Short circuit withstand calculations.
- Any drawing or information specifically required by the purchaser to check the suitability of design.
- Dimensional and OGA drawing of Unit-Station Auxiliary Board
- Dimensional and OGA drawing of WAB panels
- Interlocking and control Scheme
- Technical parametric and constructional details of Air circuit breakers
- Technical parametric and constructional details of moulded case circuit breakers
- Single line diagram of LT Scheme offered
- Foundation details of the panels
- Cable openings in the floor for cable entry to panels and cubicles
- Technical literature for all the equipment offered in the bid
- Any other informative details to illustrate the scheme

10.10.5 Design calculation

The Contractor shall submit the design calculation in accordance with "General Technical Specification (GTS)" covering at least the following, for review / acceptance.

- Calculation for selecting the cable size with de-rating capacity with temperatures and other conditions,
- Foundation loads for panels and cubicles
- Calculations for sizing of bus bar cross section

- Calculations for selection of normal & short circuit current rating air circuit breakers and MCCBs
- Fault level of each board
- Thermal ability to withstand short circuit
- Burden & Knee point voltage requirements of CTs

10.11 Spare Parts

The spare parts shall include the following for supply.

Sl. No.	Description	Quantities
1	Circuit breaker trip & closing coil	2 nos. each
2	Current transformer of each type used	1 no. each
3	Potential transformer of each type used	1 no. each
4	Fixed and moving contact of type used (each size comprises 3 set moving and 3 set fixed contact)	1 set
5	Under voltage relay	2 nos.
6	Bus insulators	6 nos.
7	Indicating lamp each type used	2 nos. each
8	Numerical Protective relay each type	1 no.

10.12 Special Tools

The Contractor shall propose the list of recommended special tools (other than those included under “Tools and Appliances” above) including their make and detailed specification as recommended by manufacturer(s) and to be accepted by the Purchaser.

10.13 Quality Assurance and Testing

The bidder shall submit the quality assurance plan along with bid for approval of the purchaser. The Contractor shall follow the quality assurance and testing requirements as per quality assurance plan approved by the purchaser.

10.14 Guaranteed and Technical Particulars

Guaranteed and Technical Particulars as called for in Vol. VI shall be furnished along with the bid. Bids lacking in this may be considered unresponsive. Particulars subject to guarantees shall be clearly marked

10.15 Completeness of Equipment

All fittings and accessories of the 415 V Switchgear which may not have been specifically mentioned in these specifications, but are usually necessary for completion of the above equipment, shall be deemed to be covered by the specification; and shall be indicated and furnished by the supplier without any charges to the purchaser.

10.16 Deviation from Specifications

While the purchaser does not bind himself to accept any deviation, due consideration will be given to any special devices or equipment put forward by the supplier with a view to increase the efficiency of the equipment and minimize the maintenance cost of the equipment as a whole.

Should the supplier wish to depart from these specifications, he shall submit a complete and itemized list of such deviations, together with full particulars of the reasons for the deviations in a separate schedule with special reference to clause and paragraph nos. of this specification. Unless this is done and also the purchaser's concurrence in respect of such deviations is obtained in writing, the equipment offered shall be deemed to comply in every resp