

# DAMODAR VALLEY CORPORATION

TECHNICAL SPECIFICATION FOR RENOVATION & MODERNISATION OF MAITHON HYDEL STATION UNIT # 1 & 3 (20 MW)

> **VOLUME - III** (ELECTRICS AND C&I)

> > PREPARED BY



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MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



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# SECTION - "A"

(ELECTRICS)

## BRIEF DESCRIPTION OF SCOPE OF WORK AND ELECTRICAL SYSTEM

CHAPTER NO - 01





### 01.0 BRIEF DESCRIPTION OF SCOPE OF WORK AND ELECTRICAL SYSTEM

### 01.01 Description of Existing Plant

Maithon Hydel Power House at Maithon consists of three units each of following capacity :

Unit # 1	:	20 MW
Unit # 2	:	23.2 MW (After Uprating)
Unit # 3	:	20 MW

Each unit is connected to 11kV/33 kV generator transformer through 11 kV bus duct. Output at 33 kV from Generator Transformer is evacuated to 33 kV Switchyard. 33 kV Switchyard consists of three nos. GT bay, 2 nos. bus coupler bay and 9 nos. outgoing feeder. Out of 9 nos. 33kV outgoing feeders, 2 feeders each are connected to 33/132 kV, 50 MVA Power Transformer for power evacuation through 132 kV lines. 33kV & 132 kV switchyard is located adjacent near the main Control room outside of power house.

Existing Unit # 1 & Unit # 3 (for which renovation and modernization with new TG work is to be taken up) is connected to 33kV power system through 11/33 kV generator transformer. Generator transformer is located in transformer vault inside access tunnel of underground power house. The important parameters of existing generator transformer of Unit # 1 & Unit # 3 are as follows.'

Rating	-	25000 kVA
Type of cooling	-	OFWF
Voltage ratio	-	33/11 kV
Connection	-	Yd1
Impedance	-	10%
Location	-	separate vault adjacent to access tunnel
Connection	-	Bus duct - LT side (11kV side)
	-	Cable (33 kV side)
Location Connection	- -	separate vault adjacent to access tunnel Bus duct - LT side (11kV side) Cable (33 kV side)





Generator output is taken through a bus bar arrangement to the generator disconnecting switch (GDS) panel. After GDS, it is connected to 11/33 kV, 25000 kVA, 50Hz, 3 Phase Generator step up transformer through overhead bus duct. Tapping has taken for LA PT panel and auxiliary transformer.

Unit auxiliary transformer of Unit # 1 & Unit # 3 are located at 11kV panel floor inside Power House. 11 kV power supply for Unit auxiliary transformers are available either from generator in operation or back feed from grid supply. Common AC Distribution Board (ACDB) for power house is installed in generator floor. Incomer for Common ACDB is provided from unit auxiliary transformer of Unit #1, Unit # 2 and Unit # 3 with a bus coupler arrangement. Separate Unit Auxiliary Panel is available for unit #1 & Unit #3. Incomer for each Unit Aux. Panel is fed through common ACDB.

A common control room consists of control, protection, metering and annunciation panels for 132 kV system, 33kV System, generators, generator transformers is provided. Generator is being synchronized at 33 kV through synchronization arrangement.

Separate DC System for Power house and common control room is available. Each DC System consists of 250V, 200AH Battery bank, 250V,150A battery charger and DC Distribution board. In addition, DC system has also 2 nos. MG set for power house. Each MG set has 3 phase, 50c/s,15kW, 970rpm motor and 250 – 300V generator. Each MG set has one DC Distribution board.

### 01.02 Scope and Brief Description of Work

The job shall be done on turnkey basis. The scope of work for the R&M of Unit # 1 & Unit # 3 with new TG includes dismantling and proper storage of the dismantled equipment/facility,

Design, detailed engineering, construction/manufacture or procurement of new electrical equipment, shop testing, packing, transportation, loading and unloading, delivery at site, storage at site, handling, erection, pre-commissioning tests and





commissioning of all equipment/system including preliminary acceptance test, performance guarantee, post commissioning services. Scope of bidder shall also include following :

- Supply of mandatory spares, commissioning spares
- Supply of special tools and tackles for the equipment/systems supplied
- Insurance during transit, storage, erection and commissioning
- Minor civil works required for fixing of electrical equipment/panels/cables/bus bars, support and reinforcement of existing foundation etc.

The Bidder shall be responsible for complete satisfactorily working of system with guaranteed parameters. All the major equipment shall be installed, tested and commissioned under supervision of representative of manufacturer of respective equipment.

The Bidder shall also include in their scope of work the fault level calculation for the complete network taking into account minimum/ maximum generation. The relay settings shall be recommended accordingly.

Bidder shall visit the site and make himself aware of existing unit, space for the bus duct, generator transformer, HT/LT Panels, Main Control Room etc. and shall take care of all aspects while designing/executing the work.

### **Miscellaneous Activities**

Following miscellaneous works shall also be included in the scope of bidder;

- Obtaining certificate from Chief Electrical Inspectorate of the state and CEA for installation and energizing the complete electrical system and equipment covered under the package. (Fees paid to statutory authorities shall be reimbursed to the bidder against production of receipt).
- Any modification or additional requirements by Statutory Authorities shall have to be carried out without time and cost implication to the purchaser.
- Arranging any other statutory approval, if required.





### 01.02.01 Supply, Erection, Testing Commissioning

The scope of bidder shall include all electrical equipment required for the power plant unit and auxiliaries covered under their scope for renovation and modernization of Unit # 1& 3 of Maithon Hydel Station.

The major equipment covered under scope of supply for each unit shall be as follows:

- 1. Generator: 20MW, 11kV, 176.5rpm, 0.85 PF. (Refer Vol II for Scope of Work and Technical Specification).
- 2. Static Excitation System: New Static Excitation System with dual channel digital AVR (Refer Vol II for Scope of Work and Technical Specification).
- 3. Excitation Transformer,
- 4. Generator Transformer: 11/33kV, 3Phase, 25000 kVA, OFWF,
- 5. Generator Terminal Cubicle:
  - Generator line side terminal cubicles consisting of Surge Suppressors, Voltage Transformer, Surge Capacitor, Current Transformer etc.
  - Generator neutral side with suitable bus links for formation of STAR POINT and neutral side CT for protection. The Generator shall be grounded through neutral grounding transformer, secondary resistance etc.
- 6. Generator Disconnecting Switch: Replacement of pneumatic operated 11kV Generator Isolator Panel (Disconnecting Switch) with motorized off load isolator having manual over ride facility.
- 7. Metering and Protection System: Metering and protection for Generator, Generator Transformer and Unit Auxiliary Transformer shall be provided. There shall be two set of Numerical relays for protection namely Main-1 and Main-2. Main-1 relay panel is not in the scope of bidder. Redundant Protection Relay Panel for Generator and Generator Transformer containing Main-2 relays shall be in Bidder's scope.

Redundant Protection Relay Panel shall comprise of redundant protections for Generator, GT, Overall differential protection and Lock Out relays for both the units. The following protections shall also be included in new Redundant Protection Relay Panel:

- (a) Back up Over Current Protection for UATs,
- (b) Rotor E/F protection scheme with latest state of the art technology,
- (c) 100% stator E/F protection,





- (d) Standby E/F protection and
- (e) BU Impedance protection
- (f) Low impedance REF for new GT.
- 8. 11kV Bus Duct: HT Bus duct from generator disconnecting switch panel to generator transformer with tapping and termination arrangement for existing Unit Auxiliary Transformer and new excitation transformer with all accessories including termination at both end.
- 9. Replacement of 11kV UAT#1 Isolator panel along with motorized isolator. CTs and associated busbars with busduct for connection with 11kV side UAT#1 busbar.
- 10. One (1) no. 220V DC Distribution Board –for Control Room (Over ground).
- Two (2) Sets of 220V, 200AH plante type battery bank each set for Control Room (Over ground) and Power House (under ground).
- Two (2) sets of Float cum Boost Charger each set for Control Room (Over ground) and Power House (under ground) as replacement of existing MG sets at Power house & control room along with change over panel.
- 13. All DCDBs shall have provision to receive two input supplies along with suitable changeover between the two input sources.
- 14. Retrofitting of existing two (02) nos. of 250V DC Float cum Boost Charger as 220V DC Float cum Boost Charger.
- 15. Local Control Stations, if required.
- 16. Electric Motors and Actuators including LT motors for drives and MOVs etc.,
- 17. Local Push Button stations for drive motors, as required.
- 18. 33kV unearthed cables for evacuation of power from GT upto 33kV switchyard: 2RX3CX240sq.mm per GT.
- 19. LT Power and control cables, instrumentation cables as per requirement and accessories including their termination at both ends.
- 20. Bus duct supporting structure, Cable supporting structures, GI cable trays (ladder type and perforated type), cable racks, other associated accessories and fire sealing materials for laying, termination and sealing of cables are under bidder's scope of supply. Cable trestles, if needed within the battery limit for supporting bidder's cables, shall be in the bidder's scope. Bidder shall lay separate trays for laying different type of cables like power, control and screened cables.
- 21. Supply of all erection materials, required during erection shall be under bidder's scope.





- 22. Complete earthing system for all the equipment/systems equipment earthing and electronic earthing as per actual requirement. Earthing connection of all new equipment at two points to existing network.
- 23. Welding sockets (415V), Power receptacles, 240 V sockets, 240V Industrial type sockets etc. are included in the scope of the bidder.
- 24. Illumination within battery limit including DC emergency lighting.
- 25. 33 kV Switchyard Equipment:
  - New 36 kV SF<sub>6</sub> Circuit Breaker for GT Bay # 1 & GT Bay # 3.
  - New 36 kV Isolator
    - 2 Sets each for GT Bay# 1 & 3 with associated connectors and pipe bus.
    - 2 Sets each for diversion of Generator Transformers of Unit # 1 & 3 through existing 33kV Bus Coupler Circuit Breaker – Bc#1 & BC #2 respectively
  - New 33kV Current Transformer
    - Two set each for GT Bay # 1 & GT Bay # 3.
    - One set each for diversion of Generator Transformers of Unit # 1 & 3 through existing 33kV Bus Coupler Circuit Breaker – Bc#1 & BC #2 respectively
  - Conductors, connectors, insulators and required no. of gantry with associated structure to be included in the scope for the said job. Moreover, necessary protection equipment for implementing diversion scheme also need to be included. as per dwg. No. MEC/11/S3/Q7K6/TS/E/05 enclosed in Volume IV.

Erection, testing, commissioning including transportation of all equipment and materials are in the scope of bidder.

Supervision of erection, testing and commissioning of TG set, their controls including electrics shall be by representatives of respective equipment manufacturer.

Installation & testing of cabling system, including cable, trays/supports etc. shall be in the scope.

Laying and termination of all interconnecting cabling required for completeness and commissioning of the Unit shall be in the scope of bidder.

All control metering and protection cables required for connection to relays, meters, signaling alarm, control, monitoring etc. at control room shall be provided, laid and





terminated at both ends by the bidder e.g. control cables from HT transformer's marshalling boxes to MCR, junction boxes of 33 kV isolator, CB, earth switches, CT/PT of yard to marshalling box and marshalling box to MCR.

All the control switches in the Panels and Mechanical Equipments shall be Lock out tag out (LOTO) enabled. Details of the LOTO enabled control switches and mechanical equipment shall be finalized during detailed engineering.

A brief description of control philosophy and layout for complete power plant is given in the subsequent chapter for understanding of bidder. Bidder shall provide accordingly. Irrespective of the details provided, bidder shall include complete electrics for the Unit under his scope of work.

The detailed specification and schedule of quantities also covering the minor equipment shall be worked out by the bidder for the total implementation of the job.

The technical requirements of the main equipment involved are covered in technical specification section and other appropriate sections forming part of this specification.

All other existing equipment and structures necessary to complete the work within battery limit.

### 01.02.02 Dismantling:

Dismantling of all equipment within battery limit

Bidder has to remove all the old/ existing equipment along with cables. All the unused existing equipment shall be removed, packed and placed in a proper place as decided by the purchaser. Following major existing equipment shall be dismantled

- 33 kV circuit Breakers, current transformers and Isolators of GT # 1 & GT # 3 Bay.
- Unit # 1 & Unit # 3 Generator Transformer,
- 11 kV Generator Panels
- HT, LT Power and Control cables

(Note: 415V power Cables from UAT to Common ACDB incomer shall be retained)

- Existing 11kV UAT#1 isolator panel, associated busbars with busduct and other accessories for connection with 11kV side UAT#1 busbar.
- Cable trays, supporting structures, cable racks etc.
- Excitation-AVR-PT Panel,





- HT Bus duct,
- Neutral grounding cubicle,
- Field Breaker Panel,
- CTs, PTs, LAs etc,
- Battery Banks, MG sets and DCDBs,
- All Steel structure required to complete the job,

### 01.02.03 Battery Limits and termination points

The scope of Renovation & Modernization of Unit # 1&3 of Maithon Hydel Station (i) shall start from Penstock up to draft tube end and (ii) shall include complete electrics and C&I upto drives. Power evacuation upto 33 kV GT bay including generator transformer shall be included in bidder's scope.

### 01.02.04 Exclusions

The following equipment have been excluded from the scope:

- a. DCS / PLC for TG Control
- b. SCADA
- c. Unit Control Panel for Unit#1& 3
- d. Synchronising panel
- e. 415V AC Unit Auxiliary Board and common ACDB
- f. 132 kV yard equipment.
- g. Unit Auxiliary Transformer # 1 & # 3
- h. 220V unit DCDB for Unit#1& 3
- i. Unit Protection Panel for Unit#1&3 (containing Main-1 relays)

### 01.03 Electrical System Design

### 01.03.01 General

### Standards

The design, manufacture, assembly and testing as well as performance of the equipment shall conform to the relevant IS specifications (latest revision). In case the bidder is not in a position to comply fully with certain IS specifications, or in





respect of certain items for which there are no IS specifications, the bidder may base his proposals on IEC/BS/VDE/DIN recommendations or other reputed national or international standards subject to the approval of the purchaser/Consultant.

All equipment supplied and all work done including system design and detailed engineering shall also comply with the statutory requirements of the Government of India, the Government of Jharkand and with the Indian Electricity Rules.

### **Climatic Conditions**

The climatic conditions generally prevailing at Maithon have been described in Volume I (Commercial Volume).

Electrical Equipment selection and de-rating shall generally be based on ambient temperature of 50 deg. C.

### 01.03.02 **Design Criteria**

Standard Voltage levels The standardized voltage levels as given in table no. 01.01 shall be adopted.

### Table 01.01

### **Standard Voltage levels**

SI.No.	Description	Voltage level		
i.	Generation	11kV, 3 Phase, 3wire, 50Hz, Resistance earthed		
ii.	Evacuation and Transmission	33kV, 3 Phase, 3 wire, 50Hz effectively earthed		
		132 kV, 3 phase, 3 wire 50Hz effectively earthed		
iii.	Station supply	415 V, 3 phase, 4 wire, 50 Hz, effectively		
		earthed.		
iv.	A.C. Drive motors	415 V, 3 phase, 4 wire effectively earthed		
v.	Metering	110 V, AC PT. voltage		
vi.	Control & protection of LT	220 V, DC 2 wire unearthed		
	switch- gear, D.C. drives			
vii.	Panel lighting and space	230V, 1 phase, 2 wires space heaters 50 Hz,		
	heaters	A.C. with point earthed.		





### Permissible variations

The system unit/plant equipment shall be designed suitably for variation in voltage and frequency as indicated in Table 01.02

### Table 01.02

### Variation in Voltage and Frequency

	Description	Voltage	Frequency
SI.No			
1.	Permissible variation with rated	+ 6% to - 6%	+ 3% to - 5% For LT system
	performance/ rated current and	+ 6% to - 9% ,	+ 3% to - 5% For HT
	control maintained		system effectiveness system
		+10% to -12.5%	+ 3% to - 5%For EHT system
2.	Permissible variations for	+/- 10% ,	+3% to - 5%
	control and regulation equipment		
	with rated performance and		
	control quality maintained.		
3.	Permissible voltage dip	- 5%	
	at LT switchgear bus for		
	starting of LT motors		

### **Basic Insulation Levels**

Equipment shall be designed suitably for basic insulation levels as given in Table 01.03.

### Table 01.03

### **Basic Insulation Levels**

SI. No	Nominal voltage kV	BIL kV (peak)
1.	132 kV	650
2.	33 kV	170
3.	11 kV	75
4.	415 V	1.1





### Symmetrical short circuit ratings

The three phase symmetrical short circuit ratings of the switchgear at different voltage levels will be as indicated in Table 01.04.

### Table 01.04

### Symmetrical Short Circuit Ratings

SI. No.	Voltage level	Symmetrical Breaking capacity	Making Capacity
1.	132 kV	40 kA	100 kA
2.	33 kV	25 kA	62.3 kA
3.	11 kV	40 kA	100 kA
4.	415 V	50 kA	75 kA
5.	220 V DC	10 kA	-

The rated short circuit withstand duration for switchgear of 132 kV is 3.0 sec, 33 kV is 3 Sec and for 11 kV it will be 3 Secs whereas for 415 V including MCCs it will be 1 sec.

### Motor Starting and permissible voltage dips :

Voltage dip on starting of the largest motor shall be limited to 15% of the nominal voltage at the motor terminals.

### System Earthing

132 kV systems is effectively earthed.33kV system is effectively earthed.11 kV System earthed through resistance415 V system will be effectively earthed in line with IE Rules.

### **Other Requirements**

The electrical distribution scheme to be provided will be subject to approval of purchaser/purchaser's consultants.

Miscellaneous items such as relays, type of relays, relay ranges, number of poles for relays, scale of meters, CT ratios, links, fuses, switches, indication lamps, terminal blocks, aux. relays, timers associated with main relays, size of control cables shall be supplied as per the approved scheme/to achieve scheme requirements.





All LT CTs shall be of 5A secondary and HT/EHT CTs shall be 1 amp. Secondary. Control cable from CT to panel shall of 4 sq.mm. copper.

Energy meters and corresponding CTs and PTs shall be as per amendment dated 04.06.2010 to CEA (Installation and operation of meters) regulation 2006 shall be as follows :

Energy Accounting and audit meters

- 1. In generating stations, the accuracy class of meters at a point after the generator stator terminals and before the tap off to the unit auxiliary transformer (s) shall not be inferior to that of 0.2S accuracy class. However, the accuracy class of other meters shall not be inferior to that of 1.0S accuracy class.
- 2. The accuracy class of meters in transmission system shall not be inferior to that of 0.2S accuracy class.
- 3. The accuracy class of meters in distribution system shall not be inferior to that of 0.5S accuracy class.
- 4. The accuracy class of Current transformer (CTs) and Voltage transformers (VTs) shall not be inferior to that of associated meters

All erection/installation accessories, cable termination and jointing kits, cable fixing, dressing, tag numbers, route markers, supporting materials for all equipment shall be part of the bidder's scope.

Motor space heater (if required) power supply shall be fed from respective MCC/Distribution board. Space heaters will be interlocked with motor main power supply.

Earthing mat is already provided for complete power plant area. Existing earthing connections/ strips needs to be checked for continuity and to be refurbished / extended if needed for making suitable to connect all equipment in the scope of bidder.

Selection of components and cable size for MCCs shall be as per chart given in Annexure-I.

Bidder to submit a system wise drive list indicating process interlocks, permissive conditions etc. with places and mode of control for each drive control system philosophy with provision of various control, indication, measuring devices at various places. This shall be approved by the purchaser/consultant. Based on above





approved philosophy bidder shall have to provide all equipment/materials and prepare a control scheme/logic diagram.

Above mentioned control philosophy and interlocking logic shall be prepared as per the technological requirement.

Bidder shall include in his scope dummy panels for switchgear and control panels, wherever civil beam blocks cable entry to panel.

For control and protection requirement, DC supply shall be used.

### 01.03.03 **Design of Electrical Auxiliary System**

The electrical auxiliary system shall be designed considering available short circuit levels, switchgear duties and voltage dips on auxiliary buses for the various operating conditions. The impedance values of transformer shall be selected with a view to limit the fault levels and voltage dips.

### 01.03.04 **Power Distribution Scheme**

The electrical power distribution and control scheme shall be based on the scheme elaborated below. Bidder shall follow the system design in general on these lines and design the equipment based on criteria given in earlier paragraphs.

The generator shall generate power at 11 kV. The generator shall be directly connected to LT side of 11/ 33 kV, 25 MVA generator transformer through HT Bus duct. From Generator transformer power will evacuate through 33kV Cables to existing GT bays GT#1 & GT#3.

Existing 3 phase, 50 Hz, 11000/433 V, 400kVA Unit Auxiliary transformer of unit 1 & unit 3 shall be retained. Unit Auxiliary Board of Unit # 1 & unit # 3 and common ACDB shall be retained.

The electrical distribution scheme shall be based on common ACDB shall be fed from LT side of unit Aux. transformer of all units and incomer of unit auxiliary board shall be fed from common ACDB. Existing scheme is shown in single line diagram no. MEC/11/S3/Q7K6/TS/E/01 and MEC/11/S3/Q7K6/TS/E/03

### **Power Evacuation**

Existing transformers are installed in transformer vault adjacent to power house access tunnel. 33/132 kV switchyard is existing and located outside of power plant





near control room building. Power will be evacuated from 11/33 kV generator transformer to 33 kV GT #1 and GT# 3 bay through 33kV, UE, 2R X3CX240sq.mm XLPE Cables.

### 01.03.05 Elaboration of Electrical Scope of Work

The scope of work and different design requirement have been given in different chapters, however, for ease of understanding it is briefed in following paragraphs.

### 01. Generator Transformer

New Generator Transformer for Unit # 1 & 3 shall be provided. Rating of each generator transformer shall be 11/33 kV, 3 Phase, OFWF, 25 MVA.

### 02. Generator Terminal Cubicle

### a) Line Side Terminal Cubicle

New line side terminal cubicle shall consists of

- i) line side CT for metering, protection and AVR shall be provided in this cubicle.
- ii) 11/ 0.110kV Potential transformer for metering, protection, AVR and for synchronization shall be provided
- iii) Lightning arrestor.

### b) Generator Neutral Grounding Cubicle

The generator neutral grounding equipment shall be housed in a metal enclosed cubicle. The high resistance grounding of a generator neutral shall be adopted by connecting the primary of a single phase distribution type earthing transformer between generator neutral and ground with the transformer secondary being shunted by resistance with a voltage relay and harmonic filter. Current transformers for metering & protection shall be provided in this Cubicle.

### 03. Metering and Protection System

There shall be two set of Numerical relays for protection namely Main-1 and Main-2. Main-1 relay panel is not in the scope of bidder. Redundant Protection Relay Panel for Generator and Generator Transformer containing Main-2 relays shall be in Bidder's scope.

Redundant Protection Relay Panel shall comprise of redundant protections for Generator, GT, Overall differential protection and Lock Out relays for both the units. The following protections shall also be included in new Redundant Protection Relay Panel:





- (a) Back up Over Current Protection for UATs,
- (b) Rotor E/F protection scheme with latest state of the art technology,
- (c) 100% stator E/F protection,
- (d) Standby E/F protection and
- (e) BU Impedance protection
- (f) Low impedance REF for new GT.

### 04. HT Bus Duct

11 kV generator busduct shall be phase segregated with rectangular shaped enclosure. Enclosure shall be continuous type. Bidder shall include the Generator busducts consisting of following minimum items;

- a) Generator main Busduct from generator terminals to generator transformers and tap offs to unit auxiliary transformer
- b) Generator busduct tap off to surge protection & VT cubicle
- c) Generator busduct tap off to Excitation Transformer
- d) All associated equipment/items like Terminal bushing flexible/rigid joints, required no. of bends, silica gel breather, space heater, etc
- e) Set of maintenance tools and tackles as required.
- f) Earthing of busducts with continuous run of conductors
- g) Necessary support structures, erection hardware

### 05. Generator Disconnecting Switch

A motorized isolator with manual operation facility enclosed in a panel shall be provided for isolation of generator from generator transformer.

### **06.** Unit cum Station Auxiliary Transformer

Existing 400kVA, 11/0.415 kV, Cast resin dry type transformer of Unit # 1& Unit #3 shall be retained.

07. New static excitation system with digital AVR along with Excitation Transformer

For detail refer Volume – II of Technical Specification.





### 08. 415 V Unit Aux. Board and Common AC Distribution Board

415V Unit Auxiliary Board (UAB) of Unit#1 & Unit # 3 and common AC distribution board is not in the scope of bidder. However termination at both end from UAB/ Common ACDB to drives / LT load is in the scope of bidder.

# 09. DC System (Battery bank, Battery Chargers, DC Control Panel and DC Distribution Board)

### DC System for Control Room:

Existing battery bank shall be replaced with new 220V, 200AH plante type battery bank. Existing 250V, 150A float cum boost battery charger shall be retrofitted as 220V, 150A Float cum Boost Battery Charger. Existing MG set shall be dismantled and one new 220V DC FCBC shall be provided in place of MG set. Existing Common DC Distribution Board shall be replaced with new DCDB.

All cables including terminations is in the scope of bidder.

Both the chargers shall be connected to new control room DCDB through change over panel.

### DC System for Power House:

Existing battery bank shall be replaced with new 220V, 200AH plante type battery bank. Existing 250V, 150A float cum boost battery charger shall be retrofitted as 220V 150A Float cum Boost Battery Charger. Existing MG set shall be dismantled one new 220V DC FCBC shall be provided in place of MG set.

All cables including terminations is in the scope of bidder.

Both the chargers shall be connected to existing Common Power House DCDB through change over panel.

### 10. LT Motors

AC squirrel cage industrial motors shall be fed at 415V, 3 phase, 50 Hz, with DOL start.

415 V AC energy efficient motors shall be provided to all auxiliaries covered under this package as per system requirement.





### 11. Cabling (Cables, Cable supporting materials, trays etc)

All HT/LT power, control cables and cable accessories supporting structures, cable installation, cable terminations with necessary junction boxes and fire sealing are under the scope of bidder for all areas covered in the package.

All control and protection cables required for connection to relays, meters, signalling alarm, control, monitoring etc. at main station building shall be provided, laid glanded and terminated at both ends by the bidder. Existing cables shall be removed and placed in proper condition in a place identified by the purchaser's store.

All erection/installation accessories, cable termination and jointing kits, cable fixing, dressing, tag numbers, route markers, supporting materials for all equipment covered in the package shall be part of the bidder's scope.

Bidder may use existing cable trays provided vacant cable trays are available. However, strengthening of its' supporting structures, if needed shall be carried out by the bidder for laying of cables under this scope.

Selection of components and cable size for MCCs shall be as per chart given in Annexure-I.

Bidder shall have to submit the layout indicating location of all major electrical equipment and cable routes including levels of floor, clearances, entry/exit points, cable structure details during detailed engineering stage.

### 12. Miscellaneous

### Illumination

Illumination of Power house (inside) and Power House wall (outside) is in the scope of bidder. New wiring & light fittings for office shall be provided. Light fittings shall be selected considers aesthetic look and requirement. Light fittings near all equipment within battery limit shall be provided. Main Lighting Distribution Board shall be retained.

### **Earthing Materials**

Separate earth pit shall be provided for major power house equipment (generators, transformers etc)





New GI flexible/flats are to be provided for connecting all equipment within battery limit to existing earth grid.

### Local Control Station

Local Control Station shall be provided near all motors.

### 13. Cabling and Linking of All Switchyard Equipment pertaining to unit-1 & unit-3 to Unit control Room is in the scope of bidder.

### 14. Control & Instrumentation

Supply and erection of DCS / PLC for unit control is not in the scope of bidder. However interfacing of any equipment / system with existing DCS / PLC is in the scope of bidder. All termination for interfacing is in the scope of bidder.

The automation control shall have normal operation control, Governor control, process protection control.

The Control System among other things shall have

- Automatic Control of the unit
- Acquisition of operational data about generating units, transformer, 33 kV CBs. Unit Auxiliaries, Station Auxiliaries.
- Indication & recording of faults
- HMI with Technological equipment
- Annunciation
- Operation Documents

The Control shall be of two level

- Local manual / Automatic
- Control from MCR and UCR

The main control desk of the unit in MCR shall have the following minimum analogue control, metering and indication.

### MANUAL CONTROL

- Normal Start
- Normal Stop
- Emergency Stop





- GCB switch ON/OFF
- FCB switch ON/OFF
- Load lower / raise
- Speed Lower / raise
- Voltage Lower / raise
- Reactive power Lower raise
- Synchroscope / Bus Selector Switch.

### 15. Switchyard Equipment

Existing 33 kV Breaker of GT#1 Bay and GT#3 Bay shall be replaced with new  $SF_6$  Circuit breaker.

36 kV isolators of both GT bay#1 & GT Bay# 3 shall be replaced with motorized cum manual isolators.

All Current transformers of GT Bay # 1 & GT Bay # 3 shall be replaced.

# 16. Diversion of Generator Transformer through existing 33 kV Bus Coupler Circuit Breaker

Diversion of power from Generator transformer of Unit # 1 & Unit # 3 shall be carried out through bus coupler BC # 2 and BC # 1 as per enclosed Drawing No. MC/11/S3/Q7K6/TS/E/05 (ref: Volume-IV) to avoid generation loss in case of problem in GT Bay # 1 & GT Bay # 3 breaker. 36 kV isolators and current transformers along with pipe bus, connectors, post insulators and associated supporting structures including gantry shall be provided. The development and implementation of diversion scheme with necessary protection equipment shall be in bidder scope.

## PERFORMANCE REQUIREMENT AND GUARANTEE

CHAPTER NO - 02







### 02.00 PERFORMANCE REQUIREMENT AND GUARANTEE

- 02.01 The bidder shall study the specification and satisfy himself thoroughly regarding the workability of the plant, equipment and systems offered and also take full responsibility for the guaranteed operation and performance of the same as well as for their smooth, safe and reliable working.
- 02.02 All equipment shall be guaranteed for workmanship, materials design and satisfactory performance to the parameters in accordance with the specification document and relevant clauses of the Commercial Volume. The guarantee for performance shall cover individual items and systems for their ratings / outputs.
- 02.03 The bidder shall also guarantee the integrated operation of all the systems and equipment covered in his scope as a whole including interfaces required to be established with other related systems and equipment.
- 02.04 The bidder shall conduct performance / acceptance tests on each of the major items of equipment supplied to demonstrate that the equipment and system supplied are capable of achieving the performance parameters specified and contracted for, in accordance with the General Conditions of Contract. The total system performance shall also be guaranteed and demonstrated.
- 02.05 Should the tests specified show that the unit has failed to achieve the guaranteed parameters, the supplier shall carry out necessary modifications or part replacements to achieve the guaranteed parameters and for successful demonstration the tests shall be repeated

### **TECHNICAL SPECIFICATION**

CHAPTER NO - 03



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



### 03.0 TECHNICAL SPECIFICATION

### 03.01 GENERATOR TRANSFORMERS

### 03.01.01 Electrical Design

- Generally as per IS 2026
- 3 phase core type
- Rated output voltage ratio, vector group shall be as specified in technical particular for design.
- Rated frequency 50 Hz + 3%, -5%.
- Insulation level shall be designed according to the voltages specified below.

SI no.	Nominal System voltage	11 kV	33 kV
1	Max. system voltage (kV)	12	36
2	One minute power frequency withstand voltage (kV)	28	70
3	Peak impulse test with stand voltage (kV)	75	170

- Transformers shall be capable of delivering rated current at an applied voltage upto 105% rated voltage without exceeding the temperature limits.
- Overload capacity as per IS 6600 1972 unless otherwise specified.
- Shall be operable at its rated capacity at any voltage within  $\pm$  10% of rated voltage of the particular tap.
- Transformer shall be Bi-directional
- For altitude exceeding 1000m above mean sea level, an adjustment of the temperature rise shall be necessary in accordance with IS 2026 (Part-II 1977).
- The max. temperature at the end of the specified duration shall not be more than 250 °C with the temperature prior to short circuit corresponding to maximum permissible overload.
- Designed for suppression of harmonics especially 3rd and 5th.
- In case of forced cooled transformers, these shall be able to deliver rated power for 10 minutes even if the forced cooling fails with the winding hot spot temperature limited to 140 °C. Where the cooler are provided, similar operation shall be permissible for 20 minutes on failure of one cooler.
- The flux density of transformer shall not exceed  $1.9 \text{ Wb/m}^2$  at any tap position with  $\pm 10\%$  voltage variation from voltage corresponding to the tap. Transformer shall also withstand following over fluxing conditions on combined voltage and frequency fluctuation
  - a) 110% for continuous operation



#### MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



- b) 125% for at least one minute
- c) 140% for at least five seconds
- Noise Level

The noise level of transformer shall not exceed the values specified in NEMA TR - 1.

03.01.02	Technical Particulars of the Ge	enerator	Transformer
-	Service	:	Outdoor
-	No. of Phases	:	3 Phase
-	Voltage HV/LV	:	33 kV/11 kV
-	Frequency	:	50 Hz
-	Continuous rating	:	25 MVA
-	Winding connection	:	HV – Star / LV – Delta
-	Vector group	:	YNd1
-	Cooling	:	OFWF
-	Percentage impedance	:	10 % (Indicative)
-	Maximum permissible		
	Temperature rise over		
	ambient of 45 deg C		
	a) In top oil	:	50 deg. C
	b) In winding	:	55 Deg. C
-	Type of Tap Changer	:	Off Circuit tap changer
-	Tapping Range	:	+7.5% to -2.5%
-	Total tap positions	:	5
-	Taps above nominal voltage	:	3
-	Taps below nominal Voltage	:	1
-	Voltage per step variation	:	2.5 %
-	Short circuit capability	:	To withstand the rated short circuit at its terminals for three seconds
-	Termination	:	HV : Cable LV : Bus bar
-	Short cicruit level on HV side	:	1750 MVA
-	Parallel operation	:	Suitable for parallel operation with transformers





MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



### 03.01.03 Construction

### **Magnetic Circuit**

- The core shall be constructed from high grade cold rolled non aging grain oriented silicon steel lamination.
- Laminations shall be annealed in a non-oxidizing atmosphere to relieve stresses and restore the original magnetic properties of CRGO sheets after the cutting and punching operations.
- CRGO sheets shall be coated with insulation varnish compatible with the cooling liquid.
- Insulation to withstand annealing temperature as high as 850 Deg. C and shall reduce eddy current to minimum.
- Ducts to be provided to ensure adequate cooling.
- Core, framework and clamps arranged and tightened to securely hold laminations in order to prevent any settling of displacement in case of heavy shocks during transport, handling or short circuits.

### Windings

- Material shall be electrolytic grade copper.
- Shall be subjected to shrinkage treatment
- Completed core and winding to be vacuum dried in full vacuum and impregnated immediately.
- Shall be braced to withstand shocks due to rough handling, and forces due to short circuit, switching or other transients.
- Permanent current carrying joints in winding and leads shall be brazed.
- Coils shall be supported using dried and high pressure compressed wedge type insulation spacers.
- Insulating materials shall be compatible with transformer liquid under all service conditions.
- Leads to the terminal board and bushings shall be rigidly supported.

### Insulation

- Inter turn and inter coil insulation shall be designed such that di-electric stress is uniformly distributed throughout the windings under all operating conditions.

### Off-Circuit Tap Switch

- Externally hand operated
- Designed for sustained over current of at least 150% of the rated current of the winding.
- Shall not occupy any intermediate position between clearly marked tap position.
- Capable of repeated operation and withstanding short circuit forces.



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- Integral handle with pad locking facility at every tap position.
- Tap position indicator
- Inspection and/or repair shall not require removal of transformer from tank nor major draining.

### Tank

- Welded thick gauge plates stiffened and reinforced to withstand without deformation all stresses applied during transport and operation or short circuit conditions.
- Oil tight welds and joints
- The tank body excluding tap changing compartments, and coolers shall be capable of gauge pressure of 68% and or 500 mm of mercury vacuum.
- Plates shall be protected internally against corrosion due to insulating liquid.
- Provided with inspection opening and cover/with handling equipment to provide access to bushing connections.
- Form of cover shall be such as to prevent any stagnant water deposit and to drain gas bubbles towards the buchholz relay
- Tank shall be capable of withstanding of 250 mm of mercury vacuum.
- "Each tank shall be provided with lifting lugs suitable for lifting the transformer complete with oil "
- A minimum of four jacking pads, in accessible position to enable the transformer complete with oil, to be raised or lowered using hydraulic or screw jacks the minimum height or the lugs above the base shall be as follows :
  - i) Transformers up to and including 10 tones of weight –300 mm excluding the under base dimensions if detachable.
  - ii) Transformer above 10 tones of weight –500 mm excluding the base dimensions, if detachable.
- Suitable haulage holes shall be provided.
- The tank cover shall be fitted with pockets for a thermometer and for the bulbs of oil and winding temperature indicators. Protection shall be provided, where necessary, for each capillary tube.
- The thermometer pocket shall be fitted with captive screwed tap to prevent ingress of water.
- Conservator Vessels, Oil gauges & Breathers.
- Conservator mounted on frame, integral with tank in such a manner that under all conditions and the lowest oil level the bushings remain under the head of liquid.
- Conservator volume shall be sufficient to maintain oil from ambient to oil temp. of 90 deg.C.



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- Oil filling hole with cap, and a drain valve to drain the oil completely shall be provided. One end of the conservator shall be bolted into position so that it can be removed for cleaning purposes.
- Silica gel breather with inspection window shall be mounted at 1.4 m from ground level and connected to conservator.
- Prismatic type oil level gauge with max. and min. levels marked. One 150 mm diameter dial type magnetic level gauge with alarm and trip contacts shall also be provided.

### **Buchholz Relay**

- Double float relay as per IS 3637-1966.
- Shut off valves on either sides of the buchholz relay
- Pot cocks at the top and bottom of relay drain plug, inspection window, calibrated scale, terminal box with oil tight double compression type brass gland.
- Potential free, self reset independent alarm and tripcontacts, rated to make, break and carry 2 amps at 220V DC. No auxiliary relay shall be used to multiply the contacts. Contacts are to be wired to the marshalling box.

### Cooling

The cooling system provided shall be OFWF type .

OFWF - Oil forced, water forced

Cooling system shall be designed and supplied with a concept of 2 x100% configuration to facilitate one working and one stand by. On tripping of oil pump, cooling water valve shall also be tripped to avoid ingress of water.

Two (2 nos.) Pump – motor set (1 working and 1 standby) shall be provided along with pipes, valves etc to facilitate water for cooling of oil

The oil circuit of oil coolers shall be provided with the following :

- 1. A valve at each point of connection to the transformer tank
- 2. Removable blanking plates to permit the blanking off the main oil connection of each cooler
- 3. A drain valve 25 mm lowest point of each bank cooler
- 4. A thermometer pocket fitted with a captive screwed cap on the inlet and outlet oil branches of each separately mounted cooler bank
- 5. Air filter valve at the top and bottom of each cooler
- 6. Air release plug

In addition , the following are to be provided as per IS : 6088

- a) A suitable differential pressure gauge fitted with electrical contacts
- b) Oil and water flow switches fitted with electrical contact
- c) Flow indicator



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### Valves and connections

- Valves of sluice type with hand wheels
- Made of gun metal
- Clear indication of open and closed position
- Provided with blanking plates or screwed plugs
- Padlocking facility to lock in closed/open position.

### Terminations

It shall be possible to withdraw the transformer easily after disconnecting the connections without disturbing the busduct terminations. For busduct termination, proper matching flange arrangement shall be provided. For Overhead line termination, proper bushing shall be provided.

### Bushings

- Conform to IS 3347 Part 5 1979, Part 3 1988 and 2099 1986.
- Minimum rated current of line and bushings shall be 1.5 times rated current of the corresponding windings
- Clamps and fittings made of steel or malleable iron shall be hot dip galvanised.
- Bushings rated 400 Amps and above shall have non magnetic clamps and fittings only.
- Neutral bushings shall be provided as required for earthing of neutral point.

### **Bushing current Transformers**

- CTs for back up earth fault shall be provided on the neutral end.
- Removable at site without opening transformer tank cover/active parts.
- Secondary leads shall be brought to a weather proof terminal box and from there to the marshalling box.

### **Oil temperature Indicator**

150 mm dial type thermometer with manual reset maximum reading pointer. there shall also be two potential free contacts for alarm and trip signals. The alarm and trip settings shall be independently adjustable. The temp. sensing element mounted in a pocket of oil, shall be connected to the indicator through capillary tubing. Contact rating at DC shall be minimum 0.5 amps.

### Winding Temperature Indicator

a) Local winding temperature indicator (WTI) shall have a 150 mm diameter dial type indicator with a manual reset max. reading pointer. There shall be two potential free contacts for alarm and trip signals. For transformers with forced cooling, another set of contacts shall be provided to start/stop the forced cooling system automatically. The settings for closing/opening of each contact shall be independently adjustable. Contact rating at 220V DC shall be minimum 0.5 amps. The device shall be complete with lamp, sensing element, image coil, calibration device, aux. CTs etc. as required.



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b) Remote winding temperature indicator with resistance type temperature detector, shall be provided additionally.

### Marshalling box

- All outgoing connections from the transformer i.e buchholz relay, temp. indicators, level indicators, CT secondary, fault contacts for annunciations, including forced cooling system etc. shall be wired to a marshalling box.
- Degree of protection of enclosure shall be IP 52 for indoor and IP 55 for outdoor type respectively.

### Earthing

- All metal parts of the transformer with the exception of individual core laminations, core bolts, and clamping plates shall be maintained at fixed potential by earthing.
- Two tinned copper earthing terminals
- One end of bushing CTs shall be earthed.
- Ensure equipotential to transformer frame and top cover which should be connected using copper flat.

### List of fittings and Accessories

- Identification plate
- Rating and diagram plates.
- First fill of oil as per IS 355,1983 with 10% excess in drums
- Cooling system complete with accessories as specified
- Off-circuit tap switch as specified.
- Conservator with oil level gauge.
- Dehydrating breather
- Buchholz relay with alarm and trip contacts.
- Oil filter valves at top and bottom of tank
- Drain off valve at lowest location to allow complete draining
- Oil sampling device at top and bottom
- Pressure Relief devices with alarm and trip contact
- Pockets with thermometers for oil temp. and winding temperature indicators.
- HV, LV and neutral bushings.
- Bushing CTs as specified
- Dial type oil and winding temp. indicator with maximum reading pointer and alarm and trip contacts
- Lifting lugs and jacking pads
- Earthing terminals
- Inspection cover





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- By-directional rollers/flanged wheels as specified
- Marshalling box.
- Flat base and foundation bolts.

### 03.02 GENERATOR TERMINAL CUBICLE

#### 03.02.01 LINE SIDE TERMINAL CUBICLE

Line Side Terminal Cubicle shall consist of Potential Transformer, surge protection equipment, Protective capacitor and current transformers for AVR and generator metering. Current Transformer for Generator metering and Automatic voltage Regulator shall be provided in LAVT cubicle.

#### Panel specification shall be as follows :

1. 2. 3. 4.	Panel Construction Gland Plate Type BusBar	:	Sheet steel not less than 2.0 mm thick 3mm CRCA Indoor, Floor mounted Main – 100x10x3R AL.(High tensile fastners to be used for busbar joints. Earth Bus – 50x6 mm Cu. FLAT	
5.	Cable Entry	:	Bottom	
6.	Degree of Protection	:	IP-54	
7.	System Fault Level	:	40 kA for 3 Sec	
8.	11 kV clearance	:	Phase to Phase	: 127 mm (Min)
			Phase to earth :	90 mm (Min)
9.	Name Plate	:	Black letters engraved	l on white background
			Adhesive type	
10.	Wiring	:	650 /1100 grade PVC	insulated multistranded
			Cu cable	
11.	Painting	:	Enclosure – Interior / E	Exterior

### Generator Voltage Transformer

To provide power supply for metering, synchronisation, AVR and protection purposes voltage transformer shall be provided in LA-VT panel. These will be connected after the generator outgoing terminals. VTs shall be of dry type cast resin design mounted in separate panels. High voltage side of VTs shall have fuses with MCBs on low voltage side. Low voltage star winding shall have all three phases and neutral connections brought out to terminals.

Voltage transformer shall have 4 core (2 core for protection, 1 core for metering and 1 core for AVR). Accuracy class of this shall be 0.2. The technical parameters shall be as follows :


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Rated continuous voltage	:	11 kV
Ratio	:	11 KV/√3 : 0.110 kV/√3
Burden	:	As per requirement Minimum 100 VA
Power frequency withstand voltage	:	As applicable for generator cable
Impulse withstand voltage	:	do

#### **Surge Protection Equipment**

The surge protection cubicle shall comprise of surge diverter and protective capacitor on each phase to protect the generator from the effect of transient over voltages. Surge protection equipment and VTs as described above shall be mounted in dust proof isolated phase compartment with provision for entry of main bus tap off into the compartments.

Protective capacitors shall be single pole units i.e. one per phase, non inflammable synthetic liquid impregnated type connected between each phase terminals and ground. Each capacitor shall be provided with a built in discharge resistor to drain the residual charge after being de-energized.

Surge divertors shall be of station class type with 10 kA discharge current and shall be of design specifically meant for protection of rotating machines, other salient particulars of surge divertors should be chosen in accordance with relevant IS-3070,Part-I, 1974.

#### **Generator Current Transformer**

To provide Protection and metering for generator, suitable current transformers shall be provided in the separate panels (LA-VT Panel and Neutral grounding cubicle) after generator bushings. Separate cores of CTs shall be used for differential protection, over current protection and measurement purposes. CTs shall be bar primary type . Accuracy class of Protection CTs shall be 5P30 and for differential CTs, the class shall be PS. The knee point characteristics of differential CTs shall be matched with the relays. The technical parameters are elaborated below :

Туре	:	Epoxy cast resin
Rated continuous current	:	1500 amps
Ratio	:	1500/1A
No. of cores	:	As per requirement
Short time rating (3 sec)	:	40 kA
Power frequency withstand voltage	:	As applicable for generator cables
Impulse withstand voltage	:	do —



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



## 03.02.02 Generator Neutral Grounding Cubicle

The high resistance grounding of a generator neutral shall be adopted by connecting the primary of a single phase distribution type earthing transformer between generator neutral and ground with the transformer secondary being shunted by resistance with a voltage relay and harmonic filter. This will reduce transient overvoltage limit at the point of fault and contribute to a positive selective relaying in the event of generator stator E/F. The value of resistance shall be so chosen that the energy loss in the resistor equals the

The value of resistance shall be so chosen that the energy loss in the resistor equals the capacitive kVA of the generator windings, the generator surge capacitance, the capacitance of the generator open bus bars and generator cables and the associated generator transformer with respect to earth during ground fault conditions.

The generator neutral grounding cubicle shall consist of Neutral grounding distribution transformer, Off load manual Isolator, current transformers for generator protection, resistance.

#### Panel specification shall be as follows :

1. 2. 3. 4.	Panel Construction Gland Plate Type BusBar	:	Sheet steel not less than 2.0 mm thick 3mm CRCA Indoor, Floor mounted Main – 100x10x3R AL.(High tensile fastners to be used for busbar joints. Earth Bus – 50x6 mm Cu. FLAT	
5.	Cable Entry	:	Bottom	
6.	Degree of Protection	:	IP-54	
7.	System Fault Level	:	40 kA for 3 Sec	
8.	11 kV clearance	:	Phase to Phase : 127 mm (Min)	
			Phase to earth : 90 mm (Min)	
9.	Name Plate	:	Black letters engraved on white background Adhesive type	
10.	Wiring	:	650 /1100 grade PVC insulated multistranded	
11.	Painting	:	Enclosure – Interior / Exterior :- RAL 7035	

Panel shall also have marshalling box, space heater, thermostat MCBs etc as per requirement.

The earthing transformers shall be dry type for indoor installation. The generator neutral grounding equipment shall be housed in a metal enclosed cubicle. The metal enclosed neutral grounding cubicle shall be connected to the neutral compartment of the star point of the generator. Technical parameters of earthing transformer shall be as follows:



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Primary voltage	:	11.0 kV
Secondary voltage	:	*
Continuous capacity based on 30 min. duty cycle	:	*
* Final values to be decided during detail engg. stag	e.	

### 03.03 METERING AND PROTECTION SYSTEM Control, Relay and Mimic Panel

DCS and turbine auxiliary control panel is not in the scope of bidder, however interfacing to DCS and turbine auxiliary control panel for Complete control, monitoring, interlocking, sequencing, metering, annunciation and protection of complete TG sets and complete electrics of the unit is in the scope of bidder. Hardwired back up panels shall also be provided for turbines and generators.

Complete control, operation and metering requirements for the following:

- Turbine, Generator and generator transformer
- Relay panels for generator and generator transformer including relay test kit

#### Metering

#### i) Generator

The ammeters, voltmeters, MW meter, MVAR meter, frequency meter, power factor meter, energy meter (MWH) meter, MVARH meter, exciter field voltage and exciter field current meter including necessary transducers are available in Generator Control Desk / Panel located in Control Room.

However, the scope of the bidder shall include the provision for additional unit parameters, if required, in the existing Operator's console. Number of annunciation alarm/trip points shall be finalized during detailed engineering stage. Generator protection panel shall consist of numeric type protective relays (microprocessor based communicable on open protocol like MODBUS/IEC, Password protected with fault recording facility and time stamping) and associated wiring.

Bidder shall provide state of art equipment system in the control room fulfilling the functional requirement of all the equipment for smooth and trouble free operation of the unit. Minimum no. of control desks/panels shall be as per requirement to have control, monitoring, interlocking, sequencing, metering, annunciation and protection of complete TG set, and complete electrics of the unit.

Bidder shall provide above annunciator windows at the top of operator's console. Number of annunciation alarm/trip points shall be finalised during detailed engineering stage and 20% spare windows shall be included for future use. Annunciations shall also be provided in the DCS / PLC.

Interlocking arrangement shall also be provided to take care of all the approved logic schemes. Bidder shall provide necessary wiring, control and required items to achieve the



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approved logic/ scheme. Local mode operation of the drives for test/trial etc. shall be carried out by selecting local/remote selector switch of panel in local position. Permissive conditions for start and tripping of various mechanism shall be provided as per approved logic diagrams.

Synchronization Panel/ desk with Synchroscope and necessary meters, indications, control switches, relays, etc is not in the scope of bidder.

Generator protection panel shall be consisting of numeric type protective relays and associated wiring.

## 03.03.01 Panel/Desks

#### **Constructional Features**

Panels shall be arranged to form a continuous board with the mimic and control equipment type with rear hinged door except in MCR. Side terminal blocks, control signaling circuit breakers, resistors, fuses, links, isolating switches etc.

- Flush mounted meters, relays, switches, recorder, level indicators, temp. scanner, signal lamps etc. on front of the panel.
- Made of cold rolled pressed sheet steel thickness of not less than 2 mm.
- Provided with 75 mm base channel & 15 mm anti vibration pad.
- shall have bottom cable entry, double compression cable glands, lugs and gland plates.
- Provided with space heater and interior illumination lamp with switches.
- Anodised aluminium inscription plate both at back and front side of size to enable a person to read from 5 meter shall be provided.
- Painted after proper degreasing, pickling and chemical phosphatising
- Lamp test facility to test all indicating lamps of the panel simultaneously.
- Earth bus securely fixed. 50 x 6 copper ground bus for all panels -Control desk will have mosaic type construction and for relay panel rack type construction shall also be acceptable.



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# Technical Particulars

1.	Panel	:	Sheet steel not less than 2.0 mm thick
2.	Enclosure	:	IP 41
3.	Gland plate Thickness	:	3mm CRCA
4.	Provision of cable glands	:	Yes
5.	Inscription front & rear	:	Both sides
6.	Painting	:	Enclosure – Interior / Exterior : RAL 7035
7.	Control supply	:	220 V DC
8.	Signaling bus isolation	:	ON/OFF switch
9.	Control buses	:	As per circuit requirement
10.	Relays	:	Numeric (self-diagnostic feature)
			With communication facility
11.	Protective relays	:	Drawout type
12.	Auxiliary relays	:	Non-drawout
13.	Master trip relay	:	Yes
14.	Auxiliary relays	:	As per circuit requirement
15.	Instrument size	:	Minimum as per requirement
16.	PT secondary voltage	:	110 V
17.	CT secondary current	:	1A

## Number of Panels

Details of main control, monitoring, protection, interlocking, sequencing, etc have been described elsewhere. Bidder shall prepare panel wise bill of materials considering SLD and the scheme requirement. Only new protection panel per unit shall be included in R&M. Number of control relay and metering panel and their respective positions shall be finalised during detail engineering stage.

## Wiring

- Wired with 1100 volt grade multistranded copper wire PVC insulation having area 2.5sq.mm. External CT connections shall be made with 2.5 sq. mm copper wires.
- CT & PT wiring shall be done with colour coded wires.
- Wire shall not be joined or tied between the terminal points. All wire termination shall be made with insulated sleeved crimping type lugs.
- No bunch will contain more than 12 wires.
- Wire end shall be fitted with moisture and oil resistant insulating material having glass finish with identification number clearly engraved in black.



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#### **Terminal Blocks**

- Stud type terminal blocks vertically mounted.
- Stud type terminal blocks shall be provided with brass studs.
- In each terminal block 10% spare terminals shall be provided.
- CT terminal shall be suitable to terminate 4 sq.mm cable and shall be link type to facilitate shorting of CT wires during testing etc.

#### **Control Supply**

- The control voltage shall be 220V DC
- For switching off supply disconnecting devices with aux. contacts for indication of control supply.
- One number 240 V single phase 5 A point in all panels for testing purpose. AC supply shall have single feeder
- DC supply shall have duplicate feeders with selection arrangement.

#### Transducers (if applicable)

Various transducers (4-20 mA range) shall be provided either in separate transducer panels or mounted in control panels to facilitate remote monitoring of the parameters and to hook up with DCS/PLC /SCADA system.

#### TRANSDUCER RATINGS General

	or ar		
1.	Make	:	Approved make
2.	Output	:	4-20 mA DC
3.	Load Resistance capability	:	Suitable for DDC hookup
4.	Accuracy	:	0.5% of full scale
5.	Repeatability	:	0.1% of full scale
6.	Linearity	:	0.05% of full scale
7.	Residual ripple in output current	:	5% max.
8.	Power frequency withstand voltage	:	2 KV rms for 1 minute
			between wires and case
9.	Maximum burden on CT/PT	:	1.0 VA





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#### Current Transducer

1.	1. Nominal Input/Rated current		1 Amp AC
2.	Overload capacity without loss in	accuracy	
	Continuous	:	120% of rated current
	Short time	:	10 times rated current for 0.5 sec.
Volta	age Transducer		
1.	Nominal Input/Rated voltage	:	110/(sq.rt of 3) V AC
2.	Overload capacity without loss of	accuracy	
	Continuous	:	120% of rated voltage
	Short time	:	2 times the rated value for 0.5 sec.
Pow	er Transducer		
1.	Nominal Input		
	Rated voltage	:	110VAC (3 ph PT supply)
	Rated current	:	1 A AC (3 ph CT supply)
2.	Overload capacity without loss of	accuracy	
	Continuous	:	120% of rated voltage
	Short time	:	2 times the rated value for 0.5 sec.

Auxiliary power supply, if required, shall be derived by bidder from the 415 VAC, 3 ph/4-wire or 220V DC power supply provided at each switchgear.



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



# 03.03.02 Specification of Items Indication lamps

- Shall be panel mounted with rear terminal connection
- Shall withstand 120% of rated voltage on continuous basis.
- Bulbs and lenses shall be replaceable from the front.
- Shall be LED type.

# Semaphore indicators

- Shall rotate <u>+</u> 45 deg. on energisation.
- Shall be mounted in such a way that it forms part of mimic.
- Shall withstand 120% of rated voltage on continuous basis.

## Control switches

- Generator breaker control switch shall have four position viz. Trip, Close, Neutral after trip and neutral after close.
- Other switches shall be as per the requirement of the scheme.
- Type of operation handles of switches shall be spring return pistol grip type.
- All switches shall be provided with inscription labels.
- All switches shall have a rating 10A/500V.
- Switches shall be dust protected, heavy duty switch board type
- Contacts shall be silver surfaced
- Stay put type selector switch shall be provided for auto/manual, DC source selection, local/remote etc.

## Aux Relays

- Shall be contained in dust and moisture proof cases.
- Close/trip circuit supervision relays (to be provided if features are not available in numeric relays) shall be suitable for connection in series with close and trip coil of breaker and trip supervision relay shall be suitable for monitoring the healthiness of tripping circuit on both breaker open and close conditions. In protection circuit DC failure supervision relay shall be provided.
  - The relays shall be suitable for operation between 70-110% of rated voltage.



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#### Numeric relays

- Stringent measures including shielding of long internal wiring shall be taken to make relays immune to voltage spikes.
- Shall withstand 5 kV, 1/150 microseconds as per IEC.
- Shall be protected against transient/induced over voltage by providing suitable surge arresting device.

#### Annunciation

All electrical annunciations connected with generator, generator systems and unit system shall be displayed in DCS system.

The main annunciation points shall be as follows :

- 1. Generator alarm/trip indication (separate for each electrical protection /discrepancy). FCB trip, Bearing-Stator temp. high/trip, overspeed alarm/trip, CO2 release, AVR failure, cooling coil temp.
- 2. Generator transformer

Buchholz, oil/winding temperature, oil level low - alarm Buchholz, oil/winding temperature - trip condition, oil pump trip, PRD operated / cooling water valve closed / fire fighting operated.

#### 03.03.03 Electrical Protection System

New Redundant Relay Protection Panel for each unit shall be provided. This section covers the details of the protection adopted for various electrical equipment, viz. generators and their auxiliaries, generator transformers, Unit Auxiliary Transformer and all associated electrical equipment etc.

Main-1 protection containing Generator Numerical Protection Relay and Generator Transformer Numerical Protection Relay is not in the scope of the bidder.

Main-2 i.e., redundant protection comprises of numerical relay for Generator Protection, Generator Transformer Protection, Overall Differential Protection and Lock-out relay shall be in the scope of the bidder.

Apart from Main-2 protection, following are required to be incorporated in new Redundant Relay Protection Panel:



#### MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



- (a) Back up Over Current Protection for UATs,
- (b) Rotor E/F protection scheme with latest state of the art technology,
- (c) 100% stator E/F protection,
- (d) Standby E/F protection,
- (e) BU Impedance protection,
- (f) Low impedance REF for new GT.

Supply of necessary CT and PT for implementation of above protection schemes shall be in bidder's scope.

The protective relays used for protecting various equipment shall be numerical type with communication facilities. They shall be selected or grouped that in the event of non-availability of any relay or any one group, for any reason, e.g. power supply failure, on-line testing of any relay or many relays or any other reason whatsoever, the relays in other group shall completely protect the respective equipment since the same is expected to be energized / running.

Selection of protective scheme will be based mainly on reliability (main & standby), sensitivity, selectivity. All main protections shall be fast acting type in order to clear the faulty system from the healthy system in earliest possible time to minimize damage to equipment and ensure continuity of power supply, if possible. Bidder shall suitably design tripping system covering different protection under different class of trippings of generator and turbine.

Numeric microprocessor based relays shall be provided suitable for communication to DCS / PLC / SCADA consisting of comprehensive protection with fault recording facility, metering provision and self testing facilities in line with present state-of-the-art system. The protection system will be in modular design comprising digital signal processing and a data bus for signal exchange, digital input / output units, analogue input-units, analogue / digital conversion units, field interface units, etc.

All numeric relays shall be password protected and shall have sufficient binary input/output contacts as per actual requirement plus 10 % spare. No auxiliary relays shall be used for contact multiplication. The relays shall have capability of capturing waveforms and disturbance recording at the time of fault. Moreover, all the relays shall have real time stamping facility.

Complete relay co-ordination for the various systems and sub-systems shall be done by the bidder.



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The system shall have necessary interface and compatibility with distributed digital type process control system.

Protections for the various electrical equipment and generator are enlisted below;

#### 1.0 Generator Protection

The following protective schemes are proposed for the generator.

- Generator differential protection: This will offer selective and high speed protection for generators against internal faults like phase to phase and three phase faults. The relay shall be ultra high speed, high-impedance type, immune to transients with operating time as short as 8 milliseconds for ultra high speed and 30 m sec for high impedance type relays. The relay shall be stable for all external faults.
- b) Generator stator 100% earth fault protection : The neutral of the generator will be earthed through a distribution transformer, whose low voltage winding will be loaded by a suitably rated resistor. The recommended protection scheme shall detect earth fault at any point on stator winding to provide 100% protection. This relaying shall also be made to supervise the integrity of grounding system healthiness.
- c) Standby stator earth fault (0-95%) protection : The protection scheme shall include an inverse time or definite time neutral voltage displacement relay connected to the open-delta winding of the generator VT. This relay shall be immune to third and higher harmonics. This relay protects the winding only upto 95% from the phase side. This relay will also give earth fault protection for 11kV system during back charging of the generator transformer.
- d) Generator field winding earth fault protection with latest state of the art technology: The protection scheme shall be in two stages. The field power supply is derived from unearthed DC source. The relay will be operating on the basis of monitoring insulation resistance by injecting sub harmonic currents in field system. The first stage, shall operate when insulation resistance goes below 80 Kohms and gives alarm. The second stage will operate below 5 Kohms and will initiate tripping of the unit.
- e) Generator negative sequence protection: Protection envisaged shall protect the generator from harmful effects of negative phase sequence currents. Each negative phase sequence relay shall be having two stages of protection. First stages shall initiate alarm and trip the unit after a definite time lag (e.g. 1000 seconds). Similarly, second stage shall trip the unit when I sq.t = k exceeds preset value. The present limits shall be co-ordinated with that of the generator and also among themselves.



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- f) Loss of excitation protection : The protection for loss of excitation shall comprise of two stages. Both stages shall have offset mho relay characteristics. Stage I shall be set to respond for loss of excitation condition when load on the machine is 30-100% of rated value. The unit shall be tripped after a short time delay. The second stage shall trip the unit after longer time delay. It shall cater for loss of excitation condition when unit is lightly loaded (e.g 0-30%). Required under voltages relay interlocks shall be provided.
- g) Generator under frequency protection : Under frequency protection is provided to protect the unit from prolonged under frequency with definite time delay plus cumulative time delays. Stepped under frequency protections shall be provided for TG. No. of steps and their respective time delays shall be selected based on % of acceptable loss of life and load shedding/recovery curve of the grid.
- h) Generator over voltage protection : The protection scheme shall envisage provision of two stage type definite time, high drop-off to pick up ratio over voltage relays. 1st stage shall be short time delayed high set type and second stage shall be long time delayed low set relay. The protection settings shall be choosen depending upon voltage regulator response characteristic and generator withstand capability. The setting of this relay also shall be based on withstand capability given by the manufacturer.
- i) Generator stator over-current protection: This relay is voltage restrain over current used for tripping of generators on short circuit.
- j) Generator Reverse Power Protection: This protection is provided against motoring of the generator. Timer shall be provided in the scheme.
- k) Generator VT fuse failure protection : The protection scheme shall consist of voltage balances type relays whereby voltage between two sets of VTs shall be continuously monitored. The scheme shall be able to detect open circuit in any phase of the VT secondaries as well as primaries or fuse failure. This will give an annunciation and block the operation of AVR and voltage operated relays.
- I) Generator field over voltage protection : This protection gives protection of generator rotor due to rotor overcurrents caused by sustained system voltage depression or malfunction of the control system. The relay will be DC operated definite time delay over voltage relay and shall be used for alarm. Surge voltage protection shall also be provided for the field.



#### MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



- m) Generator, generator transformer over-fluxing protection : This protection shall be provided for overfluxing protection of generator, generator transformer. For this purpose two relays shall be provided (one high set and other low set). Both relays shall operate on the V/Hz ratio. The highset unit shall trip the unit for very high overfluxing conditions after a short time delay and low set unit shall trip the unit in longer time delay. Complete protection characteristics shall be coordinated with composite V/Hz withstand characteristics of all three equipment. If AVR is provided with under excitation limiters in manual mode, control functions shall be arranged from overfluxing protection to limit/control over- excitation at first stage and if V/Hz still persists tripping function shall be taking over.
- n) Bearing failure protection : This is an alarm function. Upon occurence of alarm, bearings shall be inspected at the earliest opportunity.
- o) Generator Overspeed : Two electrically operated and one mechanically operated Over speed shall be provided. Settings shall be finalized during drawing approval stage.
- p) Generator breaker back up protection : Bidder is to provide this protection system after study of existing system and (dedicated relays need) to be provided on scheme to be hooked up with existing protection system.

# 2.0 Generator Transformer Protection

The following protective schemes are proposed for the Generator Transformers:

- a) Generator & Generator Transformer differential (87TG)
- b) Generator transformer Buchholz (63)
- c) Generator Transformer Over current / earth fault (50/51)
- d) Transformer restricted earth fault protection (64T)
- e) Generator transformer over voltage (59)
- f) Generator transformer under voltage (27)
- g) Generator transformer Breaker failure (50BF)
- h) Generator transformer over fluxing (24)
- i) Generator transformer Over / under Frequency (81 O/U)

# 3. Unit Auxiliary Transformer Protection

- a) Back up over current protection,
- b) Standby earth fault protection and
- c) Back up impedance protection.





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# 4. Comprehensive motor protection for motors of 75 kW and above

Comprehensive numeric motor protection including but not limited to the following;

- a) Instantaneous over current protection
- b) Differential protection (for rating above 1000 kW)
- c) Instantaneous time over current protection in two phases and definite time delayed over current alarm on the third phase
- d) Negative phase sequence protection
- e) Thermal overload taking -ve and +ve phase sequence into account
- f) Earth fault
- g) Locked rotor protection
- h) Winding temp monitoring and alarm for rating beyond 1000 kW
- i) Under voltage protection

#### 5. LT motor protection (for motors less than 75 kW)

The motors rated below 75 kW shall have bimetallic relays. Also following protections shall be provided

- i) Under Voltage
- ii) Overload
- iii) Single phase preventer

## 6. Generator Excitation System

#### **Excitation transformer**

- Overload
- Over current protection
  - Winding temp

## **Excitation system**

- Load angle limiter
- kVA & kVAR limiter
- Stator current limiter
- Rotor current limiter
- Volt/Hz ratio controller
- Cross current compensation

#### Thyristors

- Fuse failure / fan failure (Alarm)
- Over current
- Thyristor failure supervision & thyristor overload



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## 7. 415 V Switchboard

- i) 415V Incomer
  - Over current
  - Earth fault Timers
- ii) 415V Outgoing (MCC feeder)
  - Overcurrent
  - Earth fault relays for selective tripping of feeder
- iv) 415 V Motor Feeders (Above 110 kW)
- Comprehensive motor protection relay (Microprocessor based)
- iv) 415 V Motor Feeder (less than 110 kW)
  - Under voltage
  - overload
  - single phase

# v) Bus PT

U/V relays

415 V incomers shall have under voltage/timer relays for auto- changeover as described in clause 02.05.

## 03.03.04 Protective Scheme Requirement General

- All required protection relays shall be provided. Auxiliary relays, timers switches etc. required to make the scheme complete shall be considered as part of the scope of work. Details of major relays and meters are highlighted in clause 02.02.03.(indicative)
- All CT-PT shall be suitable for the relay-meter requirement lead burden and as shown in the enclosed single line diagram.
- All interfacing/essential interlocking cabling from unit as well as from 33 kV switchyard and bay are in the scope of bidder.
- Aux. Relays shall be provided for each transformer fault.
- Contact arrangement and number of poles/ways in control/selector switches shall be as per the requirement/approved scheme.
- Generator tripping system shall be designed such a way so that on electrical faults



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only generators shall be tripped and on mechanical fault generator with turbine shall be tripped with signal to close the gate. Details of the scheme shall be finalized during detailed engineering stage.

- For control supply distribution, panel to panel separate set of terminal blocks shall be provided at top of the control panel. All items/accessories required for above in each panel and in incoming panels shall be provided by the bidder.

Wherever required bidder shall provide aux. relays for contact multiplication.

#### 03.03.05 Synchronisation Scheme

Synchronising panel consists of synchronoscope, double voltage and frequency meter and auto synchronizer is not in the scope of bidder. However, all interfacing/essential interlocking cabling for manual / auto synchronization of unit is in the scope of bidder. synchronizing scheme shall be finalized during detailed engineering stage to suit the generator being offered.

#### 03.04 HT BUS DUCT

The overhead 11 kV HT busduct shall be three phase, phase segregated type. The busduct shall be installed inside power house from generator to Generator transformer and tapping for existing Unit Auxiliary Transformer and new excitation transformer.

The HT busduct shall comply with the requirements of the latest version of relevant IS / IEC standards. The busduct shall be designed to carry maximum continuous current under normal conditions without exceeding temperature rise limits

The bus assembly shall be designed to mechanically withstand a rated continuous current as well as the specified short circuit current without damage or permanent deformation of any part of the bus structure.

Bidder shall include the Generator busducts consisting of following minimum items:

- 1. Generator main Busduct from generator terminals to generator transformer with tap off to unit auxiliary transformer, excitation transformer and Line side terminal panel.
- 2. All associated equipment/items like flexible/rigid joints, required no. of bends, silica gel breather, space heater, etc
- 3. Set of maintenance tools and tackles as required.
- 4. Earthing of busducts with continuous run of conductors
- 5. Necessary support structures, erection hardwares



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#### **GENERAL TECHNICAL REQUIREMENT**

1.	Applicable Standard	IS : 8084	
2.	Rated system voltage and frequency	11 kV, 50 Hz	
3.	System earthing	Non effectively earthed	
4.	System short-circuit level, kA (rms)	85 kA (for 3 sec) for main run	
		152 kA (for 3 sec) for tap off	
5.	Type of busduct	Phase Segregated	
6.	Service Indoor / Outdoor	Indoor	
7.	Maximum voltage at which the busduct	12 kV	
	can operate continuously		
8.	Busbar material - Conductor	Aluminium Alloy	
9.	Busduct support structure required	To be provided	
10.	Current ratings		
11.	Rated continuous current	1600A	
12.	short time Current Rating for 1 sec	40kA	
13	Dynamic current withstand rating kA	100 kA	
	(peak)		
14	Type of Cooling	AN	
15.	One min. dry power frequency withstand	28 kV	
	voltage		
16.	Impulse withstand voltage	75 kV	
17	Supporting insulator		
a)	Туре	Porcelain / EPOXY	
b)	Max. distance between supports	To be worked out based on	
		short circuit calculation	
c)	Rated Voltage	12 kV	
d)	One minute power frequency withstand	35 kV	
	voltage		
e)	Impulse voltage withstand value with	75 kV	
	1.2/50 micro sec. wave shape		
f)	Minimum Creepage Distance	240 mm	
18	Earth Bus		
a)	Material	AI	
b)	Size	As per requirement	
19	Enclosure		
a)	Туре	Phase Segregated	
b)	Degree of Protection	IP 52	



## MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



c)	Material of Enclosure	AI
d)	Thickness	3 mm min.
20	Design Ambient Temperature	50°C
21	Maximum temperature when carrying	
	rated current continuously	
a)	- Conductor	
a) 1	Bolted Joints (Plain or tinned)	90°C
a) 2	Bolted Joints (Silver Plated)	105°C
b)	Busduct Enclosure	80°C
22	Accessories	
a)	Seal-off bushings	As per requirement
b)	Silica gel breather	To be provided

Length of the busduct shall be calculated by the bidder based on approved layout and location of the generators and generator transformers.

Generator bus duct shall be suitable for air and water tightness test as per IS : 8084

Rating, type and detailed technical particulars of the generator neutral bus duct shall be as per requirement and as per standards prevailing.

## GENERAL ARRANGEMENT

- 1. 11 kV generator busduct shall be phase Segregated with Rectangular shaped enclosure. Enclosure shall be continuous type.
- 2. Comprising of following sections, as applicable, to make the installation complete and to match with the terminal equipment :
  - Generator lead-in section with flexible hood and links.
  - Straight section in standard length.
  - Matching section (length as required).
  - Generator transformer lead-in section with flexible links
  - Corner sections (horizontal and vertical)
  - Phase cross-over section (If required to match phase sequence of the board).Link section.
- 3. Silica gel breathers at appropriate locations.
- 4. Space heaters and power supply arrangement for the space heaters
- 5. Earthing of busducts with continuous run of conductors
- 6. Generator neutral bus duct along with all the generator CTs, SAPT, NGT and loading resistor, all associated accessories, etc.



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# CONSTRUCTION DETAILS

- 1. Degree of protection for enclosure IP 52 or better inside machine hall.
- 2. Enclosure material : Aluminium of minimum thickness 3 mm. Bidder shall include enclosure with the thickness required for the rectangular shape and mechanical/ electrical strength point of view.
- 3. Maximum temperature of enclosure under rated operating conditions limited to 80<sup>o</sup>C
- 4. Bolted covers with gaskets for easy inspection and access to insulators and bus bar joints.
- 5. Rubber bellows at transformer end to take care of vibration (Flange on which rubber bellow shall be seated shall seam welded to avoid ingress of water into the transformer).
- 6. Hinged and gasketed inspection access cover at suitable intervels.
- 7. Seal off bushings and frames complete with bolts
- 8. Provision for draining moisture.
- 9. Provision for mounting on brackets.
- 10. Supply of GI supporting structures with necessary hardwares. Supporting structures shall be fabricated from standard steel sections and shall be hot dipped galvanised after fabrication.
- 11. For termination at generator end, suitable seal off bushings shall be provided, if required.
- 12. Necessary supporting foundation including civil works to be provided.
- 13. Suitable adapter chamber shall be provided for terminating the bus duct on to Switchgear. Matching flanges shall be provided at both ends of the bus duct run. Flexible terminal connectors shall be provided for termination at switchgear end.

## Surface treatment

Two coats of epoxy paint for outdoor and synthetic enamel paint for indoor application, preceded by de-rusting, cleaning chemically, degreasing, pickling in acid, cold rinsing, phosphating, passivating and spraying with two coats of zinc oxide primer.

Shade of paint

Interior : Black/white/light yellow

Exterior : Light grey shade 631 of IS - 5 1978 (unless otherwise specified) and further stoved.

# **BUSBARS AND CONNECTIONS**





#### MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



- 1. Material EC grade aluminium alloy equivalent to E91E WP conforming to IS 5082-1981.
- 2. Final operating temperature of both bus bars and joints under continuous operation in enclosure limited to 90°C by thermometer method.
- 3. Bus bar arrangement as per IS 5578 (1991).
- 4. Phase identification by colour at ends and at regular intervals.
- 5. Busbars shall be of welded construction.
- 6. Copper flexible busbars surface shall be tinned
- 7. Contact surfaces shall be silver plated.
- 8. Flexible connections for termination on equipment.
- 9. Expansion joints on straight runs with joints staggered in adjacent phases.
- 10. Bimetallic joints for jointing between dissimilar metals.
- 11. Busbar conductors shall be given coat of black mat.
- 12. Busbar support insulators of non-hygroscopic material having high impact and di-electric strength with an anti-tracking contour.

## PROTECTIVE EARTHING

- 1. GI/Aluminium earth bus of size 50 x 10 mm running throughout the length of the busduct, positively connected to the body of the busduct.
- 2. Provision at each end of busduct for terminating external earth conductor.

#### INSULATORS

- 1. Bus support insulators shall be interchangeable.
- 2. The insulator shall be designed and mounted in such a manner so as to facilitate easy inspection, removal and replacement without disturbing the conductor.

#### SPACE HEATER

Adequate number of thermostatically controlled space heater shall be provided to maintain internal temperature above the dew point to prevent moisture condensation within the bus duct. Supply for space heater shall be 240V, single phase, 50Hz.

## BUS DUCT SUPPORT

The busduct shall be supported from floor / roof beams or steel inserts.All hardware shall be galvanised.



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# 03.05 11kV GENERATOR DISCONNECTING SWITCH

#### Features

- Triple pole air break, fault make, load break type
- Independent motorized cum manual quick make and quick break type
- Mechanical trip device
- Mechanical ON/OFF indicator
- Suitable to connect cables on incoming and outgoing
- Shall have 4 NO + 4 NC aux contacts.
- Earthing switch shall be provided on transformer side having rating same as that of main disconnecting switch.
- Totally enclosed, floor mounted
- Shall have padlocking facility
- Panel door shall be mechanically interlocked so that isolator cannot be closed on open position of door and door cannot be opened on close position of isolator.
- Earthing switch shall be interlocked with the isolator blades to prevent simultaneous closing of both

#### **Technical Particulars**

Technical Particulars		11 kV
1.	Standards	
	i) Switchboard	IS: 12729-1988
	ii)Isolator	IS : 9921 –1982
2.	Туре	Air break / fault make / load break
3.	Nominal system voltage	11 kV 3 phase
4.	Highest system voltage	12 kV
5.	Rated frequency	50 Hz
6.	Rated continuous current	1600 A
7.	Short time rating	40 kA,3 Sec.
8.	Rating making current	65.5kA Peak
9.	Impulse withstand voltage	75 kV
10.	One minute power frequency	35 kV
	withstand voltage	
11.	System earthing	unearthed
12.	Termination	Bus duct
13.	Aux. Contacts	4 NO + 4 NC
14.	Interlocking	As specified.
15.	No of poles	Three (3)
16.	Service	Indoor
17.	Enclosure	IP52 or better



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# 03.06 DC DISTRIBUTION BOARD AND LOCAL CONTROL STATION

#### 03.06.01 DC DISTRIBUTION BOARD

- The 220V DC distribution board shall have double busbar arrangement, viz. one set of the +ve and -ve connected to charger-1 and another set of +ve and -ve bus connected to charger-2. It shall be possible to connect the bus bar arrangement with either charger through selector switches.
- Switch board will be floor mounting type sheet steel enclosed with degree of protection IP 52 or better. Board will be compartmentalized design.
- The switch boards shall be provided with suitable quantity and type of outgoing feeders for the auxiliaries, control supplies to various panels / systems. For each load and auxiliary, one separate feeder shall be provided.
- The feeder rating and quantity shall be as per requirement. 20% of the total feeders shall be kept as spares.
- Each outgoing circuit shall be connected to both the sets of bus bars through selector switch. It shall be possible to connect each outgoing circuit to either set of bus bars. Each outgoing circuit shall have MCCB..
- The continuous current rating of the bus bars and incomers for 220V DCDBs shall be the maximum DC load (excluding the momentary load) on the bus plus 20% margin rounded off to the next higher standard rating.
- Instruments shall be as per IS 1248, accuracy class 1.5, 96 x 96 mm size.
- AC meters shall be taut band type, DC meters moving coil type.
- DC meters shall be zero centre type where applicable.
- All power wiring will be done through single core PVC insulated copper wires/buses. All control wiring will be done through single core; PVC insulated copper wire of 2.5 sq. mm. All connections external to the panel/switch board will be terminated in suitable terminal blocks. Inter panel wiring will be only between terminal blocks.



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- Battery earth fault relay shall be provided. All relays shall be in draw out cases and with mechanical hand reset operation indicator.
- Indicating lamps for supply 'ON' shall be provided for each outgoing feeder. L.E.D indication shall be provided

#### 03.06.02 LOCAL CONTROL STATIONS

- Near all drives local control stations shall be provided.
- Sheet steel construction, dust and vermin proof, wall/structure mounting.
- Control switches, push buttons and indication lamps mounted on front hinged gasketted and lockable door.
- Suitable knockouts with glands on the bottom or top cover for cable entry.
- Terminals to be suitable for 2 cores of 2.5 sq.mm conductors with 20% spare terminals.
- Readily accessible shrouded terminals.
- Wiring with extra flexible wires.
- Stop push button to be lockable type with mushroom head.
- Inscription in English on corrosion resistant metal strips.
- Enclosure conforming to IP-54 class for indoor and IP55 with canopy for outdoor.



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## 03.07 BATTERY BANK & BATTERY CHARGERS

### 03.07.01 SCOPE OF SUPPLY

#### 220 V DC system

The 220V DC system is designed to cater the control, protection, interlocking, annunciation and emergency DC loads and DC lighting.

Separate DC system shall be provided for power house and control room

Each 220V DC system shall be provided with 1x100% battery of 220V DC, 200AH, 1x100% new 220V Float cum boost charger and reuse of existing 250V, 150Ah Float cum boost charger in power house and in control room building as 220V, 150Ah Float cum boost charger. New DCDB for Control room to be supplied and Old DCDB shall be retained at Power House.

Existing 250V, 150Ah Float cum boost charger (FCBC) in power house and in control room building shall be retained and reused.

One set of special tools and tackle.

Mandatory spares.

All relevant drawings, data and instruction manuals.

## 03.07.02 GENERAL REQUIREMENTS

Codes and Standards

Major standards, which shall be followed, are listed below. Other applicable standards for any component if not covered in the listed standard shall also be followed:

Indian Standards	Title	International & Internationally Recognized Standards
IS : 1652	Stationary cells and batteries, Lead acid batteries with Plante' positive plates	IEC896-1
IS : 266	Sulphuric acid	
IS : 8320	General requirements and methods of tests for lead-acid Storage batteries	





#### MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



IS : 1146	Specification for rubber and plastics container for lead acid storage batteries	
IS : 6071	Synthetic separator for lead acid batteries	
BS-6290	Lead acid stationary cells and batteries. Specification for High Performance Plante' cells	
IS : 1885 (Part-15)	Electrical vocabulary, primary cells and batteries	
IS : 1069	Quality Tolerances for Water for storage batteries	IEC-60050
	IEEE Recommended practice for sizing for lead acid batteries for stationary application	IEEE-485
	IEEE Recommended practice for installation design and installation of vented lead acid Batteries stationary application	IEEE-484

#### 03.07.03 **DESIGN CRITERIA**

Design Basis and Sizing Criteria for 220 V Battery

220 V D.C. system provides reliable sources of D.C. power for control, indication, protection and annunciation of the plant equipment. In addition, it provides for the emergency loads/services on failure of A.C. supply.

Each 220 V D.C. system comprises of one (1) set of 220V, 200AH storage battery bank, Battery bank shall have, 2 No. Float cum boost charger and 1x100% sectionalized DCDB with all other related equipment & accessories.

All sets of batteries mentioned above shall be lead acid PLANTE type and complete with associated float charger and float-cum-boost chargers. The charger & battery systems shall be of same capacity and rating.

The batteries shall be installed indoor in a clean but hot, humid and tropical atmosphere.

The battery and charger combinations shall be such as to ensure continuity of D.C. supply at load terminals without even momentary interruption.

For continuous operation at specified ratings, temperature rise of the various





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components of battery and charger shall be limited to the permissible values as stipulated in relevant standards.

Battery shall be sized to cater for the following loads

- Closing and spring charging of breakers
- Tripping breakers.
- Solenoid valves.
- Indicating lamps, Protective relays, Auxiliary relays on switchgears and control panels
- Emergency lighting
- Supplies to UPS Inverters
- > Any other loads

The sizing of the lead acid with plante batteries shall be as per IEEE-485. Following Factors to be considered for Battery Sizing:

- Design Margin: 1.15
- Aging Factor: 1.0

The No. of cells, end cell voltage shall be considered based on the minimum and maximum voltage windows and cable drop etc. as per system requirement.

DC scheme shall ensure that each critical consumer is fed from two different bus sections. DCDBs shall be provided with adequate number of feeders on each section.

Ampere hour capacity (minimum) shall be as specified in Technical particulars for design for 10 hours discharge rate with final voltage per cell 1.85V.

During float mode, charger shall be rated to cater to the following:

- a) Trickle charging current of the battery
- b) Continuous load on the DC system
- c) 25% spare capacity over above loads

The output voltage of the float mode charger shall be adjustable between 230-240V.

The charger shall also be capable of delivering the rated load even under the specified voltage and frequency variations.

The float-cum-boost charger shall be sized to restore the fully discharged battery to full charge condition in eight (8) hours with 25% margin over maximum charging rate and also to operate as a float charger.

The batteries & chargers shall be so designed that the maximum fault level on DC



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DB is limited to 25KA (Indicative only; the actual value shall be decided by the bidder after substantiating the same by calculation.)

#### System Concept for 220 V DC

DC system shall be parallel redundant with load sharing type. Normally the chargers connected to the battery shall supply the DC loads and also keep the battery under float charge. On failure of supply from charger, the battery shall take over the DC loads without any interruption.

When the battery require boost charging, the first charger shall operate on boost charge mode while the second charger shall supply the DC load on float mode through automatic changeover arrangement.

Interlock shall be provided to ensure that the battery can be taken to boost mode only if the second charger is healthy and running. Interlock defeat arrangement shall also be provided for initial charging of battery.

#### Battery

#### General

- a) The battery shall be Plante type
- b) The plates shall be designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuation of load.

## Construction

- a) Each cell shall be assembled in sealed type, heat resistant, shock absorbing, robust, clear view SAN container.
- b) Electrolyte level shall be marked on the clear view container or level indicators as applicable. The markings shall be for upper and lower limits.
- c) Sufficient sediment space shall be provided so that the cells shall not have to be cleaned out during normal life.
- d) Vent plugs for sealed in type cells shall be anti-splash type.
- e) Separator between plates shall permit free flow of electrolyte. Separator shall be wood or other acid resisting material. Proper arrangement to keep end plates in position shall be furnished.
- f) The cells shall be supported on porcelain insulator (if required) fixed on to the rack with adequate clearance between adjacent cells.
- g) The cell terminals posts shall be provided with connector bolts and nuts, effectively coated with lead to prevent corrosion



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- h) Lead or lead coated copper connectors shall be furnished to connect up cells of battery set.
- i) Positive, negative and 84th tap terminal posts shall be clearly and indelibly marked for easy identification.
- j) Lead-coated bent copper plate, tubular copper lugs, teak wood clamp, bolts, nuts, washers, etc. shall be furnished for connection of outgoing stranded copper cables from battery to charger.
- k) The battery shall be shipped uncharged with the electrolyte furnished in a separate non-returnable container.10% extra electrolyte shall be furnished to cover spillage in transit or during erection.

#### Racks

- a) The racks for supporting battery cells shall be constructed of best quality teakwood with acid resistant insulation between the cells and the rack and shall be painted with at least three (3) coats of anti-acid paint, the shade of which shall be subject to approval of the Purchaser.
- b) Racks shall be freestanding type, mounted on porcelain insulators.
- c) Numbering tags for each cell shall be attached on to the racks.
- d) Two Tiers should normally be considered for batteries.

## **Battery Charger**

One no. Float cum boost charger with automatic change over switch for existing 220V, 200AH, 10Hr discharge rating battery bank shall be provided.

- i. Float cum boost Battery charger will be comprised of the following;
- a) Microprocessor based IGBT/thyristor based battery charger
- b) MCCB, line contactor and overload relay on the AC side
- c) Dry type double wound rectifier transformer with copper conductor and class 'B' insulation
- d) The panels shall conform to the degree of protection IP-42
- e) Filter circuit at the output
- f) MCCB on DC side
- g) Control and protection circuits
- ii. In float mode, the charger operates with a constant voltage controller and the output voltage of the charger will be maintained within  $\pm$  1% of the set voltage for + 10% input AC voltage variation, or 0 100% load variation, or both occurring



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simultaneously. The output voltage required can be set externally through potentiometers in the range 90-120% steplessly.

- iii. In boost mode, the charger will be suitable to operate in a constant current as well as constant voltage mode with manual selector arrangement, controller suitable for two-rate charging. The charging current will be externally adjustable from 20% to 100% steplessly.
- iv. Provision of charging with manual control of output voltage will also be provided.
  Electronic current limit, adjustable between 85-105 percent of rated current will be provided. During boost charging, the charger will be cut-off as soon as over voltage occurs. Ripple content in the charger's output voltage will not exceed 0.5% in float mode and 3% in boost mode.
- vii. The supply to the charger will be at  $415V \pm 10\%$ , 50 Hz +3% and -5% unless otherwise specified.
- viii. The following relays will be provided:
  - a) AC input supply to charger failure
  - b) Earth fault
  - c) Float bus over and under voltage
  - d) Boost bus over voltage
  - e) Boost over current for each charger circuit
  - f) All relays will be in draw out cases and with mechanical hand reset operation indicator.
- ix. The following indications will be provided.
  - a) AC supply ON (for 3 phases separately) for each charger
  - b) DC supply ON for charger
  - c) Boost/float mode ON for charger
  - d) Supply ON for each outgoing distribution feeder
- x. Instruments for the following measurement will be provided;
  - a) AC input voltage and current of each charger (through voltmeter/ammeter selector switches)
  - b) DC output voltage and current of each charger
  - c) Battery charging/drain current of each charger with necessary shunt
  - d) Battery trickle charging current (through amplifier)



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- e) DC bus voltage (through selector switch) to measure between Positive to Earth, Negative to Earth & positive to negative.
- xi. Static type annunciation will be provided for the following;
  - a) AC supply failure to charger
  - b) Battery earth fault (+ve & -ve separately)
  - c) Float bus over/under voltage
  - d) Boost bus over voltage
  - e) Boost over current for each charger
  - f) Failure of thyristor/diodes for each charger
  - g) Failure of blocking diode
  - h) Output MCCB open for each charger
  - i) Battery MCCB open
  - j) Battery room exhaust fan OFF
  - k) D.C.Voltage Low
  - I) D.C.Voltage High
  - m) A.C.Input Under Voltage
- xii. One repeat alarm point for all above annunciations will be provided to facilitate annunciation of "Fault in Charger" in control room.

#### 03.08 ELECTRIC MOTORS

#### 03.08.01 Low voltage squirrel cage induction motors :

Constructional features:

- Frame sizes and ratings and other facilities as per IEC
- For motor frames upto 315, cast iron or steel construction body; for frames above 315, steel construction shall be used.
- Casing feet to be integral with the motor body.
- Continuous duty LT motors upto 200kW Output rating (at 50 deg.C ambient temperature), shall be premium Efficiency class IE3, conforming to IS 12615 or IEC : 60034-30.
- Degree of protection for motor, bearings and terminal box to be IP-55.
- Cylindrical shaft ends, unless otherwise specified
- Shaft extension as per requirement.



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- For motor of rating upto 5 kW, Ball bearings shall be used for both DE & NDE end. For ratings above 5 kW the DE end shall be provided with roller bearing and NDE end shall be provided with ball bearing.
- Bearings shall be suitable for running of motor in either direction. Terminal box:
- Terminal box suitable dimension to receive copper cables and provided normally on the right side as viewed from drive side or on the top as per the requirement.
- Terminal box frame with opening for cable rotatable by 4x90 deg.
- A suitable earthing stud shall be mounted inside the terminal box.
- Terminal Box shall be suitable to receive the aluminium cables as given in Table-I.
- Extension of Terminal box as required shall be done to receive the Aluminium cables to avoid cramping of the cables in the terminal box.

#### Cooling:

- Motors shall be of TEFC design
- Ventilation shall be effective irrespective of direction of rotation.

#### Quality of operation:

- Motors shall be dynamically balanced with full key on the shaft- end and fan.
- Vibration intensity shall be limited as per IS 4729.
- Continuous noise level should not exceed 85 db A at a distance of 1.0 m from motor body

# Electrical design

- Suitable for DOL starting
- Motors suitable for being switched on to a solid main even at phase opposition at a maximum residual voltage of 50% i.e. the motor shall be capable of withstanding 150% of the rated voltage.
- Motors capable to start and run-up at a minimum of 85% of rated voltage at its terminals with the driven mechanism/equipment connected.



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- Capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% of the rated voltage at its terminals.
- Starting torque shall be not less than 160% of rated torque.
- Starting current shall be less than or equal to six times the rated current.
- Motor shall be capable of withstanding locked rotor current for at least 5 seconds longer than the starting time at 80% voltage under rated load conditions.
- Continuous duty motors shall be capable of three equally spread starts per hour under normal condition or two starts in quick succession from cold or one hot start, under rated load condition.
- All continuous duty motor (S1-100%) shall be of high efficiency to **Eff 1** class as per IS 12615- 2004.
- Motors provided with class 'B' or class 'F' insulation. Permissible temperature shall be limited to 120 deg. C in case of class'B'insulation and in case of class F insulation, permissible temperature shall be 130 deg.C as measured by resistance method. Class H insulation shall be considered in specific cases. Limiting temperature shall also be limited to 130 deg C in case of Class H insulation as measured by resistance method.
- Motors selected shall be of normal starting torque type, high starting torque type, high slip type or stall torque type as required for the specific application.
- Four pole motors to be used for all general applications, unless specific drive requirement or economy calls for other poles.

#### 03.08.02 Valve Actuators

- The actuator shall be designed for operation on 415V, 3 phase, 50 Hz system.
- The actuators shall be suitable for voltage frequency variations as indicated in Chapter Electrical design criteria.
- The actuators shall consists of motor, torque/ position limit switches, clutch, hand wheel, position indicator, space heater.
- The actuators enclosure shall be totally enclosed dust tight, water proof without the necessity of any canopy.
- Insulation of the drive shall be class 'B'.
- Two torque limit switch one for each direction and four for end of travel limit switch (two for each direction) shall be provided.
- Hand wheel shall declutch automatically when motor is energised.



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- Position transmitter, potentiometer type shall be provided for remote indications wherever required.
- Internal wiring shall be of 1.5 sq.mm copper wire, however, terminals for external connections shall be suitable for 2.5 sq.mm
- Motor data sheet for each type of motor actuator shall be furnished alongwith internal wiring diagram, suggested control schematic and torque limit switches contact development.

#### 03.09 CABLES

#### 03.09.01 Cable Specification

Types of cables of following grades and general specifications shall be used taking into consideration the application requirements. All cables shall have FRLS (Fire Retardant Low Smoke) PVC compound for inner and outer sheath.

#### 33 kV Cables

#### Type – 1

33 kV (UE) heavy duty power cable, 3-core, with compact circular stranded (rm/V) Aluminium. conductor with extruded conductor shielding of semiconducting material, XLPE insulated, with insulation shielding over individual cores consisting of extruded semiconducting compound followed by lapped semi conducting material and copper tape, cores stranded together with a holding tape provided with a common covering of extruded inner sheath, galvanised steel wire armoured and FRLS PVC outer sheath of type ST2 compound as per IS : 7098 (Pt-II)-1973 as ammended upto date. Copper screen shall be suitable to carry 1 kA E/F current for one second.

## Type 2 :

1.1 kV, heavy duty power cable multicore with standard sector shaped (sm) or with compact circular stranded (rm/V) or circular stranded (rm) Aluminium conductors as applicable, XLPE insulated type A suitable for 70 deg. C. operation, core stranded together provided with a common covering of FRLS PVC inner sheath of type ST1 PVC compound, galvanised round steel armoured and FRLS PVC outer sheathed of type ST1 PVC compound conforming to IS:1554 (Part-I) - 1976, as ammended upto date.



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# Type 3 :

1.1kV circular stranded (rm) annealed copper conductor, PVC/XLPE insulated of type A PVC compound suitable for 70 deg.C operation, as per IS:5831 - 1970, cores stranded together provided with a common covering of PVC inner sheath, galvanised steel armoured and overall FRLS PVC sheathed of type ST1 PVC compound and multi-core to IS : 1554 (Part-I) - 1976,

## 03.09.02 Cable Selection

- In general, cables for LT drives shall be selected as per Annexure-I, however, size and type of cables for specific applications shall be selected giving due consideration for the following:
- Thermal heating effect/permissible current carrying capacity.
- Voltage drop
- Short time current/overload requirement
- Protection system grading and short circuit current carrying capacity.
- Ambient conditions
- Cable grouping factors

In selection of the cable following ambient conditions shall be taken into account.

Cables laid directly in ground in single way ducts or pipes buried underground.

- Thermal resistivity of soil : 150 °C cm/W
- Soil temperature : 40 °C
  Depth of laying (to the : 75 cm for 1.1kV highest point of cable or grade cables and top surfaces of ducts) 90 cm for HT cables
- Horizontal formation axial : 15 cm in case of spacing cables laid directly in ground in a group and approximately touching in case of single way ducts or pipes.

Cables laid in free air/in conduits in free air.



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Ambient air temperature: $40^{0}$ C & As specifiedfor the respective shops.

Cables laid in ventilated ducts/gallery

Ambient air temperature : 40°C

The minimum cross sectional area for HT power cables shall be 185 sq.mm.

The minimum cross-sectional area of the cables used in LT power circuits shall be 6 sqmm per core if with aluminium conductor or 4 sqmm per core if with copper conductor. Maximum cable size shall be 185 sq mm for motors and 240 sqmm for incomers to MCCs, PCCs etc.

For power supply to moving mechanisms subject to vibrations, flexible copper cables preferably single core should be used. In these cases, a separate core should be provided for earthing. Cables used for circuits of techo-generators, brakes, solenoids, field windings and secondary windings of measuring transformers shall be copper conductor with cross-sectional area not less than 2.5 sqmm per core. All control cables shall have copper stranded conductors except for mobile and portable equipment where control cables shall be of flexible type. Copper cables shall be used for all cranes/hoists.

For control circuits, PVC insulated and FRLS PVC sheathed multicore cables with copper conductors having a minimum cross-sectional area of 2.5 sqmm per core shall be used. The number of cores may be standardized as 2,3,4,5,7,10,14,19,24.Each core of control cable with 7 core and above shall be numbered at every 1 meter intervals.

In multi-core control cables, the following minimum reserve cores shall be kept at the engineering stage:

Upto 7 cores	-	One reserve core
10 cores	-	Two reserve cores
14,19 & 24 cores	-	Three reserve cores

Sequential length marking shall be provided in outer sheath of all power and control cables.

Standard drum length for all types of power and control cables shall be offered.

ISI marking at every meter of cable length shall be provided.





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Cores of multi-core control cables shall be serially numbered.

For all cables, extra length of 2 metres will be left before jointing.

#### Additional Tests on cable

To prove the fire retardent low smoke characteristics, the following additional tests shall be conducted at works on any size of each type of cable namely, H.T/ power, L.T. power, control and instrumentation cables.

Oxygen index test as per ASTM D 2863. Minimum value of Oxygen index shall be 30. Flammability tests on finished cable as per the requirements of IEEE-383 and IEC-332-1. Smoke generation by inner/outer sheath fire as per ASTM D 2843. The cables shall meet the requirements of light transmission of minium 40% after the test.

#### 03.09.03 Cable termination & joints

Following type of cable termination and joints shall be used for XLPE cables in indoor and outdoor applications:

- 1. Tapex type
- 2. Heat shrinkable type
- 3. Pre moulded push on type

Tapex type system:

The stress grading material shall be wrapped around the cable core, over lapping the edge of the outer conducting layer. The tape layer shall fuse together to form a compact rubber body around the stress grading material and cable core and thereby excert an active pressure on cable.

Heat Shrinkable type system :

The stress control and grading wherever necessary shall be by means of semi conducting heat shrinkable tubing. Environmental sealing between heat shrinakable material and cable surfaces shall be achieved by using hot melted sealants or adhesives. Where such sealents or adhesives shall be exposed to high electrical stress, same shall be track resistant type.

Premoulded Push On type system:

Premoulded refers to moulded Ethylene Propylene Diene monomer rubber components.


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Sealing between the premoulded push on material and cable surface shall be achieved by semi conducting pad which has cold flow properties.

The termination and straight joints for HT/LT cables shall be supplied in kit form. The kit shall include all insulating and sealing material apart from conductors fittings and consumable items. Necessary devices required for termination and joints shall be provided.

# 03.10 MISCELLANEOUS

# 03.10.01 Illumination

# 1.0 General

The lighting system inside and outside power house units are designed based on the desired minimum illumination levels recommended by IS and the practices followed in industries, architectural arrangement, building dimensions including mounting height, environmental considerations, ease of maintenance and reliability of the lighting distribution network.

and

2.0 Illumination will be provided in machine hall, control room, Office, conference room, stair case from machine hall to control room, corridors in front of control room and battery/charger room and any other premised under the battery limit.

The illumination system will include the following in required quantities;

- Lighting DBs
- Light fittings with lamps
- Lighting fixtures accessories
- Cables and wiring
- Ceiling fans
- Receptacles

- Switches
- Conduits
- Brackets
- Hangers
- Clamps
- ∎ JBs
- 3.0 The illumination system shall be designed as per IS:3646-1992. The minimum level of illumination, type of fittings, maintenance factor to be considered is as given below:

Area	Type of Light Fittings & Lamps	Lux level (min)
Control room with false ceiling	LED Luminaire equivalent to Mirror optics with anti glare features type fluorescent or CFL down lighter	300
Office, Conference room with false ceiling etc.	LED Luminaire equivalent to Mirror optics with anti glare features type fluorescent or CFL down lighter	300

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Civil Staircases of plant building	LED Fixtures	100			
Machine Hall	Machine Hall: High bay/Medium bay integral type LED light fittings compatible with 400W /250W HPSV lamps of Philips type HPK 225 SON 250/400W wide beam /narrow beam as per requirement OR equivalent.	200			
Electrical rooms without false Ceiling	LED Luminaire equivalent to Industrial trough type fluorescent fixture	200			
Toilets	FoiletsGeneral purpose batten luminaire with energy efficient T5 lamps 1x28W of Philips type TMS 122/128 HF (with MASTER high efficiency TL5-28W/840 lamp) OR equivalent.				
Battery Room	Totally enclosed corrosion proof LED.	250			
DC Lighting – Control Room	LED light fixtures, Decorative recessed type with cylindrical reflector	-			
DC Lighting – Other Areas	LED Fixtures	-			

# 4.0 Lighting Power distribution

Existing Main Lighting Distribution Board shall be retained The distribution of lighting power supply for the individual areas within battery limit shall be done at 415V, 3 phase, 4 wire bus system through Main Lighting Distribution Boards (MLDB). The outgoing feeders of the MLDB shall feed the required numbers of Sub Lighting Distribution Boards (SLDB) for lighting. Each SLDB shall receive power at 415V AC, 3 phase, 4 wire and distribute it into 240V, 1 phase circuits for connection to the lighting fixtures and 240V receptacles. The SLDBs shall be located in the rooms, bays, etc preferably near entry/exit. covering the respective zone. The SLDBs shall be located in the electrical rooms in the respective area. Separate neutral chamber shall be provided for neutral busbar inside SLDB.

# 5.0 **Control room illumination** -

Control room illumination shall be provided with decorative fittings mentioned in above table flushed to the false ceiling. Decorative type two numbers 60 watt light fittings shall also be provided as emergency lights. Lux level of control room shall be 400. Light fittings layout and their type shall be approved during detail engineering.

# Cables/Wiring and switches -

In control room, wiring shall be above the false ceiling and PVC conduits shall be used on



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side walls. 3 nos, 240V, 3 pin socket outlets with plug tops and switches shall be provided. In switch board 16 Amp MCB as incomer shall be provided and decorative type ON/OFF switches shall provided for each fitting.

# 6.0 **Emergency lighting**

This will be provided by emergency AC/DC Lighting fixtures located strategically in control room, S/S areas and emergency exits. These lights will be ON all the time, normally from station supply. In case of failure of normal AC system, these lights will be energized from the Station DC supply through automatic switching. The changeover in the reverse direction shall also be automatic. All equipment/ cabling required to achieve above shall be included by bidder. All DC emergency lighting shall be through LED lamp. Quantity of DC emergency lighting fixtures shall be 20% of the normal lighting fixtures. Also it shall be suitable for 3 hours duration.

# 7.0 Illumination of other areas

In existing plant indoor and outdoor illumination has been provided however at certain locations within battery limit additional fittings needs to be provided during erection stage to facilitate the work.

# 8.0 SPECIFICATION OF SUB LIGHTING DISTRIBUTION BOARD (SLDB) A. General :-

Туре	:	-	Metal clad Shall be suitable for 415/240V,3 phase and neutral.
Construction	:	-	Totally enclosed.
		-	Dust & vermin proof.
		-	Welded back and sides
Enclosure class	:	-	IP54 .
Type of execution	:	-	Single front
Mounting	:	-	Wall mounting .
Installation	:	-	Indoor





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# **B. Constructional Features :-**

- 1.0 Sheet steel CRCA, Thickness 2 mm .
- 2.0 Cable entry
  - Incomer :- Bottom cable entry.
  - Outgoing :- Top / Bottom cable entry.

# 3.0 Design

- One Incomer and outgoings .
- All the components shall be accessible from front
- Access to the operating handle of the incoming isolating switch shall be from the front of the cubicle without opening the front door.
- Operating knobs of outgoing MCBs shall be accessible only after opening the front door of the cubicle.
- Protective insulated cover plate (3 mm thick bakelite sheet ) shall be provided inside the cubicle to shroud all the live parts .

# 4.0 Gland plate

Undrilled detachable gland plates (3 mm thick) shall be provided at the top and bottom with suitable gaskets for cable entry

# 5.0 Earthing

Two separate earthing terminals shall be provided

# 03.10.02 Erection, installation accessories

All support structures required for cables, busducts and for electrical equiment including conduits, inserts, shall be provided to complete the erection job in all respect. Cable tag markers, clamps, sealing compound, pull boxes, marshalling boxes etc. shall be considered as part of the bidders scope.

# 03.10.03 Other Items

- All required safety items like rubber mats in front of LT board, shock treatment chart, Two nos. first aid boxes shall be provided in each electrical premises. Junction boxes, wherever required, shall be provided.



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# 03.11 SWITCHYARD EQUIPMENT 03.11.01 36 kV SF<sub>6</sub> Circuit Breaker Type

Outdoor type suitable for installation in open yard and in moist environment of Himalayas.

Three identical single pole units linked together for simultaneous operation, complete with supporting frames and tie-rods.

Capable of interrupting small inductive currents caused by switching of unloaded transformers and low capacitive currents without causing undue over-voltage.

# Standards

IEC Publication 62271-100 or other equally reputed national/international standards.

# **Technical Particulars**

a)	Nominal system voltage	:	33 kV
b)	Highest system voltage	:	36 kV
c)	Rated frequency	:	50 Hz
d)	Rated continuous current	:	1250 A
e)	Symmetrical short circuit level	:	3000 MVA
f)	Туре	:	SF6
g)	Closing mechanism	: spring chanis	Motor operated charging me- m with motor
h)	Closing coil	:	220V DC
i)	Tripping coil	:	220V DC
j)	Number of poles	:	3 (Three)



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k) S cir	Symmetrical short cuit rupturing capacity	:	25 kA
I) SI	hort time current rating (three sec.)	:	25 kA
m)	Making capacity and dynamic stability current	:	63 kA peak
n)	Total break time for any current upto the rated breaking current measured from the instant of trip coil energisation	:	Less than 3.5 cycles
o)	First pole to clear factor	:	1.5
p)	Whether the circuit breaker is intended for rapid reclosing	:	No
q)	Operating duty min - CO	:	0-0.3 sec - CO - 3
r)	Dead time of the breaker 15-20 cycles	:	Adjustable between
s)	Latching requirement	:	Trip free
t)	System neutral	:	Solidly earthed
u)	Rated one min. power frequency withstand voltage 1) Insulation level of bushings	:	70 kV rms
v)	Rated lightning impulse withstand voltage	:	170 kV peak





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w)	Min. creepage distance highest system voltage	:	2.54 cm/kV of
x)	Control supply voltage	:	220V DC
у)	Aux. contacts with each circuit breaker interchangeable at site	:	12 NO + 12 NC
a1)	Type tests for perfor- mance verification	:	As per IEC / IS
b1)	i) Phase discrepancy	:	If the position of control all three breaker poles after switch-ing is not same then an opening command shall be initiated to all poles after a definite set time delay. Signal shall be given to control room for alarm 'Phase discrepancy trip'
ii)	For compressor system		
-	Rated voltage of	:	415V, 3 ph, 50 Hz,
-	Capacity of air receiver operations	:	3 close and 3 open
iii)	Accessories	:	
-	ON/OFF indicator	:	Mechanical as well as electrical
-	Emergency tripping mechanism	:	Mechanical
-	Termination suita- bility with connectors	:	ACSR/ Pipe Bus





#### MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)

1



Anti pumping relay operation counter, local control panel local/remote selector switch Shall be provided

# Bushings

- Equalized electrical stress internally and over the bushings surface
- Free from radio interference
- Provision for expansion over normal operating temperature range
- Leak-proof magnetic indicator at the top of the bushing to indicate oil level at all times
- Bushings with combination potential and power factor test cap.

#### **Operating Mechanism**

- Shall be suitable for remote control from the electrical control room.
- A local control switch with locking arrangement shall be provided for each breaker for local operations i.e tripping and closing during maintenance, test etc.
- Local/remote selector switch shall be provided in the mechanism cabinet.
- Interlocked to prevent remote operation when the selector switch is in the local position.
- Provision of anti pumping relays to prevent repetitive operations of the breaker due to high speed operation on non-release of the control switch.
- Provision for connecting oscillograph recorder to measure the operation timings of the breaker.
- Provision of pole slipping relay
- Each breaker shall have ON/OFF indication lamp along with a mechanical 'open/closed' position indicator visible to a man standing on ground, with the mechanism cabinet closed.



# MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



- Also facilities for remote indication of breaker 'open'/'closed' position in the electrical control room.
- One close coil and two trip coils.
- An operation counter for each breaker.
- Cabinet for operating mechanism and its accessories shall be of IP55 protection with pad locking facility. Cabinet shall be simplex type all equipment mounted on front side and wiring on back in proper wire ways.
- Anti condensation heater shall be provided in the local cabinet with load break fuse switch. It shall house relays for control and interlocking as per scheme requirement.
- Wire-ways/cable ways shall be provided in op. mechanism cabinet to ensure aesthetical neat and orderly wiring. All the connection shall be at back and equipment in front.
- Closing circuit to operate satisfactorily from 80% to 110% of the rated control voltage and tripping from 50% to 110% of the rated voltage.

# Interlocks

Opening or closing of the isolator/disconnecting switch shall be prevented when the breaker is in closed position.

# **Terminal Connections**

- Shall be suitable for ACSR conductors/ Pipe bus
- Suitable terminal earth connector for earthing connections shall also be supplied.

# 03.11.02 36 kV Isolator Type and construction

- Triple pole gang operated suitable for outdoor installation in open yard under the specified site conditions.
- Center post rotating type, with double break and with contacts coming in horizontal plane preferred.
- Common actuating mechanism for all three poles.



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



- Single pole units shall be interchangeable
- Switch blades shall be of copper and of one solid piece construction.
- Clearance between live parts and grounded structures, shall be as per the relevant standards.
- Interphase clearance shall be about 2.1 meters and mounting height not less than 3 meters.
- Length of break in full open position shall be such that there is absolutely no possibility of arc over from the live parts to the de-energised parts.
- Speed of operation during opening or closing shall ensure minimum arching.

Technical particulars

a)	Nominal system voltage	:	33 kV
b)	Highest system voltage	:	36 kV
c)	Rated frequency	:	50 Hz
d)	Туре	:	Triple pole,air break, off load, double break with earth switch (As per IS : 1818)
e)	Continuous current rating	:	800 A
f)	Short time rating 3 sec.	:	25 kA
g)	Making capacity and dynamic stability current rating	:	63 kA peak
h)	Insulation level		
i/	Impulse withstand voltage	:	170 kV
ii/	One min. power freq. withstand voltage	:	70 kV



# MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



i)	Min. creepage distance	:	2.54 cm/kV
j)	Operating mechanism	:	Motor driven with provision for hand operation in emer- gency. Motor to be rated for 415V, 3 Ph 50 Hz AC
k)	Tripping mechanism	:	Mechanical trip device
I)	Termination	:	ACSR conductor both sides
m)	Earthing switch	:	On load side of iso- lator, mechanically, interlocked with isolator
n)	Auxiliary contacts	:	6 NO + 6 NC for iso- lator 6 NO + 6 NC for ear- thing switch
0)	Installation	:	Outdoor on suppor- ting structure with padlocking facility
p)	Castel key interlock	:	With 33 kV circuit breaker and earthing switch for correct sequence of operation
q)	Electrical interlock	:	Between isolator, earthing switch and circuit breaker (for correct sequence of operation and safety)
r)	Control voltage	:	220V DC/415V AC
s)	Hardware	:	Hardware used for isolator mounting and mechanical operation shall be hot dip galvanized.



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



# Making and Interrupting Capability

Disconnecting blades shall be capable of carrying rated current continuously as well as specified short circuit current for the specified duration without causing mechanical damage to any part and without damaging the insulation, during temperature rise.

The switches shall be capable of making on to faults specified and withstanding the dynamic stresses involved.

Shall also be suitable for interrupting small inductive and capacitive currents such as those which occur while disconnecting lines at no-load, busbars or voltage transformers under energized condition.

# Contacts

High pressure self aligning adjustable type

Shall be well protected all round by a metal cover to provide not only electrostatic screening but also to prevent coarse dust from entering between the contacts.

Contact pressure shall be released before any movement of the blades and the opening direction takes place and shall be applied after the closing travel is completed.

Sufficient wiping action to make contacts self cleaning.

Contacts shall be of high grade high conductivity heat resisting copper and shall be silver plated.

Temperature rise of contacts shall not exceed 55 deg. C over the ambient of 45 deg. C.

# **Operating Mechanism**

Shall be suitable for remote and local electrical operation with provision for manual operation as well.

Interlocked to disconnect the operating motor circuit in case of manual operation.

Operating mechanism and its controls shall be so designed that under no circumstances the travel of the switch blades is interrupted before it reaches the fully closed or open position.

Signalling device for all poles both for closed position and open position for remote as well as local indication.



#### MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



Provision for padlocking the mechanisms in either the open or closed position.

Housing for the operating mechanism and its controls shall be of sheet steel weather and dust proof construction with rubber gaskets conforming to enclosure protection class IP-55.

The cabinet shall accomodate reversible magnetic starter, spring return control switch, interlocking relays etc. for motor operation, anti-condensation heater, load break fuse switch for heater and a light socket.

# **Earthing Switches**

Disconnecting switches shall be provided with earthing switches on both sides or on one side (as per single line diagram) forming integral part.

Rating of earthing switch shall be same as that of the isolator/disconnecting switch with respect to rated short time current and dynamic peak withstand current.

The earthing switch blades shall be operated by a separate mechanism but interlocked so that these can be closed only when the disconnecting switch is open and vice-versa.

# Interlocks

To be interlocked with associated isolators and circuit breakers.

Earthing switches and isolator interlocking :

- For closing of isolators, associated earthing switches, shall have to open and it is to ensure that isolators are not used for on load closing.
- Final wiring or contact multiplication relays, blocking solenoid etc. shall have to be provided as per approved logic diagram.
- Earthing switch and circuit breaker interlocking :
- Breakers can be closed if associated earthing switches are open and isolator are in closed position.
- Auxiliary relays and circuitry shall be such that interlocking cannot be bypassed even on failure of control supply.



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



# **Terminal Connections**

Shall be provided with high conductivity terminal connectors made of extruded aluminum and bimetal arrangement with stainless steel fastener suitable for ACSR conductors.

# 03.11.03 33 kV Current Transformer

# Туре

- Outdoor type suitable for installation in open yard where no protection against sun, rain and inclement atmospheric conditions exists
- Oil immersed, nitrogen topped, hermetically sealed type self cooled.
- Suitable for service in industrial environment.
- 3 core single phase with primary injection facilities.

# **Technical particulars**

a)	Standard	:	IEC Publication 185/ or equivalent
b)	Nominal system voltage	:	33 kV
c)	Highest system voltage	:	36 kV
d)	Rated frequency	:	50 Hz
e)	System neutral earthing	:	Solidly earthed.
f)	Rated continuous current	:	Core-1 : 500/5 , 5P(O/C & E/F) Core-2 :500/5, 0.5 (Metering) Core – 3 :500/1 PS (Differential Protection)
g)	Short time thermal current rating for 3 (three) seconds duration	:	25 kA (rms)
h)	Dynamic peak withstand current rating	:	63 kA (peak)



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



i)	Class of insulation :	В	
j)	Insulation level		
	<ul> <li>Rated lightning impulse withstand voltage (1.2/50 micro second impulse)</li> </ul>	:	170 kV peak
	<ul> <li>Rated one minute power frequency wet and dry withstand voltage</li> </ul>	:	70 kV
k)	Temperature rise		
-	Oil top of housing (measured by thermometer)	:	45 deg. C
-	Winding (measured by increase in resistance method)	:	50 Deg. C
I)	Terminals	:	Suitable for ACSR conductor/ Pipe Bus
m)	Marshalling Box	:	IP 55 enclosure
n)	Accuracy Class	:	As per enclosed SLD

# Current Transformer Secondary Circuit

- All secondary leads from the multi-ratio current transformers to be carried in a single conduit to terminal blocks in the mechanisms housing for convenience in changing ratios
- Change in CT ratio shall be independent from primary circuit
- CT ratio shall be as per single line diagram
- Burden shall be as per Single Line Diagram
- Knee point voltage to be decided during detailing.



# MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



# 03.11.04 Insulators

# Disc Insulator

The insulator discs shall be cap and ball pin type with Ball and Socket coupling suitable for use in suspension of tension strings.

The electrical and mechanical characteristics of the Disc Insulator shall conform to specific technical parameters of this specification

# Post Insulator

Post Insulator shall be suitable for upright mounting on steel structures. The electrical and mechanical characteristics of the Post Insulator shall conform to specific technical parameters of this specification

The Hardware fittings for Suspension / Tension string shall be supplied complete in all respect and all metal parts shall be galvanized.

# i) ACSR Conductors

ACSR Moose Conductor shall be provided for 110 kV Switchyard.

# ii) Clamp, Connectors

All clamps connectors shall be designed suitable to the specification for Aluminum Tubular pipe bus and specification for ACSR conductor as applicable.

# iii) Steel structures and supports, nut and bolts

Complete steel structures for mounting various equipment of 33kV switchyard shall be provided

# iv) Aluminium Tubular Pipe Bus

v) Aluminum tabular busbar of 3" diameter for 33kV switchyard at Maithan hydel Power Station shall be provided.



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



# 03.12 ERECTION SPECIFICATION

# 03.12.01 Guidelines for design of system and engineering the layout of electrical equipment General

The bidder shall prepare the layout drawings taking into consideration the requirement listed below.

# Electrical premises

All electrical premises shall have adequate space to accommodate the electrical equipment from the point of view of operation and maintenance, and conform to IE Rules & Regulations.

The clearance between the ceiling of the electrical room and top of the tallest equipment shall not be less than 1m, 2m where the equipment are to be maintained from top and additional height of lifting tackle wherever required.

Air tight door arrangement shall be provided for electrical control rooms.

# Cable Installation

Cables will have to be run partly along the structures and columns of the buildings, wherever it is necessary i.e. to a nearby shop cable trench /channel or surface duct shall be provided. Cable channels inside turbine floor shall be avoided.

Installation of cables directly buried in ground shall generally conform to the requirement given in IS: 255.

If the cables are crossing the road/rail track, cables shall be laid in concrete cable ducts, G.I. pipes. 25 % spare conduits/pipes/duct openings shall be provided.

Cables in trenches shall be laid on 8 cm of riddled sand and covered with 8 cm of riddled sand. RCC slabs shall be provided for covering these trenches. The maximum trench depth shall normally be 1.5 m and thickness of top cover of 75 mm. If the trench is to cross railway tracks/roads or any load bearing area the cables shall be taken through suitable GI conduits/pipes/ducts.

# Laying in surface ducts / on structures

Cable racks for cable trays shall be fixed at a maximum interval of 1.5 m. Cables leaving the ground/floor shall be protected upto 2 m height by conduits/metallic guards.



# MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



Galvanised prefabricated ladder type cable racks and trays shall be provided to lay cables in shafts/cable basements. Cables shall be laid in separate racks according to the voltage/application classification. The cables shall be laid from top to bottom in order of HT on top rack followed by LT cables and other cables on lower racks.

All necessary frame works and fixings for the support of cables and accessories shall be supplied.

Cables shall be suitably protected against heat, and mechanical damages.

# Structures for cable laying

Cables shall be laid on ladder type cable trays. Ladder type cable trays shall be selected from sizes 200 mm, 400 mm & 600 mm and shall be fabricated from 40x40x3.1 mm GI slotted angles for longitudinal members and 25x5 mm perforated flats for cross members placed at an interval of 250 mm along the length of cable tray.

Supporting vertical racks and horizontal hooks shall be of 50x50x6 mm angles. Cable racks and hooks shall be of welded construction.

To avoid damage during cable laying, cable structures shall have no scales, abbrasive or rough surfaces or cutting edges.

# **Transformer installation**

Mineral oil filled transformer shall be installed at transformer yard.

# Earthing

Entire system shall be earthed in accordance with the provisions of the relevant IEC recommendations/ IS code of practice IS 3043-1987 and Indian Electricity Rules, so that the values of the step and contact potentials in case of faults are kept within safe permissible limits.

Parts of all electrical equipment and machinery not intended to be alive shall have two seperate and distinct earth connections each to conform to the stipulation of the Indian Electricity Rules and apparatus rated 240 V and below may have single earth connections.

Earthing mat consisting of earthing electrodes and cross connecting conductor is already provided by the purchaser and bidder has to connect equipment earthing to the grid. Existing earth pits shall be renovated and rusted materials shall be replaced with equivalent material and bimetal washers shall be provided wherever GI strips shall be connected to existing copper network.



# MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



For protective earthing separate conductor shall be used for flow of earth fault current as elaborated below.

The LV side neutrals of the distribution transformers shall be connected to two separate earthing electrodes. They shall also be connected with the neutral bus of the corresponding switchgear and in turn switchgear neutral bus shall be connected to the earthing bus of the switchgear. The protective conductor for connection from switchgear earthing bus to MCCs/DBs and further to motors shall be either through fourth core of cable or armouring of cable. In case of armouring on cable, same shall be double steel wire armouring. The fourth core or armour of cables and all conduits for cables shall also be connected to the earthing mains. A continuous earth strip shall run in each side of cable channel and in cable ducts and trenches.

All joints in the run of the main earthing conductors will be welded or brazed type. Connection to equipment structure shall be bolted type.

# Conductor sizes for earth connections:

# High voltage systems - 75 x 5 mm GI flat for:

- Transformers
- Earthing resistors
- Earthing leads to earth electrodes.

# LT system where the voltage does not exceed 650V normally :

- 6 Sq.mm Stranded GI wire for :
- Motors and starters upto and including 2.2kW, shunt limit switches, push buttons and master controllers, Light fitting,JBs,PBs, etc.
- Instruments and miscellaneous small items protected by fuses of ratings not exceeding 15A.
- 16 Sq mm Stranded wire for :
  - Motors and starters above 3.7 kW and upto and including 15 kW.





MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



# 25 x 3 mm GI flat for:

- Motors and starters above 15 kW, and upto and including 45 kW
- Control desks, cabinets, LCB, socket outlet isolators, SLDBs/DBs.

# 50 x 6 mm GI flat for :

- Motors and starters over 45 kW
- Switchboards, MCC, PDB, PCC MLDB.

# 50 x 6 mm GI flat (minimum) for :

- Main earthing ring in plant buildings
- LT transformer neutral
- LT Switchboards and other equipment protected by circuit breakers.

#### Sheet metal enclosed panels control desks and boxes

The base frames of all panels, desks, posts etc., shall be welded to structures or to the civil inserts provided on the floor/walls. Fabrication of supports/frames, wherever required, shall be done by the bidder.

The shipping section shall be placed in position before removing the protective covering to eliminate scratch/damage. The shipping section shall be moved by using rollers under the shipping skids wherever lifting cranes are not available. The bidder shall do the assembly at site as per manufacturer's general arrangement drawings and installation instruction. While assembling a complete board comprising several unit type cubicles, the board as a whole shall be aligned. The panels shall be properly levelled prior to grouting the holding down bolts or welding the panels to the inserts. All interconnection of busbars and wiring between the panels shall be done as per manufacturer's instructions and drawings. Welding work on the panels shall only be carried out after consultation with the purchaser. Damage to the paint due to welding shall be rectified by the bidder.

# Transformers

The transformer and its accessories and mountings like radiators, conservator, thermometers, silicagel breathers, marshalling box, rollers etc., delivered at site in separate packages, shall be assembled at site after cleaning by the bidder in proper sequence as per manufacturer's drawings.

Jacks shall never be placed under valves or cooling tubes. Suitable stopper shall be provided both in front as well as rear of transformer to keep the transformer stationary in its position.



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



The oil conservator and the pipes shall be erected as shown in the manufacturer's drawings. All radiator tubes shall be cleaned before installation.

Before the transformer is filled/topped with oil, oil samples shall be checked by the bidder from each container. The oil shall possess the dielectric strength as per relevant IS. Oil shall be filled upto the mark shown.

The bidder shall also test the oil from each transformer to determine its suitability for use. If required, the bidder shall carry out drying and filtering operations as per IS code of practice to ensure that moisture is completely removed and the oil is free from impurities. This may be carried out by using oil filtering equipment to be provided by the bidder having vacuum as well as heating arrangement. Only after the dielectric strength of oil and other parameters are checked and approved, the external connections shall be made to the transformers.

The dial thermometers shall be screwed to the thermometer pockets after removal of the blind plugs.

All necessary cabling shall be connected before charging of the transformer. This will include signalling cables upto marshalling box and from marshalling box to meters, if not already done.

Any modifications to HT and LT terminal box to accommodate the number of cables or bus duct to be terminated shall be carried out by the bidder. Naked light and flame shall never be used near the transformer. Instructions given by the manufacturer's erection & commissioning manual shall also be followed.

# Busbar

Busbar installation shall be commenced from the middle section and the buses shall be fastened without tightening the bolts. The buses shall lie freely on the insulators without warping and if necessary, suitable packing shall be provided at the insulators.

Final tightening of the bolts shall be done after the complete laying of buses. Approved means shall be used for tightening of the bolts.

Bimetallic strips/washers shall be used wherever aluminium busbars or aluminium cables are terminated on copper busbars.



# MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



# Limit switches

The places of installation shall be seen from the engineering drawings and the switch shall be secured by means of adjustable bars. Any modifications required in positioning of limit switches as per site conditions shall be done by the bidder.

#### Miscellaneous equipment Cables Installations

Cable shall be fixed to racks or trays or cleats as required for proper support, accessibility and neatness of installation. Cable tags shall be provided at a regular interval of 30M. For cable run shorter than 30M one cable tag shall be provided in the middle. These tags shall be in addition to end cable tags. The cable tags shall be marked with cable number, size and voltage grade. Middle tag shall be indicated with destination. The end tag shall be with second terminal point.

Cables shall be clamped rigidly at an interval of not more than 1500 mm in horizontal, and 1000 mm in vertical & inclined run and at bends.

In the cable galleries, cable structures shall be properly arranged giving sufficient clearance for movement of personnel from one part of the gallery to the other. It shall also be possible to escape easily in case of fire.

Cables laid in over ground structures shall be protected from the direct solar radiation. Road crossing points sufficient clearance shall be provided with due consideration to road traffic. In outdoor structure cat ladder and walkable platform shall be provided to facilitate cable removal/addition on the cable trays.

Perforated trays shall only be used where necessary for the support of a number of small cables. Each tray shall be firmly supported at suitable intervalsand shall carry the weight of its cables without sagging. Trays shall be painted and where the surfaces or edges are cut or otherwise impaired during erection, they shall be made good by coating with aluminium paint.

Small cables may be bunched together under one saddle provided that in any bunch all cables have sheaths of the same material. The number of cables shall not exceed four wide and two deep.

Not more than one cable shall be drawn into one conduit unless otherwise agreed. After the cable has been drawn in, the conduit shall be sealed by an approved means.



#### MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



All cables shall be tested for proper insulation before start of laying work.

Cables shall be laid in conduits, racks/trays, cable trenches, along with structures or buildings, as per cable routing drawing and cable list.

Suitable adjustment shall be made in cable routes, if required at site, with a view to avoid any interference with any part of building, structures, equipment, utilities and services with the approval of the purchaser.

While laying cables, care shall be taken that kinks, twists or mechanical damage do not occur to the cable.

All bends in cables shall be made with due consideration to the minimum permissible bending radius of the cables.

On being pulled, the cable shall not be allowed to drag drawing along the ground or over a second cable already laid. Special care shall be taken while pulling through an opening where other cables have already been laid. Only approved cable pulling devices shall be used.

No joints shall normally be made at any intermediate point in through run of cables unless the length of the run is more than the standard drum length. In such cases where jointing is unavoidable, the same shall be made inside proper bases having plastic moulds and shall have moulded epoxy resin construction. Provision shall be made for earthing continuity at the joint. Cable splicing and jointing shall be done in accordance with the relevant IS code of practice and manufacturer's instructions. Insulation resistance of cables shall be checked before cable jointing.

Adequate length of cables shall be pulled inside the switch boards, control panels, control desks, etc. so as to permit neat termination.

All cables shall be neatly dressed without interlocking or cross over. While laying the cable vertically, these shall be clamped at suitable intervals. Horizontal runs shall be rigidly secured to trays on racks/hangers in all the places where the direction of the route changes as well as at cable terminations or joints. The clamps shall not be done up so tight that the insulation is damaged or deformed.

Cable markers shall be provided on either side of road crossing at each turning and at 30 m intervals at straight runs for underground cables.



# MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



Where cables are required to cross roads, surface drains and water, oil, gas or other pipe lines, they shall be taken through reinforced spun concrete or steel pipes.

Entry of cables from underground to the buildings or trenches shall be through pipe sleeves. After laying of cables, the sleeves shall be sealed with bitumin or epoxy compound with sand matting and cement plaster to make them fully water tight.

Special consideration shall be given for protection of cables against chemical and mechanical damage.

All cable entry openings in the equipment shall be sealed with fire proof materials. All cable openings in walls and floors shall be sealed after laying of cables by water and fire proof materials.

All cables shall be provided with identification tags indicating the cable number in accordance with cable lists. Tags shall be fixed at both ends of the cable and at 30 m spacing for straight runs as well as on both sides wherever cables are crossing walls/floors. The tags shall be of aluminium/PVC with numbers punched/painted on them and securely attached to the cables by non-corrosive wires. The shape of tags shall be round, triangular and rectangular for control, medium voltage and high voltage cables respectively.

Glanding shall be done for direct entry of both power and control cables into the panels by the bidder. Double compression type brass cable glands shall be used.

The cables shall be terminated in accordance with relevant connection diagram. Termination and clamping shall be carried out in such a manner as to avoid strain on the terminals.

All power cable terminations shall be by means of crimping type cable lugs. For flexible conductors, soldered termination shall be adopted. In case of aluminium power cables termination on copper bus bars, suitable aluminium copper bimetallic washers shall be used. Corrosion inhibiting grease shall be used for aluminium cable terminations.

Suitable numbered and coloured letter interlocking type ferrules shall be provided for end termination of power and control cables.

Control cable entering switch boards, control panels, control desks etc. shall be neatly bunched and strapped with PVC perforated straps and suitably supported to keep it in position at the terminal blocks. All spare cores of each cable shall be segregated, marked spare, neatly dressed and suitably taped at both ends.



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



When the cores of two or more multicore cables take a common route, cores of each cable shall be separately bound and the separate bundles neatly bound together.

Individual cores of control cables shall have plastic interlocked type coloured ferrules with engraved numbers at both ends of the circuit for identification.

The bidder shall be responsible for correct phasing of motor power connections and shall interchange connections at the motor terminals box, if necessary, after each motor is test run.

The trays shall be earthed and rendered electrically continuous by welding the trays to the grounding strip at not less than two places from both sides of the tray.

# **Exposed conduits**

Exposed conduits shall be laid along walls, floors, ceilings, on steel supports etc. as per working drawings/site requirements in consultation with the supervisory personnel. The conduits shall be neatly run and evenly spaced.

Fixing of conduits to the supports on wall, column, structure shall not be done by welding. Exposed conduits shall be adequately supported by racks, clamps, straps etc. Jointing of conduits shall be done only in straight portion and not in bend portion.

The bidder shall have available at site bending facilities for conduits as well as dies for threading conduits of diameters and threads corresponding to the standards. The threaded ends of conduits shall be painted with anticorrosive paint. The outer ends shall be smoothened free of burrs and sharp edges. Sealing shall be at both ends of conduits.

Flexible metallic conduits shall be used for termination of connections to motors and other electrical equipment like pressure switches etc. which need to be disconnected at periodic intervals.

All conduits shall be effectively connected to the earth terminal of the equipment where it terminates.

Both ends of conduits shall be suitable earthed. Earthing continuity to be maintained by means of flexible wire wherever two conduits are joined with sockets.

Approved conduit bending machines to be arranged by the bidder shall be used for bending conduits in the field. The radius of any conduit bend shall be as per standards for cabling. Bends shall be free from cracks, crimps or other damage to the pipe or its coating.

# DRAWINGS/DOCUMENT TO BE BY SUPPLIER AFTER PLACEMENT OF ORDER

CHAPTER NO - 04





# 04.0 DRAWINGS/DOCUMENT TO BE BY SUPPLIER AFTER PLACEMENT OF ORDER

# 04.01 General

- Name of co-ordinators with address, telephone/FAX numbers for all sub-contractors, pertaining to electrical job.
- List of equipment/tools and manpower proposed to be arranged for installation erection and site handling of the equipment.
- Name of site incharge with office/organisation and date of opening of site office.
- Quality control manuals
- Detailed list of drawings and documents containing information on current state of the project.
- Monthly progress report furnishing status of
  - Planning
  - Manufacture
  - Transport
  - Erection
  - Testing & commissioning

# 04. 02For Approval

# A. Calculations

- 1. Relay settings with calculations and graph for justification of all relay settings (current, voltage and time).
- 2. Calculation to justify generator CT/PT parameters like VA burden, knee point voltage etc. for all cores.
- 3. Calculations for Required battery capacities of the UPS system.
- 5. Calculations for voltage drop and short time rating of cables to prove adequacy of sizes.
- 6. Calculation of resistance values of NGTR & kVA of earthing transformer.





- 7. Calculation of lux levels of Control Room.
- 8. calculation w.r.t. generator busduct sizing, temp rise and insulator spacing
- 9. Calculations for short time withstand of transformers.

# B. Others

- Single line diagram indicating transformers, breaker, CT/PT, all relays, meters, LA, cable sizes, details of CT/PT ratio, VA burden, Vk value, type and make of all relays, their range, nominal and short time ratings of breakers, busbars etc. for all equipment.
- 2. Front view and GA diagrams for all panels.
- 3. Control and schematics drgs. for local/remote control/protection for each equipment and drives.
- 4. Drive list.
- 5. Synchronisation schemes.
- 6. Auto change over arrangement
- 7. Logic diagrams for start/stop of various mechanism/drives
- 8. Lighting layout for Control Room and other areas. Type of fittings, wiring arrangement, switching of fittings and single line diagram from board to fittings.
- 9. Details of protection logic (class A,B&C tripping) indicating list of electrical and mechanical protection leading to tripping of turbine generator, field breaker etc.
- 10. Equipment Earthing layout drawing
- 11. Electrical equipment layout for all electrical premises.
- 12. Bus Duct Layout, Cable structure layouts with size of structures for gallery and cable channels of different places
- 13. Sequence of inspection plan and despatch of materials to site.
- 14. List of drawings, numbering system, size, proposed date of submission (To be submitted just after LOI).





# C. For Information

- 1. Details of painting for all equipment
- 2. Bus wire arrangement for control/signal/annuncia-tion and heater supplies of control panels and switch boards.
- 3. Cable schedule indicating type of cables, from to via. route, total length, size of each cable and a final summary sheet indicating total requirement of all types of cables (for control and power both).
- 4. Core wise control cable termination details indicating ferrule no./terminal block no. for each cable/each equipment.
- 5 .Internal wiring diagrams for all panels.
- 6. VI characteristics and RCT values of CTs used in differential protection.
- 7. Cable layout drawings.
- 8. Technical particulers of all LT motors and recommended protection.
- 9. Catalogues for each type of equipment, relays, meters etc.
- 10. Installation and commissioning manuals for each equipment, relay etc.
- 11. Operation and maint. manuals indicating trouble shooting procedure for all equipment.
- 12. Type test certificates for all the major equipment.
- 13. Details of test results conducted at works for all equipment in bound Volume
- 14. Details of test results conducted at site for all equipment in bound Volume
- 15. Spare part list number and ordering procedure for all recommended spares.
- 16. Details of transport arrangement and maximum size of transportable section (weight and overall dimensions).
- 17. Details of agency proposed to be fixed for doing erection commissioning job.
- 18. Panel wise bill of material indicating type, make and brief technical particulars of all items/ accesssories mounted on the panels.
- 19. Overall GA of all the panels/equipment





- 20. Fixing details of all the panels/equipment, supporting structures, etc.
- 21. Heat loss for each equipment.
- 22. Static and dynamic loading of each equipment
- 23 .Floor cutouts and wall opening details for cables bus duct, air conditioning ducts, light conduits, exhaust fans etc.
- 24. Details and location of various inserts base plates, bolts etc. required to be provided for support of cable structure, bus duct elect. panel etc.
- 25. Conduit layout drawing indicating type, size, length and locations of conduits required to be placed in RCC wall/floor, brick wall.
- 26. Technical data sheet for each type of motors and characteristic curves for protection settings.
- 27. As built drawings incorporating site changes along with soft copies in CD.

TECHNICAL PARTICULARS TO BE SUBMITTED BY THE TENDERER

CHAPTER NO - 05





# 05.0 TECHNICAL PARTICULARS TO BE SUBMITTED BY THE TENDERER

# 05.01 GENERAL

1. Instructions

The data called for below is to be furnished by the bidder and in case the bidder becomes the supplier, the data shall form part of the contract covering the work. The performance figures quoted shall be guaranteed within the tolerances permitted in the relevant standards.

- 2. Bidder's Name (For Electrics)
  - 1. Trade Name of Bidder :
  - 2. Address for correspondence :
- 3. General conditions

Is it the Bidder's intention, if awarded the contract, to comply fully and in all respects with the Owner's specification ?

Yes/No

If 'NO' is answered to any of the above questions, the bidder shall state the exceptions in details, clausewise, partwise and chapter wise.

- 4. Tenderer to submit all data/ information / drawings / spare part list pertaining to electrics, generator, static excitation & AVR system in one volume. -
  - Agreed
- 5. Tenderer visited the site and under stood the job & location of various stood. equipment.
  - Yes





# 05.02 Design Considerations

1.0	Load	ling (unit wise)	:	
	1.1	Cold start up	:	
	1.2	Hot start up	:	
	1.3	Full Aux. load on one unit	:	
	1.4	Full Aux. load on both unit operation	:	
2.0	Batte (for tl of ter	ery capacity required ne equipment/system nderer's scope)	:	Number AH
3.0	Any other aux. supply required (Other than 415 V AC & 220 DC)			Indicate with purpose.
4.0	0 List of drives/mechanism with kW needs DC power supply		:	List to be enclosed
	Spar	es and tools & tackles		
1. 2.	List of commissioning spares List of special tools and tackles			List to be submitted List to be submitted

# Summary Of Technical Parameters Of Major Electrical Equipment

SI. No.	Equipment Description & Qty.	Make & type Country of manufacture	Total Weight.	Single largest package dimensions & wt.	Applicable std.	Rating as per design conditions of tender	Guaranteed tech. Data





# 05.03 HT Equipment

05.03.01 HT Equipment ( 33 kV & 11kV)

# **33kV** Circuit Breakers

1. 2.	Name Type	e of manufacturer	:	SF6	
3.	Rated	d voltage (kV)	:		
4.	Conti	nuous current rating (A)	:		
5.	Short time current rating				
	i)	1 second, kA (rms)	:		
	ii)	3 seconds, kA (rms)	:		
6.	Breaking capacity				
	a)	Symmetrical with %of DC component as per IEC-56 corresponding to min. ope- rating time, kA (rms)	:		
	b)	Symmetrical rupturing capacity at rated service voltage, MVA	:		
	c)	Asymmetrical, kA	:		
7.	Making capacity, kA (peak) :				
8.	Kilometric fault level, MVA :				
9.	Total break time (measured : from instant of trip coil energisation)				
	a)	at 10% rated interrupting capaci	ty :		
	b)	at rated interrupting capacity	:		



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

# (ELECTRICS AND C&I)



10. Minimum reclosing time at full : rated interrupting capacity from the instant of trip coil energisation 11. Dead time for 3 phase reclosing a) minimum, ms b) Limit of adjustment, ms : 12. Maximum over voltage to switching • transformer on no load and the charging current 13. Dry and wet 1-minute power frequency withstand test voltage for complete circuit breaker. a) between phase to phase, : kV (rms) between phase to b) : ground, kV (rms) between terminals with C) : breaker contact open, kV (rms) 14. 1.2/50 micro-second full wave impulse withstand voltage for complete circuit breaker a) between phase to phase, : kV (peak) b) between phase to : ground, kV (peak) between terminals with C) breaker contact open, kV (peak) : 15. Dry 1-minute power frequency : withstand voltage for insulator kV (rms)



#### MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

# (ELECTRICS AND C&I)



16.	1.2/5 impu the ir	0 micro-second full wave lse withstand voltage for nsulator, kV (Peak)	:	
17.	Coro kV (ri	na extinction voltage ms)	:	
18.	Cree	page distance to ground, mm		
	a) between phases			
	b)	live parts to earth	:	
	C)	live parts to ground level	:	
19.	Type of main contacts		:	
20.	Type of auxiliary contacts			
21	Number of trip coils in each breaker			
22.	Type of operating mechanism			
	a)	Opening	:	
	b)	Closing	:	
	c)	Emergency tripping	:	
	d)	Capacity of air camp. for no. of operations (for SF6)	:	
	e)	Capacity of hydraulic oil system	:	
23.	Overall dimensions (mm x mm x mm)		:	
24.	Whether breaker is suitable for automatic rapid reclosing		:	Yes / No
25	phase reclosing			Single / three
26	List of accessories provided			




27.	Shipping dimension of the largest package	:	
28.	Confirm that all details given in technical particulars are acceptable to tenderer	:	Yes/no
29.	If answer is 'NO' indicate pointwise deviation	:	
30.	Manufactuer's catalogue enclosed	:	Yes / No
HV D	isconnecting Switch/Isolator		
1.	Manufacturer's name	:	
2.	Туре	:	Single/double break Horizontal/Vertical
3.	Rated voltage kV	:	
4. 5.	Rated frequency Current rating a) Continuous A (at design temp.)	:	
	b) Current rating at site condition A	:	
	c) Dynamic through fault kA	:	
	d) 3 second rating kA e) Making current A	:	
6.	One minute power frequency dry & wet withstand voltage		
	a) across isolating distance,kV (rms)	):	
	b) to earth & between poles,kV (rms	):	
7.	1.2 / 50 micro sec.impulse		:



TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

#### (ELECTRICS AND C&I)



#### withstand voltage

	a)	Across isolating distance,kV (peak)	:	
	b)	To earth & between poles,kV (peak)	:	
8.	Type blad	of interlock between earthing e and isolator	:	
9.	Partic mec	culars of isolator operating hanism	:	
10.	Duty		:	Outdoor/Indoor
11.	No. o switc ratior	of operations, the disconnecting h can withstand without deterio- n of contacts	:	
12.	Clear	ance		
	a)	Between phases, mm	:	
	b)	Between live parts & earth, mm	:	
	C)	Between fixed contacts and blade in open position, mm	:	
13.	a)	Capacitive current that can safely be interrupted by the switch, A	:	
	b)	Magnetising current that can safely be interrupted by the switch, A	:	
14.	Туре	and make of insulator	:	
15.	No. c	f insulators per stack	:	
16.	One volta	minute dry & wet withstand ge per stack, kV (rms)	:	
17.	lmpu stack	lse withstand voltage of insulator at 1.2/50 micro seconds positive	:	





full wave, kV (peak)

18.	Creepage distance	
	a) Total mm	:
	b) Protected mm	:
19.	Type of switch base	:
20	a. Weight of complete switch/phase, kg	:
21	b. Total weight, kg	:
22.	Dimensions of switch LxBxH (mm x mm x mm)	:
23.	Shipping dimension of largest package	:
24.	Thickness of galvanising of MS parts	:
25.	Provision of earthing switch	: One side/both sides
26.	G.A drg. of disconnect switch alongwith support structure.	: Submitted/ not submitted
27.	Supporting structures	
	a) Material	:
	b) Total weight/isolator, kg	:
	c) Thickness of galvanising, micron	:
	d) Total height of structure in mm	:
28.	Power and control power supply voltage	:
29.	Confirm that all particulars given in technical particulars are accep- table to tenderer	: Yes/No
30.	If answer is 'NO' in above	:



(ELECTRICS AND C&I)



then indicate pointwise deviation

#### HV Current Transformers

1.	Name	of manufacturer	:	
2.	Туре		:	Oil filled
3.	Stand	ards followed	:	
4.	Rated	voltage (kV)	:	
5.	Rated	primary current/voltage	:	
6.	Rated	secondary current/voltage	:	
7.	Numb Rated output Core I Core I Core I Core I	er of cores : Class of Accuracy t accuracy limit factor I II V		
8.	Short	time current rating		
	i)	1 second, kA (rms)	:	
	ii)	3 seconds, kA (rms)	:	
9.	Dynamic current kA (peak) :			
10.	Temp site ar	erature rise over max. nbient degree C		
	i)	oil at top of housing (deg.C)	:	
	ii)	Winding (deg. C)	:	



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

#### (ELECTRICS AND C&I)



11.	Current density		
12.	Class of insulation		
13.	Current/voltage and phase errors at rated burden and frequency	:	
14.	Capacitor Voltage Transformer		
	a. Rated burden per phase VA	:	
	b. Class	:	
	c. Temp. coefficient of ratio per deg.C (ratio %)	:	
	d. Maximum errors with 5% primary voltage (Phase angle minutes)	:	
	e. Number of phases	:	
	f. Rated primary voltage	:	
	g. Rated secondary voltage	:	
	h. Connection	:	
	i. Rated burden per phase	:	
	j. Accuracy class	:	
	k. Power frequency withstand voltage	:	
	I. Full wave impulse withstand Voltage 1.2/50 micro seconds	:	
	m. Whether hermetically sealed	:	
15.	Number of CTs/CVTs offered	:	
16.	Number of marshalling boxes included	:	





17.	One minute power frequency dry withstand voltage, kV (rms)	:	
18.	One minute power frequency wet Withstand voltage, kV (rms)	:	
19.	1.2/50 micro second impulse withstand voltage, kV (peak)	:	
20.	One minute power frequency withstand test voltage on secondaries kV (peak)	:	
21.	Weight of oil (kg)	:	
22.	Total weight (kg)	:	
23.	Overall dimensions	:	
24.	List of accessories suitable for outdoor duty	:	
25.	Suitable for outdoor duty	:	Yes / No
26.	Whether hermetically scaled	:	
27.	Confirm that all particulars given in tech. data sheet are acceptable	:	Yes / No
28.	If answer is 'NO, indicate pointwise deviation	:	





#### **GENERATOR BUS DUCT**

1.	Make		:
2.	Rated voltage frequency		
3.	Continuous current rat	ting (main & tap off)	:
4.	Busduct material & cro	oss section	:
5.	Bus duct enclosure ma	aterial & thickness	:
6.	Heat loss in bus duct a	at rated current	:
	Middle phase kV	V/m	:
	Outer phase kW	//m	:
	Total heat loss kV	V/m	:
	Loss in bus bar kV	V/3 phase/m	:
	Loss in busduct enclos	sure kW/3 phase/m	:
7.	Short circuit rating :	KASec	:
8.	Insulation level KV (RMS)/KV peak		
9.	Bus duct Wt/m		:

#### 05.03.02 GENERATOR CT-PT-SURGE PANEL, NGTR

CURRENT TRANSFORMER	<u>Current T</u> Gen. Neu. C.T. 	ransformer Gen. Ph. C.T. 
1. Name of the manufacturer	:	
2. Type & Service-Indoor/Outdoor	:	
3. Insulation level, KV	:	
<ol> <li>Rated short time thermal current for three (3) sec. KA, rms</li> </ol>	:	



TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

#### (ELECTRICS AND C&I)



<ol> <li>Temperature rise over an ambient temperature of 50 deg. c at -</li> <li>a. Rated primary current</li> <li>b. Rated short time thermal current for three(3) secs.</li> </ol>	:		
Voltage Transformer			
1. Insulation class, KV	:		
<ol> <li>Basic insulation level, KV peak</li> </ol>	:		
3. <u>Rating</u>			
a. Voltage ratio b. Rated output, VA c. Accuracy class d. Connection	: : :		
4. Over voltage factor - a. Continuous b. 30 seconds	:		
5. <u>Temperature rise above 50°C ambi</u>	<u>ent</u>		
<ul> <li>a. At 1.2 x rated primary voltage continuous</li> <li>b. At 1.9 x rated primary voltage for 30 secs.</li> </ul>	:		
LIGHTNING ARRESTOR			
1. Make	:		
2. Service	:		
3. Туре	:		
4. Voltage rating, KV rms	:		

5. Minimum power frequency spark-



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3



(ELECTRICS AND C&I)

<ul> <li>over voltage, KV rms</li> <li>6. Arrestor insulation withstand test voltage -</li> </ul>	:
a. Impulse, KV crest b. Power frequency, KV rms	:
1 minute dry 1 minute wet	:
Surge Capacitors	
1. Name of the manufacturer	:
2. Service	:
3. Туре	:
4. Rated voltage, KV	:
5. Rating -	
a. Capacity in micro farad	
b. Guaranteed tolerance	:
6. Insulation class, KV	:
7. Test voltage between terminals-	-
a. A.C. for 1 min. b. D.C. for 10 sec.	:
<ol> <li>8. Catalogue furnished?</li> <li>9. Details of Discharge resistor</li> </ol>	:
NEUTRAL GROUNDING TRANSFO	<u>DRMER</u>
1. Name of the manufacturer	:
3. Type & catalogue no.	:
<ol> <li>I ransformer cooling type</li> <li><u>Rating</u></li> </ol>	:
a. Rated KVA	:
D. Raled high vollage, KV	•





c. Rated low voltage, Volt	:
d. Rated frequency, C/s.	:
e. Phase, No.	:
f. Impedance, %	:
g. Reactance, %	:
h. Resistance, %	:
6. Details of Tapping	
а. Туре	:
b. Rating c. No. and range of taps	:
7. Temperature rise above 50deg.c:	
8. Basic impulse level, KV peak	:
9. One (1) minute power frequency test withstand voltage, KV rms	:
Resistor	
1. Name of the manufacturer	:
2. Туре	:
3. Service	:
4. Referred standard	:
5. <u>Rating</u>	
a. Voltage, volts	:
b. Current, Amps	:
c. Time rating, min. d. Resistance, Obms	:
e. Guaranteed tolerance, %	:
6. Temperature rise above 50deg.c	:
7. Material used	





#### 05.04 RELAYS

Indicate type & make of relays proposed to be provided for

- Generator Protection
- Static excitation Transformer Protection
- Auxiliary Transformer Protection

#### 05.05 TRANSFORMER

- A. Guaranteed data
- Rating

a. Rated KVA

2.	a. Temperature rise above 50 deg. C ambient for oil filled type		
	i. Oil by thermometer, Deg. C	:	ii. In winding by resistance deg.C :
	b. Hot spot temperature in winding limited to deg. C	:	
3.	Losses		
	a. No.load loss at rated voltage and frequency	:	
	b. Load-loss at rated current and at 75 deg.C	:	
4.	Impedence at rated current frequency at 75 deg. C, %	:	
5.	Zero sequence impedance, %	:	
6.	Efficiency at 75 deg. C and 0.8 p.f. lag %	:	
	a. at 100% load	:	

:





	b. at 75% load		:		
	c. at 50% load		:		
B. <u>Ge</u>	neral Details			LT	ΗТ
1.	Name of manufacturer		:		
2.	a. Service-whether indoor	r or outdoor:			
	b. Type-core or shell		:		
3.	Reference standard		:		
4.	Type of cooling		:		
5.	Rating				
	a. Rated current, amp (rr	ms)			
	HV LV		:		
	b. Rated voltage, KV				
	HV LV		:		
	c. Generator Transforn withstanding 125% ra voltage for 1 minute a 140%rated voltage fo	ner capable of ated and r 5 secs.?	:	Yes/No	
6.	a. Terminal arrangeme	ent			
	i. HV ii. LV		:		
	b. Winding insulation ca	ategory			
	i. HV		:	Uniform/Non-uniform	



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(ELECTRICS AND C&I)



ii.LV	: Uniform/Non-uniform
c. Insulation level as per IS:2026 (Part-III) or IEC-76-3	:
7. Type of tap changer	:
8. Taps	
a. Capacity	:
b. Steps and range	:
c. Tapping provided on HV side ?	: Yes/No
<ol> <li>No load current referred to H.V and 50 c/s 100 % rated current voltage.</li> </ol>	:
10. Withstand time without injury for	
a. Three phase dead short circuit at terminal with rated voltage maintained on the other side, sec.	:
<ul> <li>b. Single phase short circuit at terminal with rated voltage maintained on the other side, sec.</li> </ul>	:
11. Insulation strength	
a. One minute power frequency test KV rms	
i. H.V. ii. L.V. iii. L.V.Neutral	:
b. Impulse withstand voltage, KV	
i. H.V.	:



:

:



ii. L.V. iii. L.V.Neutral

#### 12. Insulation oil

	a. Approx volume of oil, liter	:	
	b. Whether first filling of oil with 10% excess furnished ?	:	
	c. Oil conforms to IS:335 ?	:	
13.	Marshalling Box		
	a. Weatherproof, suitable for outdoor for oil filled type ?	:	Yes/No
	b. Degree of protection	:	
14.	a. Type of valve	:	
	<ul> <li>b. No. of valve comprising one complete set (break up of valves shall be given)</li> </ul>	:	

# 05.06 LT SWITCHGEAR, AC DISTRIBUTION BOARDS, DC DIST. BOARDS, DC STARTER PANEL & RESISTORS AND LOCAL AC STARTERS

NOTE : Tenderer to furnish the following data separately for each of the above equipment.

- Equipment Assembly
- Make:
- Type:
- Reference Standard:
- Short Circuit Rating:



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

#### (ELECTRICS AND C&I)



- a. Interrupting Symmetrical KA rms.
- b. Short-time for 1 Sec. KA rms.
- Metal enclosed: construction? Yes/No
- Degree of Protection:
- Thickness of sheet metal:
  - a. Front
  - b. Back
  - c. Side
  - d. Bottom/Top
- Dimensions of vertical: section in mm (LxDxH)
- CONSTRUCTION:
- Draw out features provided for:
  - a. Circuit breaker with SERVICE, TEST & ISOLATED position Yes/No :
    b. Voltage Transformers Yes/No :
    c. Protective Relays Yes/No :
    d. MCC modules Yes/No :
- MCC completely compart-: mentalised ? Yes/No
- All meter, switch and relays flush mounted type Yes/No

:

- Circuit Breaker
- Make:
- Continuous current rating



MAITHON HYDEL STATION

TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

:

:

:

:

:

#### (ELECTRICS AND C&I)



- a. As per manufacturer's standard:
- b. Derated factor (if any) for: site condition
- Symmetrical interrupting capacity(MVA)
- Making current (peak), KA
- Rated 1 second current, KA (rms)
- Whether drawout, semi-drawout, : or non-drawout type ?
- Closing mechanism
  - a. Type:
  - b. Rated voltage of coil:
  - c. Emergency closing mechanism: provided ?
- Rating of motor used in breaker closing mechanism
- Shunt trip coil
  - a. Typeb. Rated voltage of shunt trip coil
- Total opening time (measured from : trip coil energisation) cyc/m.sec

#### 05.07. <u>Motors</u>

#### 05.07.01 LT Motors (AC)

- 1. Make and type, reference standard :
- 2. Class of insulation
- 3. Enclosure class
- 4. Frame size



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TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

#### (ELECTRICS AND C&I)



	<ol> <li>Temp. rise over max. site ambient for winding for enclosure</li> <li>Min. volt to start</li> </ol>	:	
	<ol> <li>Whether all motors are from one make</li> <li>Type of protections envisaged</li> </ol>	: Electrical/Technological	
	<ol> <li>Deviations if any on technical design data</li> </ol>	:	
05.08	Cables (HT/LT Power control cables	)	
	The bidder shall indicate the following f	or each type and size of cables:	
	1. Make	:	
	2. Туре	:	
	<ol> <li>Shielding on Conductor (H.T. Cables)</li> </ol>		
	a. Material	:	
	b. Туре	:	
	c. Thickness mm	:	
	d. Whether extruded	: Yes/No	
	<ul><li>4. Insulation</li><li>a. Material</li></ul>	:	
	b. Type c. Thickness mm	:	
05.08.01	Cable Termination kit	XLPE PV	'C
	Make Type Complete with all accessories ?	: : :	DIG



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

(ELECTRICS AND C&I)



05.09	UPS SYSTEM: Make Capacity Overload Capacity of convertor Overload capacity of Invertor	:
	Battery Make Type AH Capacity Harmonics at rated load - with battery - without battery	:
	Overall dimensions of the panels Schematic diagram (to be enclosed)	:

#### 05.10 BATTERY CHARGER

1. 2.	Make & Type & applicable standard Rated input voltage	:
3.	Rated output voltage & current	
	a) Float	:
	b) Boost	:
4.	% Ripple content DC Bus	
	without battery	:
	At No load	:
	At full load	:
5.	Type of SCR control	:
6.	Control & Protection Features	
	Float charger	:
	Boost charger	:
7.	Enclosure type	:
8.	Overall dimensions	:
9.	No. of float cum boost chargers	:

# **INSPECTION AND TESTING**

## CHAPTER NO. 06





# 06.0INSPECTION AND TESTING06.01Inspection06.01.01General

Manufacturing progress review, inspection & testing of equipment covered under the technical specification shall be carried out by the Purchaser at the manufacturers' works/premises prior to despatch to ensure that their quality & workmanship are in conformity with the contract specifications and approved drawings.

These instructions are in addition to provisions laid down in other tender documents of the Purchaser. This Specification shall be read in conjunction with the Inspection & Testing Specification indicated in Volume - II of Tender Document

#### 06.01.02 Inspection & testing stages and finalisation of quality assurance plan (QAP)

Within 12 weeks of the award of contract the Bidder shall furnish the quality assurance plan as per proforma given to successful bidder for electrical equipment. separately with suggestive stages and hold points for undertaking inspection and testing by the Purchaser/Consultant. Total list of plant & equipment of the order shall be submitted to the Purchaser/consultant prior to submission of QAP

After receipt, scrutiny and rendering into acceptable mode of above documents, a mutually agreed programme of inspection & testing of equipment shall be finalised with the Bidder by the Purchaser/consultant.

Inspection & testing of plant & equipment shall be undertaken by the Puchaser/consultant after finalization & approval of QAP.

#### 06.01.03 **Responsibility for inspection**

Any inspection by the Purchaser does not replace the responsibility of quality assurance and quality control functions, as expected of the Bidder to be performed by him for supply of plant & equipment as part of the contractual obligations. As such, any approval which the Inspecting Engineer of the Purchaser may have given in respect of plant and equipment and other particulars and the work or workmanship involved in the contract (whether with or without test carried out) shall not bind the Purchaser to accept the plant and equipment, should it on further test at site be found not to comply with the requirements of the contract.





The Bidder is to meet the inspection & testing requirements for the equipment coming under statutory regulations e.g. weights & measures, safety, IE rules, etc. and submit certificates and documents from appropriate authority to Inspecting Engineer for the same.

#### 06.01.04 Extent of inspection

The extent of inspection & testing by the Puchaser shall vary from equipment to equipment as per design requirements.

However, indicative extent of inspection for electrical equipment is furnished below.

Extent of inspection to be carried out shall be finalised with the Bidder after award of the contract on the basis of scope of supply, technical specification and approved GA drawings. However, in case of similar bulk manufactured items, methods of sampling for inspection of different lots shall be governed by relevant Indian or international standards.

In case of critical components, the Purchaser reserves the right to undertake 100% inspection.

Extent	of	(as applicable from equipment to equipment)
Inspection		
Categories	of	Following standard bought-out items shall be accepted on the basis of
Equipment		manufacturers' test certificates:
Bought-out		- LV current transformers
items		- Standard AC motors
		- AC /DC DBs
		- Push button station in manu-facturers' standard enclosure
		- LT power, control & instrumentation cables and cable
		termination / jointing kits
		- Starters in manufacturer's standard enclosure
		- Light fittings
		- Field instruments
		- Conduits
		- Cable trays
Final		- Verification of test certificates
inspection	&	- Visual & Workmanship
testing:		- Dimensional
_		- Witnessing of routine tests as per relevant standards.
		Manufacturers' test certi-ficates for type test to be
		submitted for verification.
		- Witnessing of proto-type tests, as applicable.





#### 06.01.05 Tests, test certificates and documents

For each of the items being manufactured, following test certificates and documents (as applicable for each of the equipment) in requisite copies shall be prepared and submitted to the Inspecting Engineer for scrutiny & records.

- i) Materials identification & physical and chemical test certificates for all materials except IS:2062 -1992 and FG 150 IS:210-1978 materials used in manufacture of the equipment.
- ii) Welding procedures and welder's qualification test certificates, wherever applicable.
- iii) Routine/type/calibration/acceptance/special test certificates for electrical items.
- iv) Surface preparation and painting certificates.
- v) Certificates from competent authority for the items coming under statutory regulations.

The Bidder shall be required to produce the specimen and test pieces on which tests were carried-out by his sub-bidders and if called for, samples and specimen shall become the Purchaser's property.

Where facilities for testing do not exist in the Bidder/sub-contractor's laboratories or in case of any dispute, samples and test pieces shall be drawn by the contractor/sub-contractor in presence of Inspecting Engineer and sealed samples shall be sent to any approved laboratories for necessary tests at Contractor/sub-contractor's cost.

The Purchaser/consultant shall have the right to be present and witness all tests being carried out by the Contractor/sub-contractor at their own laboratory or approved laboratories. Also, the Purchaser/consultant shall reserve the right to call for conformatory test on samples, at his discretion.

Should the result of tests not come within the margin specified, the tests shall, if required, be repeated at Bidder's cost without any liability to the Purchaser.

#### 06.01.06 **Method of giving inspection calls**

Inspection calls shall be given by the Bidder. All calls shall accompany four sets of relevant test certificates and inspection report of the Bidder/sub-contractor after satisfactory completion of internal inspection and tests by them as per approved QAP.





#### 06.01.07 Obligations of the Bidder

The Bidder shall provide all facilities and ensure full and free access of the Inspecting Engineer of the Purchaser to the Bidder's or their sub-contractor's premises at any time during contract period, to facilitate him to carryout inspection & testing of equipment during manufacture of equipment.

This clause shall be read along with Commercial Volume (Vol.I) for further details.

06.01.08 Stamping and issue of inspection memo & certificate & waiver

#### 06.02 Testing

#### 06.02.01 **General**

Test of all equipment shall be conducted as per latest IS. Tests shall also confirm to International Standards IEC/VDE/DIN/BS.

All routine tests shall be carried out at manufacturer's works in presence of purchaser or his representative.

The bidder shall submit type test certificates for similar equipment supplied by him elsewhere. In case type test certificates for similar equipment is not available, the same shall be conducted in presence of purchaser or his representative if purchaser so desires, without any financial implications to purchaser. Heat run test based on type test certificate of similar transformer is acceptable.

The site tests and acceptance tests to be performed by bidder are detailed below.

The bidder shall be responsible for satisfactorily working of complete integrated system and guaranteed performance.

#### 06.02.02 Site Tests and Checks

#### General

All the equipments shall be tested at site to know their condition and to prove suitability for required performance.

The test indicated in following pages shall be conducted after installation. All tools, accessories and required instruments shall have to be arranged by bidder. Any other test which is considered necessary by the manufacturer of the equipment, bidder or mentioned in commissioning manual has to be conducted at site.





In addition to tests on individual equipment some tests/ checks are to be conducted / observed from overall system point of view. Such checks are highlighted under miscellaneous tests but these shall not be limited to as indicated and shall be finalised with consultation of client before charging of the system.

The bidder shall be responsible for satisfactory working of complete integrated system and guaranteed performance.

All checks and tests shall be conducted in the presence of client's representative and test results shall be submitted in six copies to client and one copy to Electrical Inspector. Test results shall be filled in proper proforma.

After clearance from Electrical Inspector system/ equipment shall be charged in step by step method.

Based on the test results clear cut observation shall be indicated by testing engineer with regard to suitability for charging of the equipment or reasons for not chargings are to be brought by the bidder.

#### 06.02.03 Site Tests

The tests to be carried out on the equipment at pre-commissioning stage shall include following but not limited to the following :

#### 1.0 Transformer

- 1. IR test on each winding to ground and between windings.
- 2. Turns ratio test on each tap
- 3. Polarity and vector group test
- 4. Measurement of winding resistance by Kelvin bridge
- 5. IR, wiring and operational tests on all control devices in control cabinet, oil level indicator, winding and oil temp. indicators, cooling fan etc.
- 6. Checking of earthing wrt transformer tank (flexible from top cover to tank) other parts, neutrals and tank to electrodes of LAs (for LAs located near to transformer)





- 7. Testing of buchholz relay for alarm and trip conditions.
- 8. For bushing CTs, tests applicable shall be as for current transformers.
- 9. Setting of oil/winding temperature indicators, level gauge and checking of alarm/trip circuits.
- 10. Check insulators for cracks.
- 11. Checking for oil leakage and arresting of leakages (if there)
- 12. Checking of operation of all valves.
- 13. Checking for open position of all the valves (except drain and filter valves)
- 14. Filteration of oil by using line filter, vacuum pump, and heater set.
- 15. BDV test on oil samples from top and bottom.
- 16. Checking of oil for acidity, water content tan delta etc. as per IS 335.
- 17. Measurement of magnetising current and no load loss.
- 18. Measurement of PI value.
- 19. Checking of silicagel breather.
- 20. Checking of noise level at no load and at full load.
- 21. Checking of air circulation conditions for indoor transformers.
- 22. Conducting magnetic balance test
- 23. Checking of other points given in manufacturer's commissioning manual.
- 24. Back charging of the transformer and checking of voltages at different tap positions.

#### 2.0 33 kV Circuit Breaker

1. IR test on each pole by Megger (Between poles and lower poles to ground).



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- 2. IR tests on control circuits.
- 3. Functional check of breaker operation on minimum and maximum specified control voltages
- 4. Checking of interlocks with isolators & earthing switches.
- 5. Checking of remote operation and tripping from protection relays and from other devices as per approved scheme.
- 6. Measurement of contact resistance
- 7. Testing for leakage of compressor and hydraulic oil system.
- 8. Checking tightness of termination connectors.
- 9. Checking tightness of earthing connections.
- 10. Checking of insulators for cracks etc.
- 11. Checking the settings of pressure switches.
- 12 Check level of pressure of air, oil and gas as per the manufacturer's manual.
- 13. Check direction of compressor motor and oil pump.
- 14. Check operation of breaker at minimum specified pressure.
- 15. Check for air leakage in air reservoir.
- 16. Check for closing and opening time and simultaneous closing of all poles through oscillograph.
- 17. Tripping of circuit breaker at reduced or over voltage i.e. at 60% & 110% .
- 18. Checking of hydraulic system and oil leakage in oil pump.

#### 3.0 **33 kV Isolator/Disconnecting switches**

- 1. IR test by HV Meggar on main poles.
- 2. IR test on control circuits.
- 3. Measurement of contact resitance for all three phases.
- 4. Functional checking for electrial and manual operation.
- 5. Checking of interlockings with earth switch and as per write up and checking of earth switch operation.
- 6. Checking operation of earth switch.
- 7. Setting and checking of auto trip operation of motor on complete close / open position of isolator (close/open operation are to be repeated ten times to observe).
- 8. Testing of overload relay of motor.
- 9. Checking for remote operation.
- 10. Checking of operation on minimum and maximum specified voltages (local as well as remote).
- 11. Checking tightness of earthing connections.
- 12. Checking of insulators for cracks.

#### 4.0 Current Transformer

1. IR test on each winding, winding to earth and between windings.



#### (ELECTRICS AND C&I)



- 2. Checking of winding ratios by primary injection set.
- 3. Polarity check on each winding.
- 4. Continuity check for all windings.
- 5. Check for connections to correct taps.
- 6. Measurement of knee point voltage and secondary winding resitance for the CTs used for differential protection.
- 7. Checking of continuity and IR values for cables from CT to Marshalling box.
- 8. Checking tightness of earthing connections.
- 9. Checking of insulator for cracks
- 10. Check output after loading of the main circuit.

#### 5.0 **Potential Transformer**

- 1. IR test of primary winding by HV megger between windings and earth
- 2. IR test of secondary winding by LV megger between windings and winding to earth
- 3. Checking of voltage ratio
- 4. Verification of terminal markings and polarity
- 5 Checking of continuity and IR values for cables from PT to Marshalling Box
- 6. Checking tightness of earthing connections
- 7. Checking of insulator for cracks
- 8. Check output on charging of the system with connected meters/relays

#### 6.0 **NGT**

- 1. Measurement of resistance
- 2. IR test by HV megger between terminal and earth.
- 3. Checking of earth connection for terminal and for body
- 4. Check for isolator operation and continuity of aux. contacts (if applicable)
- 5. Check for temp. rise of enclosure and current flow in the resistances.

#### 7.0 Bus duct

- 1. IR measurement before and after HV test
- 2. Checking tightness of bolts with torque wrench
- 3. Checking for phase sequence marking
- 4. Check for clearances between phase to phase and phase to earth
- 5. Check for minor damages/cracks in supporting insulators/bushings
- 6. Checking of busbar cracks on bends by DP method and rectification of same
- 7. Checking for inspection openings/accessibility for replacement of insulator etc.
- 8. Check tightness of earthing connections on enclosure
- 9. Checking of silica gel breather



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- 10. Checking of working of space heater (if there)
- 11. Hot air blowing to remove moisture if required

#### 8.0 LT Switchgear/MCC

- 1. IR test
- 2. HV test with 1.1 kV megger
- 3. Functional test for all feeders
- 4. Testing of all meters
- 5. Checking and calibration of overload relays and protective relays as per supplier's commissioning manuals.
- 6. Check operation of contactors from local and remote points
- 7. Checking of interlockings between incomers/bus coupler and other feeders.
- 8. Test to prove interchangeability of similar parts

#### 9.0 **PDB/DCDB**

- 1. IR test before and after HT test
- 2. HV test by 1.1 kV megger
- 3. Checking for functions of components for each module
- 4. Checking for interchangeability of similar components
- 5. Checking of tightness of earth connection.
- 6. Testing and calibration of all indicating meters
- 7. Check output of each feeder after energisation.

#### 10.0 AC Motors

- 1. IR test of stator and rotor windings.
- 2. Check tightness of cable connection
- 3. Winding resistance measurement of stator and rotor.
- 4. Check tightness of earth connections.
- 5. Check space heaters and carryout heating of winding (if required)
- 6. Check direction of rotation in decoupled condition during kick start
- 7. Measure no load current for all phases.
- 8. Measurement of temperature of body during no load and load conditions.
- 9. Check for tripping of motor from local/remote switches and from electrical/technological protection including differential protection.
- 10. Checking of vibration.
- 11. Checking of noise level.
- 12. During load running , measurement of stator and bearing temperatures (if applicable) for every half an hour interval till saturation comes.



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- 13. Checking tightness of foundation bolts
- 14. Check continuity of temp. detectors.
- 15. For actuator drives following shall be checked/tested :
  - Visual and dimensional
  - IR and operation of limit switches
  - Winding resistance

#### 11.0 Battery Charger

- 1. IR test
- 2. HV test
- 3. Checking voltage ratio of boost and float mode transformers
- 4. Checking for charging mode of batteries, constant current and constant voltage mode.
- 5. Load test on chargers by running of DC drives and by liquid resistance system.
- 6. Checking of tightness of earthing connections.
- 7. Check for all alarm conditions.
- 8. Checking and calibration of all indicating meters.
- 9. Check functional operation of charger, auto/manual change over from float to boost and boost to float etc.
- 10. Checking and setting of all relays
- 11. Check AC ripple in boost and float mode after charging.
- 12. Check polarity of cables connected to battery.

#### 12.0 Uninterrupted Power Supply (UPS)

- 1. Visual check
- 2. IR value by megger
- 3. Current limit test
- 4. Ripple test
- 5. Supply variation
- 6. Functional test
- 5. Capacity test wrt time

#### 13.0 Cables & Cables Supporting Structures

- 1. Checking of continuity/phasing and IR values for all the cables before and after HV test.
- 2. HV test and measurement of leakage current after termination of cable kits (for HT cables).
- 3. Checking of earth continuity for armour and fourth core (if applicable).
- 4. Check for mechanical protection of cables.



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- 5. Check for identification ( tag numbr system) distance placement of cable marker, cable joint etc. as per the cable layout drawing.
- 6. Check earthing of cable structures.
- 7. Check clearances from ventilation duct and light fittings for cable structures.
- 8. Check proper fixing of cable structures.

#### 14.0Indoor Lighting

- 1. Check dressing of cable
- 2. Measurement of lux level at various places
- 3. Check accessibility for replacement of lamps
- 4. Checking for black spots or poor visibility near operating and indicating equipments
- 5. Check for mechanical protection of cables
- 6. Checking for adequacy of emergency DC light
- 7. Checking for starting system of periphery lighting
- 8. Check for auto switching of battery supply on failure of AC
- 9. Checking of earthing of light panel, socket boards, light fittings
- 10. Checking of type of fittings wrt specification at various locations
- 11. Check adequacy of support of fittings
- 12. Check water tightness of outdoor located panels

#### 15.0 Earthing

- 1. Check tightness of all earth connections
- 2. Check earthing of all metallic equipments, cable trays, busbar supporting structures, yard fencing steel structures of yard, rails, gates, building column (if steel) all elect. equipments, gas/oil/water pipe lines etc. as per the drawing /specification
- 3. Measurement of earth resistance for each electrode.
- 4. Measurement of total earth resistance.
- 5. Measurement of earth loop resistance for E/F path of biggest LT drive.

#### 16.0

#### Control, Relay & Metering Panels

- 1. IR value test by megger
- 2. Checking of control cable connection.
- 3. Operational test of all components mounted on control panel.
- 4. Testing and calibration of indicating meters
- 5. Testing of all relays including aux. relays for their pick up drop up values, operation at all taps (current, voltage and time) etc. as per the manufactuerr's commissioning manuals with the help of relay testing kits.





- 6. Setting of relays as per approved setting table and checking its operation for one below and one upper settings, in the scheme.
- 7. Measurement of current and voltage in relay operating coils by secondary injection in CT and PT circuit at switchboard.
- 8. Measurement of current and voltage in relay and meter circuits during loading of the primary circuit/system
- 9. Testing of all schemes for their functions as per approved drawings
- 10. Checking stability of differential protection schemes
- 11. Checking inter changeability of similar equipments
- 12. Verification of accessibility of all operating points including resetting knob of relays
- 13. Check operation of each annunciation facias, operation of bell/hooter etc. and sequence of the system
- 14. Check operation of relays at minimum/maximum control voltage as per the specification
- 15. Integrated testing of protective relays for operation of master trip relays and tripping of breakers from operatin of master trip relay
- 16. Check dressing of cables, sealing of openings in gland plate and for provision of double compression glands
- 17. Check earthing connection of panels, fixing of panels and openings from side and bottom.
- 18. Checking and adjustment in trivector meters as per the manufacturer's instructions.





#### 17.0 Miscellaneous

- 1. Checking of continuity of the system
- 2. Checking of phase sequence from overhead line to consumer end
- 3. Checking safe accessibility of all operating points
- 4. Check availability of emergency lighting
- 5. Check availability of control/aux. supply
- 6. Ensure availability of first aid box, fire fighting equipments, earth discharge rods, rubber mats, rubber glove
- 7. Check working of ventilation system for battery room transformer room etc.
- 8. Check proper covering of cable channels.
- 9. Placement of shock treatment chart, danger boards, provision of boards indicating 'Man on Work, Do not switch ON', 'Do not switch OFF', 'EARTHED' etc
- 10. Check proper dressing of cables, mechanical protection of cables, placement of cable markers
- 11. Check sealing of all cable openings including conduit opening with fire resistance material
- 12. Check sealing of all openings at bottom of elect. panels.

# **CONTROL & INSTRUMENTATION**

SECTION- "B"





#### **CONTROL & INSTRUMENTATION**

#### 01.00.00 General

**a)** This specification is intended to define the basic requirements for instrumentation & control system for R & M Units 1 & 3 of DVC Maithon hydel power station along with their auxiliaries as specified in the tender document with a view to achieve smooth, efficient, safe and reliable operation of the process.

**b)** Measurement and control equipment to be supplied by Bidder for the process shall be complete in all respect in line with this specification and also as required for satisfactory operation of the process. Any instrumentation equipment / accessories not explicitly indicated in this specification, but considered essential for proper functioning of technological equipment and process shall be provided by the Bidder and are included in their scope of work and supply.

**c)** Monitoring, Control, Alarm, Sequential Operation & Interlock functions of the process & equipment shall be achieved through existing DCS automation system, supplied and installed under the scope of DVC.

However, Controls Logic, OLCS &CLCS logics, interlocks etc. and other necessary details shall be provided by successful bidder and full co-ordination shall also be provided by the bidder to implement the same in existing DCS system. Deputation of existing DCS OEM personnel is in the scope of DVC. Bidder has to intimate DVC well in advance, regarding schedule of interfacing work with existing DCS system.

All the instrumentation hardware signals under the scope of Bidder shall be terminated from field to junction Boxes and up to the existing DCS/ Marshalling cabinets of the automation system (located in DVC's Control room) or in the marshalling cabinet of nearest RIO panels as per wiring & termination drawings provided by existing DCS OEM/DVC. Instruments cable schedule preparation, erection, routing, laying, termination and loop checking related to R&M shall also be under the scope of successful bidder.

d) Instrumentation system (other than field switches) in general shall be





microprocessor based SMART type with HART protocol and working on 4-20 mA DC signal system. Final control elements (Control Valves) shall be electrically actuated type and these shall be complete with all the required accessories including valve position transmitter for continuous monitoring in the control room.

e) All transmitters shall have suitable surge/ lightning protection device.

**f)** The Bidder shall provide all material, equipment and services so as to make a totally integrated Instrumentation and Control System together with all accessories, auxiliaries and associated equipments ensuring operability, maintainability and reliability. This work shall be consistent with modern power plant practices and shall be in compliance with all applicable codes, standards, guides, statutory regulations and safety requirements in force.

**g)** All equipment and materials will be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) except where modified and/or supplemented by this specification. In case Indian Standards are not available for any equipment, Standards issued by IEC/BS/VDE/IEEE/NEMA or equivalent will be applicable. Equipment and materials conforming to any other standard which ensures equal or better quality may be accepted. In such case, copies of the English version of the standard adopted will be submitted.

**h)** The electrical installation will meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Codes of Practice. In addition, other rules or regulations applicable to the work will be followed. In case of any discrepancy, the more restrictive rule will be binding.

i) All the instruments shall be from the latest product ranges of reputed manufacturers as per the Technical specification. Purchaser/Consultant reserve the right of selecting particular make and model of instrumentation equipment with a view of standardization of the whole plant. Bidder shall comply with such requirements. In case, certain instruments are offered by Bidder as per his standard design and system requirement, whose make





has not been indicated in the TS Specification, Bidder shall propose make of such items with credentials and catalogues for Purchaser/ Consultant's consideration during detailed engineering stage for necessary approval/clearance. Instrumentation equipment shall be generally sourced from India. For imported equipment, if any, availability of spares & service facility from India shall be ensured by Bidder.

**j)** The equipment shall employ latest state-of-the-art technology to guard against obsolescence. In any case, Bidder shall be required to ensure supply of spare parts for minimum 15 years. In case, it is felt by the Bidder that equipment / component is likely to become obsolete, the Bidder shall clearly bring out the same to the notice of the employer at-least 2years prior and indicate steps proposed to deal with such obsolescence.

**k)** Specification datasheets for each instrumentation item shall be submitted by Bidder in standard format (e.g.; ISA format) during detailed engineering stage.

I) The instrumentation items shall be supplied by Bidder based on the finalized specification datasheets as approved during detailed engineering stage.

**m**) For smooth execution of the package, Successful Bidder shall closely coordinate with Purchaser's other agencies and extend necessary assistance as may be required by them.

**n)** Bidder shall execute complete instrumentation work in line with technical specification meeting the process requirement to the satisfaction of Purchaser/ Consultant. Bidder shall comply with all the requirements of Scope of Work and Supply; List of Measurement, control, alarm & interlock; Submission of Drawings & Documents; General Technical Rules; Supply of instruments and other related clauses/ annexure stipulated in this specification.

**o)** The successful bidder will be the responsible for completion of the Control & Instrumentation work in totality. Necessary Co-ordination will be supported by DVC.




**p)** All correspondences / documents shall be in English language and for all the data, drawings & documentation metric or SI units shall be followed.

#### 02.00.00 Scope Of Work And Supply

The scope of work shall include design, engineering, manufacture, procurement, assembly, calibration, shop testing, inspection, painting, packing, supply, transportation to site including loading, unloading, storage & handling of all instrumentation items including electrical accessories, cables, pipes, erection accessories, panels and all associated hardware, as required for completeness of instrumentation system of the package for R&M unit 1 & 3 in all respect along with site fabrication, erection, testing and commissioning of the complete instrumentation system and handing over of instrumentation and control work for the units after integrated final commissioning.

The scope of work and supply of Bidder shall also include, but not limited to, the following:

- **1.** All civil works, like chipping, digging, concreting including filling material etc. associated with erection of instruments and associated equipment.
- 2. Instrumentation equipment as per the measurement list covered under clause number 03.00.00 & also as per the measurements & controls indicated in the international /industry standard for various equipment like, pumps, compressors etc. Accordingly, the additional equipment as required for completeness of instrumentation & automation system in all respect and satisfactory operation of the process & technological equipment are also included in the scope of work & supply of Bidder.
- **3.** Fully wired panels/ cabinets, transmitter cabinets and junction boxes.
- **4.** All signal, control & Power cables as required for this packages. These shall be FRLS armoured types as specified in this specification.
- 5. All Erection materials like Cable tray, cables fittings joints, conduit, channels etc.
- 6. Submission of drawings and documents as per clause no. 04.00.00
- 7. Arranging & participation in inspection at the manufacturer's premises.





- 8. Erection, calibration, testing and commissioning of the total equipment included in this specification. All tools and tackles, special testing equipment and consumables required for erection, testing and commissioning activities shall be arranged by the Bidder.
- 9. Commissioning spares as per clause no. 05.00.00.
- **10.** Maintenance platforms and access ladders for instrumentation equipment installed at inaccessible heights.
- **11.** Compliance with General Technical rule/ specifications for instrumentation items' as indicated under clause no. 06.00.00 of this specification.
- **12.** Bidder may please note that for all imported instrumentation /equipment selection of vendors shall be made in such a way that the provision of after sales service and supply of maintenance spares for at least for fifteen years shall be ensured.
- **13.** All skid mounted instruments shall be as per OEM standards
- **14.** Double compression fittings of SS shall be considered for installation of instrumentation equipment. All junction boxes and its support shall be of SS.
- **15.** For all utilities at take off point (other than for drinking water), flow, pressure and temperature measurement shall be provided. However, for water application at take off point temperature measurement is not required
- 16. Power supply equipment & accessories including 24 VDC power supply units, Impulse pipes, isolation valves, fittings, trays, conduits, erection hardware & accessories, earthing material & accessories including earth pit(s), as required for this package.
- 17. 1 (One) set of 2 X 100% parallel redundant 240V AC ,50Hz Uninterruptible Power supply (UPS) with SSVS of minimum 5kVA or more (if required) along with Ni-Cd battery (one set) to be supplied along with ACDB containing adequate nos. of feeder for C&I system. UPS battery backup shall be supplied minimum 30 minutes.
- **18.** Turbine & Generator Vibration monitoring system with sensor shall be provided.
- **19.** Scope includes arranging visits by respective instrumentation & control equipment manufacturer's representatives at site, as & when required, during engineering,

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erection & commissioning.

- 20. Supply of one number of hand held universal type configuarator for all field instruments based on HART. The configuarator memory capacity - 32 MB programming memory and be supplied with battery & battery charger.
- 21. All electrical accessories for instrumentation system including UPS and other instrument power supply equipment etc.
- Liquidation of defect points, participation in tests for establishment of plant 22. performance guarantee (PG), final acceptance certificate (FAC) and post commissioning services as per contract.
- 23. All the spares and consumables as may be required during erection & commissioning of the instrumentation system.
- 24. Statutory approval if any will be obtained by the bidder.

#### 03.00.00 List of Measurements and controls

Following are the indicative list of measurements, controls, alarms & interlocks for the R&M Units 1 & 3 and auxiliary units and Bidder shall comply with the same. Bidder shall include in their scope of supply all the measurements and its controls, alarms & interlocks philosophy etc to be implemented in existing DCS in coordination with DCS vendor (arrangement of DCS vendor is in DVC's scope) as required to achieve the stable, efficient & satisfactory operation of their offered system and indicate detail list of the same during basic Engineering. Unless otherwise stated, all monitoring & control of the process parameters shall be achieved through existing DCS based automation system (to be supplied by DVC) and displayed in HMI stations. The field instrumentation equipment shall be offered and configured accordingly.

Measurements and controls for each R & M Unit with auxiliary units shall include, but not limited to, the following: A. Remote measurement

- 1 Generator

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- i) Stator Voltage
- ii) Stator Current.
- iii) Field Current.
- iv) Field Voltage.
- v) MW.
- vi) MVAR.
- vii) Frequency.
- viii) Power factor
- ix) Rotor Air gap \*\*.
- x) Temperature in different segment of stator wdg. and stator core.
- xi) Rotor temperature.
- xii) Partial Discharge\*\*
- xiii) Speed\*\*.
- xiv) Breaking air pressure.
- xv) Jacking oil pressure.
- xvi) kWh meter

#### 2.Excitation

- i) Excitation current
- ii) Excitation voltage
- iii) Null detector
- iv) Excitator winding temp.
- v) Kwh meter

#### 3.Generator Thrust Bearing/Upper Guide Bearing/Lower Guide Bearing

- i) Bearing pad metal temp. Thrust pads and guide pads.
- ii) Bearing lube oil temp.
- iii) Oil levels in bearing lube oil housing.
- iv) Lube oil pressure.



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- v) Hydrostatic lube oil pressure.
- vi) Water in oil detector.

#### 4. Generator Air Cooler

- i) CW inlet temperature.
- ii) CW outlet temperature
- iii) CW inlet pressure
- iv) Hot air temp. of each cooler
- v) Cold air temp. of each cooler

#### 5.Turbine

- i) Turbine Governing Valve opening in % and in mm.
- ii) Guide vane opening in % and in degree.
- iii) RB opening in % and in degree.
- iv) Guide vane locking indication
- v) Spiral case inlet pressure
- vi) Draft tube pressure
- vii) Turbine speed ( 2 out of 3)
- viii) Head cover water level
- ix) Shaft seal CW pressure and flow.
- x) Turbine inlet water flow.
- xi) Turbine inlet water pressure.

#### 6.Governor Oil Pressure Unit

- i) Oil level in sump tank
- ii) Flow of water to oil cooler
- iii) OPU tank oil level
- iv) OPU tank oil temperature
- v) Gov. Oil pressure

#### 7. Turbine Guide Bearing (TGB)

i) Lube oil temp.



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- ii) Guide bearing metal temperature
- iii) Vibration\*\*
- iv) Oil level
- v) Gap between shaft journal and pads
- vi) Water in oil detector

#### 8.CW system

- i) CW pump discharge common header pressure, flow and temperature.
- ii) Cooling water outlet temperature at Oil coolers outlet.

#### 9.Drainage

- i) Sump level
- 10. Air Compressor

#### 11. Generator Transformer

- i) MW
- ii) MWH
- iii) Ampere
- iv) Voltage
- v) oil temp
- vi) Winding temperature
- vii) Transformer oil header pressure

\*\* measurements shall be as per manufacturer standards

#### Local Measurements

Β.

Following local gauges shall be envisaged for each unit as a 'minimum:

- i) Inlet pressure of spiral casing
- ii) Draft tube pressure
- iii) Spiral casing winter kennedy differential pressure
- iv) Shaft seal cooling water pressure
- v) Cooling water system main inlet pressure



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- vi) Cooling water system strainer differential pressure
- vii) Drainage and dewatering pump pressure
- viii) Pressure receiver tank oil pressure
- ix) Governor oil pressure
- x) Hydrostatic lube oil pressure
- xi) Turbine Thrust cum guide bearing lube oil pressure
- xii) Turbine servomotor oil pressure
- xiii) Air compressor pressure
- xiv) Jacking oil pressure
- xv) Braking air pressure
- xvi) Turbine guide bearing oil/metal temperature
- xvii) Turbine Thrust bearing metal temperature.
- xviii)Generator Guide Bearing (turbine Side) oil/metal temperature
- xix) Generator Guide Bearing (Slip ring Side) oil/metal temperature
- xx) Cooling water discharge flow.
- xxi) Guide vane servomotor stroke indication (scale).
- xxii) Local turbine speed indicator
- xxiii) Guide vane opening indication
- xxiv) Oil level in pressure receiver tank (gauge glass)



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#### 03.01.00 List of Alarms & Interlocks

#### Alarm Points

SI. No.	Items	Description	
1	Generator	All electrical Protection operated*	
2	Generator	All non electrical protection*	
3	Generator	Brake Air Pressure Low	
4	Generator	PT fuse failure	
5	Generator	Rotor earth fault	
6	Generator (Guide Bearings)	Bearing temperature high	
7	Generator	Bearing temperature very high*	
8	Generator	Stator winding temperature high	
9	Generator	Stator winding temperature very	
10	Generator	Creeping	
11	Generator	Overspeed	
12	Turbine guide bearing	Bearing temperature high	
13	Turbine guide bearing	Bearing temperature very high*	
14	Turbine guide bearing	Bearing oil level low	
15	Turbine guide bearing	Bearing oil level very low*	
16	Bearing Oil	Contaminated	
17	Generator guide bearing cooler	Water flow low	
18	Generator air cooler	Water flow low	
19	Shaft Seal	Water pressure low	
20	Turbine guide bearing cooler	Water flow low	
21	Governor	Oil Level Low	
22	Governor	Oil Pressure low*	
23	Excitation Transformer	Temperature high	
24	Generator Transformer	Oil temperature high	
25	Generator Transformer	Oil temperature very high	
26	Generator Transformer	Winding temperature high	
27	Generator Transformer	Winding temperature very high*	
28	Generator Transformer	Buchholz Alarm	
29	Generator Transformer	Buchholz Trip*	
30	Unit Aux. Transformer	Winding temperature high	
31	Unit Aux. Transformer	Winding temperature very high*	
32	Auto Syn.	Lock out	
33	11 kV Feeder breaker	Fault trip	
34	415 V feeders	Fault trip	



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(ELECTRICS AND C&I)



35	Auxiliary DC Supply	Under Voltage
36	Auxiliary DC Supply	Earth fault
37	UPS	Fault in System
38	Air Compressor	Low pressure
39	CO2 bank	Released
40	Differential pressure across oil filter	High
41	Differential pressure across side stream filter	High
42	CW supply header pressure & flow	low
43	CW pumps (individual) Discharge pressure.	low
44	Circulating tank level	low
45	Brake air pressure	low
46	Drainage sump level	High and low

NOTES: \* Astrick mark points to be used for tripping purpose also Control

#### & Interlocks

#### 03.02.00 Control & Interlocks

SI. No.	Description	Interlocks	
1	Unit start /stop	Standard interlocking arrangement shall be provided for starting, emergency shut down and normal shutdown	
2	Governor opening and closing	Start / stop provision	
3	Governor oil pump	Start on Low pressure alarm & stop on high pressure	
4	Turbine Speed	Raise / Lower Provision	
5	33 kV GT Breaker closing	Syn. Closing with checking of incoming / running voltage, frequency and phase angle in auto mode, Manual mode operator will close manually but check command will be there from SCADA to	
6	33 kV GT Breaker closing	Check syn. Closing provision	
7	Generator Voltage	Raise/ Lower provision	
8	33 kV GT breaker tripping	Protection and for manual tripping	



(ELECTRICS AND C&I)



9	Compressor for governing oil system	Start on low pressure and stop on high pressure	
10	De-watering Pump	Start and stop based on sump level	
11	Governing oil	Control pressure at set value	
12	Oil filter	Auto change over with respect to the	
		differential pressure across the filter.	
13	CW pump	Interlock with circulating tank.	
14	CW pump	Stan by pump start on low pressure	
15	Drainage pump	Start on drainage sump level high & stop	
		on drainage sump level low	

The list of alarms, measurements, control & interlocks mentioned above are minimum to be provided and these shall be finalised during detail engineering stage

#### 04.00.00 Drawings and Documents

Following drawings and documents shall be submitted by the Bidder for instrumentation & control system. All communication / descriptions in the drawings, documents, technical literatures and manuals shall be in English language only.

A. To be submitted along with the offer:

1. Process and instrumentation (P & I) diagrams indicating all local & remote measurements, controls, alarms and interlock functions, using ISA symbols and using suitable tag numbers against each instrumentation equipment.

2. List of measurement & control, alarms & interlocks alongwith BOQ and brief specification of each instrumentation item.

- 3. Total power requirement for instrumentation system.
- 4. List of two years operation & maintenance spares with details & unit rates.
- 5. List of commissioning spares for all the equipment



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# B. Drawings/documents to be submitted by the successful Bidder after order placement .

#### I. For approval

- Finalised Process and Instrumentation (P&I) diagrams for all the units with all auxiliaries indicating all local and remote measurements, controls, alarms and interlock functions using ISA symbols and using suitable tag numbers against each instrumentation equipment
- 2. Finalised instrument list for the entire plant indicating type of instrument, make, model number, process conditions (max/operating pressure, temperature), scale range, quantity, application and tag number (as per P and I diagram).
- 3. Detailed Specification datasheet of each instrumentation equipment including cables indicating finalised make, model no., application, scale range, quantity, tag no. (as per P&I diagram), accuracy, power consumption etc. Data sheets for each instrument as per standard format shall be submitted with all the required details filled in.
- 4. Instrument power supply diagram with specification and bill of quantities of electrical accessories.
- General arrangement drawings and sectional views of various cabinets, panels including gauge boards, transmitters cabinets & racks etc., showing internal disposition of all components/ units with dimensional details and bill of materials.

#### II. For Information, Reference, Procedural Checking and Records

- 1. Detailed technical literature/ catalogue for each item highlighting the selected model numbers.
- Design data, sizing calculation and selection criteria along with all related charts, curves, tables and fabrication drawings of Flow sensors, control valves and actuators.





- 3. Wiring and termination diagrams with details of termination of field signals to local JBs/ panels and from JBs to panels/ marshalling racks/ cabinets and consoles including internal wiring drawings.
- 4. Cable schedules.
- 5. Control Loop schematic drawings.
- 6. Instrumentation layout drawing showing location of sensors, control valves, transmitters etc. and route of cables from these up to the control room.
- 7. Control philosophy Functional description, control philosophy for the plant indicating start up, shut down, control locations, interlocking and annunciation system, mimic pages, report/data formats.
- 8. Instrument Installation/ Hook up diagrams with bill of materials.
- 9. List of commissioning spares for all the equipment.
- 10. List of Mandatory spares
- 11. Manufacturer's test, calibration and guarantee certificates for all the instruments.
- 12. Operation and maintenance manuals for each instrument (In English language).
- 13. "As-built" documentation.
- 14. Soft copy of all the above drawings and documents in CDs / DVDs/ suitable electronic media.

Any other relevant data, drawings / documents and information necessary for review of items whether specifically mentioned or not, shall be furnished by the Bidder. The quantity of drawings and documents to be submitted to Purchaser / Consultant shall be as per contract.

#### 05.00.00 Commissioning Spares

All the spares and consumables as may be required during erection & commissioning of the instrumentation system shall be included the scope of work and supply of bidder. Though all the commissioning spares & consumables are included in bidder's scope of supply, some of the



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instrumentation items as listed below will be supplied by them as minimum spares, even if the same is not used during erection & commissioning of the package.

List of commissioning spares (Model number & range will be inline with supplied instrument. The same shall decided during detail engineering stage)

SL.	Commissioning Spares -Instruments	Qty.
1.	RTDs	5
2.	Pressure transmitter	1
3.	Flow Transmitter	1
4.	Temperature transmitter	1
5.	Pressure Gauge	5
6.	Temperature Gauge	5

#### 06.00.00 General Technical Rules

The following general guidelines shall be followed in the design of the Instrumentation system -

- The instrumentation system shall be designed using microprocessor-based instruments, unless otherwise specified. Two-wire, true Smart type transmitters, generally operating on 4-20 mA DC having HART signal super imposed with 24 V DC power supply shall be used for all the analog signals.
- 2. All measurements shall be in metric units.
- 3. All field-mounted instruments shall be weatherproof to IP-65 or better. In case, such instruments are not available, these instruments shall be housed in weatherproof enclosures. Suitable canopies shall also be provided for outdoor installations, wherever required.
- 4. Wetted parts of instrumentation equipment shall be properly selected so as to withstand physical and chemical properties of the process medium. Instruments with diaphragm type seal protection shall be used, if the process so demands.

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- 5. Instrumentation equipment to be installed in corrosive atmosphere shall be selected to withstand any adverse effect
- 6. Wherever required by the Purchaser/ Consultant, material certification for suitability of use in the given process medium shall be obtained from the standard/ approved laboratory.
- 7. Use of equipment containing mercury and other toxic substances shall be avoided.
- 8. All instrumentation equipment and accessories, including those to be used in control rooms shall be tropicalised and shall be of industrial grade and proven quality. All instrumentation equipment shall be suitable for operating continuously under the environmental conditions indicated below :-

FIELD INSTRUMENTS: PANEL INSTRUMENTS:

Temperature :	0–60°C	0–45°C (minimum)
Relative humidity :	0–95%	0-80%(non-condensing)

- 9. The enclosure protection class for various instrumentation & control equipment shall comply with the guidelines indicated in IEC/EN 60529./IS: 13947, Part-1, 1993. Generally, the following protection classes for cabinets, consoles, desks etc. shall be followed as a minimum:
- i) Air-conditioned control rooms : IP22
- ii) Indoor non-air conditioned areas:
  - a) Ventillated areas : IP 42
  - b) Non-ventilated areas : IP 54.
- iii) Outdoor areas : IP 65

All field devices shall be rated for minimum IP 65 protection class, unless otherwise specified against individual items.





- 10. For selection & sizing of instruments, barometric pressure shall be considered as 1.0207 kg/cm2.
- 11. Wherever duplication of analog signals is necessary, signal isolators & multipliers with required output shall be used. Relays shall be used for multiplication of switching signals.
- 12. All transmitters shall have built-in output digital indicators in engineering units.
- 13. Calibration checks of transmitters shall be carried out by hand-held calibrator with rechargeable battery. Hand held calibrator along with battery-charger shall be arranged by Contractor at site.
- 14. In hazardous area applications, electronic/electrical instrumentation equipment shall be suitable for hazardous area classification as per IEC. These equipment shall be intrinsically safe conforming to CENELEC standard and certified by appropriate statutory bodies (FM, BASEFA etc.). Intrinsically safe systems shall be designed using zener barriers. Where intrinsically safe design is not feasible, ex-proof enclosure certified by statutory bodies like CMRS shall be supplied. Other acceptable safety procedures (e.g. increased safety procedure, pressurisation etc.) shall be used, wherever applicable.
- 15. Explosion-proof certificates shall be provided for instruments being used in explosion-hazardous areas.
- 16. All field instruments shall be provided with stainless steel tag plates with the following minimum information engraved :-
  - Instrument tag no.
  - Model no.
  - End connections, ratings, etc., as applicable.
  - Instrument range / set point.
  - Input/output signal
  - 17.All instruments & Junction boxes shall be supplied with double compression, brass nickel plated/ SS 316, weather proof, matching cable glands. All control





room panels shall be supplied with double compression, brass nickel plated/ SS 316, weather proof, matching cable glands.

- 18.All instruments, which are with flanged connection, shall be supplied with matching flanges.
- 19. Colour code applicable for the entire plant as per Purchaser's choice/ relevant standard shall be followed for instrumentation pipelines, lamps, cables, panels, etc.
- 20. Painting work on all fabricated structures & equipment shall be in compliance with the standards being followed in the plant. This will broadly include wire brushing, sand blasting, required numbers of primary coats & final paints.
- 21.Pressure, flow, differential pressure and level transmitters shall be rugged, industrial, microprocessor based 'Smart' type. Transmitters shall work on 24 V DC nominal power supply having 2-wire, 4-20 mA DC output & 'HART' protocol based digital communication.
- 22. The typical accuracy of all transmitters shall be 0.1% or better of calibrated span for turn-down ratio of minimum 10:1. Accuracy shall include the combined effects of linearity, hysterisis and repeatability. In any application, the worst case error (WCE) consisting of static pressure effect, temperature effect, humidity effect and stability (1 year) shall not be greater than 0.75%, unless specified otherwise. Zero and span adjustments shall be non-interacting to each other.
- 23. Transmitters shall be suitably compensated against any thermal effects in the process medium.
- 24. Transmitters shall be able to withstand a minimum over pressure of 150 % of the rated pressure.
- 25. All the transmitters shall be weather-proof to IP-65.
- 26.Zero suppression & elevation features, built in/ external surge protection, output reversal facility and provision for selection of different damping levels shall be provided in each transmitter. Absolute pressure transmitters shall have provision for compensation of barometric pressure.





- 27.All transmitters shall have integral local linear digital indicators in engineering unit. DP transmitters for flow applications shall have built-in square root extractors. Local indications shall be adjusted / calibrated through hand held calibrator.
- 28. Power supply effect on transmitters shall be less than  $\pm$  0.05 % of calibrated span/10 V.
- 29. Pressure transmitters shall be supplied with 2- valve manifolds of AISI 316 material having suitable pressure and temperature rating. Flow, DP and level transmitters shall be supplied with 3-valve manifolds of AISI 316 material having suitable pressure and temperature rating. All the required accessories for mounting shall also be supplied with the transmitters.
- 30. Normally, concentric square-edge type orifice plates shall be used.
- 31. For sizing calculation latest edition of BS 1042/ EN ISO 5167-1 standard -Measurement of fluid flow in closed conduits shall be followed.
- 32. For better accuracy, the Beta ( $\beta$ ) ratio of concentric type orifice plates shall be preferably between 0.5 to 0.7.
- 33. Minimum thickness of concentric square-edge type orifice plate shall be as follows:-

2" to 12" (i.e., 50 to 300 mm)	3.18 mm
Above 12" & upto 36"	6.35 mm
Above 36" & up to 80"	10.0 mm
Above 80"	12.0 mm
For temperature >316°C	
2" to 8" (50 to 200 mm)	3.18 mm
10" & above	6.35 mm

- 34. Quarter-circle and conical entrance type orifice plates shall be used for viscous fluids.
- 35. Eccentric or segmental type orifice plates shall be used with dirty fluids.





- 36. Flow nozzle, venturi or averaging pitot tube may be used in high flow applications or where the allowable pressure-drop is low. Averaging pitot tube shall only be used for clean fluid.
- 37.All orifice plates shall normally be made of AISI 316 material, unless otherwise called for by process requirement.
- 38.Generally flange tappings shall be used. However, corner or D & D/2 type tappings can be used as per requirement.
- 39. For line sizes between 1" to 2", carrier-ring type orifice plate with corner tapping shall be used.
- 40. For line sizes less than 1", integral orifice plate shall be used.
- 41. For line sizes greater than 2", orifice plate with flange tapping shall be used.
- 42. In dirty/ contaminated process lines or process lines where line pressure is low (in mm WC range) & line size is large, D & D/2 tappings shall be used. For dirty/ contaminated gas applications, continuous N2/ compressed air purging through rotameters and/ or intermittent purging through remote operated solenoid valve in each impulse line shall be provided. For normal dirty gas applications, transmitter manifold shall be provided with purging connection.
- 43. For low pressure applications, piezometric ring arrangement shall be provided at both the tappings.
- 44.All orifice plates shall be fabricated with a collar, which shall extend outside the mounting flange.
- 45. Tag no., orifice plate bore diameter, upstream (+) and downstream (-) side marking, and plate material shall be engraved on the handle of the orifice plate.
- 46. Flanges shall be in accordance with ANSI B16.5 and of minimum Class 300 rating for line size between 1" to 2". Flanges shall be in accordance with ANSI B16.36 and of minimum Class 300 rating for line size between 2" to 8". For line size of more than 8" and upto 24", flanges shall be as per ANSI B16.5 and of minimum class 150 rating. For line sizes above 24", flanges in accordance with IS 6392, and of suitable rating shall be used.





- 47. Tag no., flange size, flange rating and flange material shall be engraved on all flanges.
- 48.Gasket material for orifice plates shall be suitable to withstand physical and chemical properties of process fluid and shall be matched with the pipeline standard, as required.For steam application, SS spiral wound & compressed asbestos filled type gasket shall be used.
- 49. Supply of orifice plate assembly shall include the orifice plate, flanges, studbolts, nuts, jackscrews, gaskets, pressure tapping nozzles and plugs.
- 50. Drain / vent hole correction shall be as per ISA RP 3.2.
- 51. Orifice plate or flow nozzle shall be installed as per standard, but not less than with straight pipe lengths of 10 times pipe internal dia. (10 D) on the up stream and 5 D on the downstream, free from bends, tees, branch pipes and control valves, etc. Upstream and downstream straight pipe lengths shall be as per section 1.1 of BS 1042. 1981 and also on the guidelines of ISO: 5167, 2003.
- 52. Control valves shall be installed after the orifice plates in the direction of flow.
- 53. All flow meters shall have drainage valves except for oxygen service.
- 54. Corrosive media shall be separated from transmitters by separating chambers with valves for isolation.
- 55. For steam flow and flow of liquid at temperature greater than 120°C condensation chambers of identical dimensions shall be used. Condensation chambers shall be installed as near to flow sensor as possible. For congealing service, seal pot arrangement shall be provided.
- 56. For slurries, viscous and corrosive liquids, 1.5"/2" size D & D/2 tappings with remote diaphragm seal type transmitters shall be used.
- 57. For sensing of level, float/ displacer/ capacitance / conductivity type sensor/ probes shall be used depending on the application.
- 58. Capacitance / conductivity type probes shall be Rod type or Rope type, as per the process requirement. For level measurement in non-conducting tanks or sumps, capacitance type instruments shall be provided with a reference electrode / ground probe.





- 59. External displacer type instruments with rotatable head shall usually be used for level measurement upto 1200 mm (48"). Displacers shall be made of AISI 316 with Inconel torque tube, unless otherwise specified or unless the process calls for any special material. Side-side flange connection shall normally be used. Stilling wells shall be provided for internal displacer type level instruments. All displacer type level instruments shall have drain valves and vent plugs.
- 60. Depending on the requirement, top mounted & side mounted type mounting shall be considered.
- 61. Independent switching contact shall be provided for each level. 2NO+2NC potential free contacts having minimum rating of 240VAC,5A, shall be provided for each switch.
- 62. All Level sensors shall have flanged type process connection and supplied with matching flanges. All Level sensors shall be covered with suitable canopy. Controller unit of the sensors shall be suitably installed at the field itself with proper protection.
- 63. All gauge glasses shall normally be steel armoured reflex or transparent type. Magnetic level gauges may also be used when liquid temperature permits and liquid specific gravity is greater than 0.9.
- 64. Reflex gauges shall be used on clean, clear, non-corrosive liquids.
- 65. Transparent gauges shall be used for interface service or when the process is dirty or viscous. Transparent level gauges, in general, shall be equipped with minimum 40 W illumination and switch.
- 66.Gauge glass material shall be toughened borosilicate glass having adequate resistance to thermal and mechanical shock. Gauge glass body and cover shall be made of carbon steel with rustproof finish, unless otherwise specified.
- 67. Gauges shall be provided with safety ball check offset type gauge cocks, vent and drain connection (with 1/2" vent & drain valves), nipples, caps etc.
- 68.Gauge glasses shall be provided with top and bottom or side connections. Where side connections are specified, the gauge glasses shall have two





connections at each end, 180° apart, with one connection at each end plugged.

- 69. RTDs shall usually be four-wire type. Sensor assembly shall be spring-loaded to ensure positive contact with thermowell. Sensor calibration shall be in accordance with IS, DIN, IEC, IPTS or equivalent standard.
- 70.RTDs shall be mineral insulated (i.e., extruded MgO) type. However, for applications exceeding 1100°C, bead type ceramic insulation shall be provided. Sheath material shall be of AISI 316.
- 71.Bimetallic type or vapour pressure type temperature gauges having minimum dial size Φ150mm/50mm as per application shall be used for local indication of temperature. Temperature gauges with smaller dial sizes may be used for machine mounted applications. Sheath material shall be of AISI 316.
- 72. For temperature gauges, external dial reset facility shall be provided for zero adjustment.
- 73. The temperature gauges shall be designed in accordance with ASME B40.200/ BS 5235/EN 13190 or other international standards.
- 74. Gauge shall have toughened glass.
- 75. Thermowells fabricated out of barstock having adequate mechanical strength shall be provided. AISI 316 shall be generally used as thermowell material, unless other wise required for process compatibility. Sensor & Thermowell construction/ assembly drawing shall be submitted alongwith specification datasheet. Thermowell shall have flanged connection.
- 76. Temperature transmitters shall be 'Smart' type. Transmitters shall work on 24 V DC nominal power supply having 2-wire, 4-20 mA DC output & 'HART' protocol based digital communication. The typical accuracy of all transmitters shall be 0.1% or better of calibrated span for turn-down ratio of minimum 10:1. All transmitters shall have integral local linear digital indicators in engineering unit.





- 77. Microprocessor based vibration monitoring system shall be provided for Turbine, Generator, HT drive motors & pump, fans and other equipment (if any). The number & locations of measurements shall be as per application requirements.
- 78. The vibration monitoring system shall comprise of vibration pick-up probe & transmitter with low noise flexible cables in flexible conduit of adequate length, terminated in local terminal boxes, pre-amplifier / electronics mounted in local weather proof boxes, vibration monitors & mounting racks / cabinets etc. The system shall include all power supplies, interconnecting cabling, calibration equipment, indicators, integrating units, signal conditioning devices and all other accessories required for monitoring of vibration at each point.
- 79. The transmitter shall have self check facility and local display. The system shall provide isolated 4-20 mA DC output in addition to communication ports for monitoring & display in automation system.
- 80.2-channel vibration monitors shall be offered for each measurement location catering for horizontal and vertical measurement. Vibration monitors shall be modular in construction, plug-in type and suitable for 19" rack mounting.
- 81. Vibration transducers shall be installed in weatherproof housing suitable for field conditions. Type of transducers shall be as per equipment manufacturer's recommendation.
- 82. The system shall provide vibration indication calibrated in velocity units along with provisions of changing of displacement unit (field programmable) for each measurement point in both horizontal & vertical planes. For each vibration monitor, two independent potential free contacts shall be made available for alarm & trip purposes.
- 83.All vibration monitoring equipment shall be functionally tested for circuit continuity and output response. All the components & interconnection cables shall be tested to ensure compliance with the specification requirements & all other applicable codes & standards.

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- 84.Calibration check facility for the vibration monitoring system shall be considered. Manufacturer's software for configuring and diagnostics of the system, as applicable, shall be provided and loaded in the system for ease of maintenance.
- 85.Bourdon tube (spiral or helical), bellows or diaphragm type sensing element shall be used in pressure gauges/ switches, depending on the process application. The gauges shall be designed in accordance with IS 3624.
- 86. Accuracy shall be  $\pm 1.0\%$  of span for pressure gauges and  $\pm 1.5\%$  of span for DP gauges. Accuracy shall include the combined effect of linearity, hysterisis and repeatability.
- 87. Pressure switches shall have repeatability of at least  $\pm$  1% of span. These shall have in-built scale.
- 88. The sensing element of pressure gauges/ switches shall be able to withstand the specified over-pressure (at least 125 % of span) for at least 30 minutes, without affecting their elastic characteristics & performance.
- 89. The element and other wetted part materials of pressure gauges/ switches shall be of AISI 316, unless process media necessitates use of other materials.
- 90. Movement material of gauges shall be of AISI 316. Outer casing and bezel material shall be either made of die cast aluminium with epoxy coating or of AISI 316.
- 91.Pressure & DP gauges shall have external zero adjustment facility and minimum IP55 housing. These shall have a linear scale and dial colour shall be white. However, DP gauges to be used for local flow measurement alongwith corresponding orifice plate shall have square root scale calibrated in terms of flow.
- 92. Pressure & DP gauges shall have dial size of 150 mm diameter. Gauges of smaller dial size may be used for machine- mounting applications.
- 93. Gauges/ switches used in pulsating pressure applications (eg. Delivery side of pumps, compressors, etc.) shall be provided with externally adjustable pulsation dampener or snubber.

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- 94. Wherever the process temperature exceeds 70°C, pressure gauges/ switches shall be equipped with Φ100 mm pig-tail siphon of the same material and schedule as the process pipeline.
- 95. Window material of gauges shall normally be toughened glass. However, where the pressure exceeds 40kg/cm2, window material of the pressure gauge shall be shatterproof glass.
- 96.For pressure measurement in dirty, slurries, viscous and corrosive fluids, diaphragm seals of suitable material shall be provided alongwith pressure sensing devices. Diaphragm seals shall be integral with the gauges /switches, unless otherwise specified.
- 97. The sealing liquid for diaphragm seal shall be an inert liquid compatible with process fluid and its temperature.
- 98. DP transmitters with digital display in engineering units shall be provided for all differential pressure measurements & interlocks.
- 99. Transmitters shall be able to withstand a minimum over pressure of 150 % of the rated pressure.
- 100. Pressure transmitters shall be supplied with 2-valve manifolds of AISI 316 material. Flow; DP and level transmitters shall be supplied with 3-valve manifolds of AISI 316 material having suitable pressure and temperature rating.
- 101. For butterfly type control valve, body material shall be carbon steel with stainless steel disc for valve sizes up to 1000mm. Generally for valve sizes of more than 1000mm, body & disc material may be carbon steel. However for specific applications, other materials may be used, as per proven practice.
- 102. Control valves shall be sized so that at minimum and maximum flow, the valve lift/ opening is between 10% to 90% for equal % and 20% to 80% for linear characteristics.
- 103. For applications with line pressure of < 3 Kg/cm2(g) & valve sizes > 800 mm, fabricated type butterfly valves may be used. For line pressure of > 3





Kg/cm2(g), cast type butterfly valves shall be used for all valve sizes. For valve sizes upto 800mm, cast type butterfly valves shall be used for all applications.

- 104. All control valves shall be provided with hand wheel.
- 105. Control valves shall be sized in accordance with ISA-S75-01.
- 106. Concentric disc type/ eccentric disc type butterfly valves shall be used in large line sizes & mainly in low-pressure applications or where allowable pressure loss across the valve is very low. Concentric disc type butterfly valves shall be designed for maximum opening angle of 60°. The maximum permissible opening for eccentric disk type butterfly valves shall be 90°. Applications where wide rangeability is required, eccentric disc type butterfly valves.
- 107. The bourdon / bellows shall be selected to withstand temperature up to 200°C. Diaphragm seal type pressure gauges / switches used in applications where the temperature exceeds 100°C shall have bourdon / bellows type element.
- 108. Pressure gauges & switches shall be provided with 3 way/ 2-way gauge cocks. DP gauges shall be provided with 3-valve manifold. These items shall be provided in addition to the isolation valves/ root valves at the process tapping point.
- 109. The working range of pressure switches shall be selected in such a way that the set pressure is between 35% and 65% of the range. The switch enclosure shall be weatherproof to IP 65. Additionally, in hazardous areas, switch enclosure shall be explosion-proof conforming to IS 2148 and suiting to the area-classification of the hazardous area.
- 110. All instruments, Junction boxes, panels shall be supplied with double compression, brass nickel plated/SS, weather proof, matching cable glands.
- 111. Instrument power supply shall be single phase 240 V AC  $\pm$  10%, 50 Hz  $\pm$  5%. All instrumentation equipment shall be suitably selected accordingly.





- 112. Terminals of 110V and above shall be labeled and isolated from terminals of lesser voltages.
- 113. All electrical systems and installations shall meet the statutory requirements of the Indian Electricity Act and rules & regulations of Central & State Government.
- 114. No instrument contact shall be used directly for alarm annunciation or interlocking. Contacts after multiplication through relays shall be used for alarms and interlocks.
- 115. Instrument power supply shall be through circuit breaker (with adjustable short circuit and overload release facility) and isolating transformer. Circuit breakers shall also be provided on the secondary side of the isolating transformer for providing power supply to a group of 2-3 instruments. All instruments shall also have individual switch fuse units.
- 116. Derivation of necessary voltage grade from the available power supply, as may be required for the offered system & distribution of power shall be carried out by the Bidder.
- 117. Power supply equipment for instruments as may be required shall be installed inside suitable panel.
- 118. All signal, control, compensating & power cables for instrumentation use shall be armoured type. The conductor for signal, control & power cables shall be electrolytic grade annealed tinned copper as per IS 2130 : 1984.
- 119. All cables shall be PVC insulated and PVC sheathed. Insulation material shall be extruded HRPVC type C and inner & outer sheath material shall be extruded HRPVC type ST2 as per IS 5831 : 1984. Depending on application, outer sheath shall be FRLS type. Additionally, asbestos, silicone or sintered Teflon sheath shall be provided in high-temperature-prone locations. Insulation thickness shall be 0.6mm.
- 120. Instrument power supply & control cables shall be made of multistranded copper conductor of 1.5 mm2 of 1.1 KV grade and other details as per IS 1554, Part 1. 500 V grade cables with multi-stranded, twisted pair copper





conductor of minimum cross-sectional area of 1.0 mm2 shall be used for signal transmissions cables. Cable pairs shall be individually and overall shielded.

- 121. For cables, applicable standards shall be latest revision of IS 8130, IS 5831, BS 5308, IS: 1554 (Part I), IS: 3975, IS: 2633.
- 122. Inner shield shall be of aluminium mylar tape, helical type & thickness shall be at least 0.06 mm and shall have 100% coverage and 25% overlap. Overall shielding shall be helical type 0.075 mm thick aluminium mylar tape with 100% coverage and 25% overlapping. Drain wire shall be provided for each pair shielding as well as for overall shielding. Drain wire shall be of annealed tinned copper, multistranded and of 0.5 mm2 size. Drain wire shall be continuously in contact with the shield. Shield shall be kept open at the instrument end and to be connected to the electronic earth pit at the panel end.
- 123. General guideline for minimum thicknesses of inner sheath, armour & outer sheath for signal cables shall be as follows :

Type of cable	Thickness of inner sheath	Thickness of armour	Thickness of outer sheath
Up to 3P x 1.0mm2	1.1 mm	1.25 mm	1.4 mm
4P-7P x 1.0 mm2	1.2 mm	1.25 mm	1.6 mm
8P-14P x 1.0mm2	1.3 mm	1.25 mm	1.8 mm
Up to 3P x 1.0mm2	1.1 mm	1.25 mm	1.4 mm
4P-7P x 1.0mm2	1.2 mm	1.25 mm	1.6 mm
8P-14P x 1.0mm2	1.3 mm	1.25 mm	1.8 mm
Up to 4P x 1.0 mm2	1.2 mm	1.25 mm	1.6 mm
5P-9P x 1.0 mm2	1.3 mm	1.6 mm	1.7 mm





10P-14P x 1.0mm2	1.5 mm	1.6 mm	1.9 mm
15P-19P x 1.0 mm2	1.7 mm	2 mm	2 mm

- 124. Ripcord shall be provided & shall be non-metallic type under sheath. Armour material above inner sheath shall be galvanized round steel wire.
- 125. Inner sheath colour shall be black. Outer sheath colour shall be blue.
- 126. Core identification shall be as per IS 1554 (Part 1). Pair identification shall be as per BS 5308.
- 127. The individual cores in multicore cables shall be PVC insulated & numbered and/ or identified by a definite colour code.
- 128. A durable marking shall be provided on the surface of the cable at regular intervals not exceeding 625 mm. The marking shall include manufacturer's name, conductor material and size, no. of pair/ core, insulating material etc.
- 129. Compensating/Thermocouple extension cables if used in high temperature zone or are to be laid on the top of the furnace/hot surface, shall be sintered Teflon insulated, sinter Teflon sheathed overall SS braided cables. Additional Glass fibre insulation shall be used for temperature zone > 250 Deg C. Mineral insulated extension cables can also be used for such application. Compensating cable shall be laid separately.
- 130. All cables from field JBs to panels /marshalling rack in the control room shall have at least 10% (minimum 1 no.) spare cores.
- 131. In earth conductor system (for body earthing of equipment) and a shield earth system (wherever required) shall be installed for measuring and control facilities. Screen wires of screened signal cables from the field shall be earthed at the electronic earth-pit of the control system, which shall be separate and independent with respect to the power supply earth grid.





- 132. Power and signal cables shall be laid in separate trays. A gap of minimum300 mm shall be maintained between power and signal cables whereverthey are laid in parallel in the tray/ duct/ trench.
- 133. Cables shall be terminated using cable glands. Cable shall enter into the control room or other room through conduit or through MCT (Multi-Cable Transit) block. Opening for cable entry in the rooms and other openings shall be properly sealed by sealing compound to make them thoroughly dust & leakage proof and to avoid entry of rodents.
- 134. At junction box and sensor end, metallic (Aluminum) cable tags with cable no. & J.B. no. at sensor end and sensor tag no. & cable no. at J.B. end shall be used. At control room end also metallic cable tag with cable no. and J.B. no. shall be used.
- 135. All cables shall be properly terminated using lugs, sleeves, printed ferrules, etc. for connection to terminal blocks. All cores of electrical cables shall be identified by their wire numbers by printed ferrules as per finalised procedure.
- 136. Aluminum perforated cable trays with sheet thickness of min. 2.5mm shall be used for laying of branch cables. For overall cable routing, hot-dip galvanised steel plates of minimum thickness of 2.0 mm and epoxy painted or fabricated tray of MS angle/ channels shall be used. The thickness of side coupler plates shall be 3mm.
- 137. Free ends of angle support & holes shall not have sharp edges and shall be properly rounded off. The width of cable trays shall be so selected that 20% of tray space is available for future use of the complete installation.
- 138. The perforated trays shall be properly supported at a regular interval of maximum 1500 mm from insert plates or steel structures. Angle supports for perforated trays shall be fabricated from 40mm x 40mm x 5mm MS angles minimum size. For fabricated trays, support shall be provided at an interval of 2.0 m for horizontal run and 2.5 m for vertical run.





- 139. Wherever cable trays are not used/ possible, conduits shall be provided for cable laying. The conduits shall be as per IS-1239 class medium & galvanized.
- 140. For cable laying through conduits, pull boxes shall be provided wherever required.
- 141. All cables and pipes shall be properly tagged with aluminium tags.
- 142. Instrument panel (wherever used) shall be freestanding, floor mounted, flush front, cabinet type. Panel dimensions shall be suitably decided for mounting of all the items and ease of operation & maintenance. All equipment inside the panel shall be located in such a manner that their terminals and adjustments are readily accessible. Wall mounting/ Pedestal mounted type panel can also be considered depending on system design & panel dimensions.
- 143. For vibration transmitters/ racks, panel front shall be provided with suitable transparent sheet for viewing from outside.
- 144. Panels shall be dust and vermin proof. Panel at field shall have IP 54 protection class and that at control room shall have IP 42 protection class. Suitable gaskets shall be provided, for this purpose.

Panel shall be made of cold rolled continuously annealed steel sheet with a minimum thickness of 2 mm for all load bearing sides (Front & Rear door) and 1.5mm for non-load bearing sides (i.e side &Top), bottom 1.5 and gland plate removable type thickness 3mm.

Panel shall be front opening or back opening type depending on requirement. Panel shall have lockable door with flush type handle. Panel inside shall be properly illuminated, operating through door switch.

145. Height of instrument panel shall be generally 2200mm including ISMC 100 base channel and 15 mm thick anti-vibration pad on top of it. If the width of a panel exceeds 600mm, double-door type construction shall be provided. Otherwise, panels shall have a single door. Final dimensions of the panel and its equipment distribution shall be as finalised during detailed





engineering stage. Height of panel located other than control room shall be as mutually agreed during detailed engineering stage.

- 146. Outside colour of the panel shall be grey as per shade no. 631 of IS:5-1978, and inside colour shall be brilliant white.
- 147. Panels shall have lifting hooks or eyebolts on the top at the four corners, for ease of transportation.
- 148. Panels / cabinets / desks etc. shall be supplied in finish-painted, as per standard practice. This will broadly include wire brushing, sand blasting, required numbers of primary coats & final paints. These shall be completely wired and tested.
- 149. For panel wiring, for control and signal transmission, multi-stranded copper wire of 1.0 mm sq. cross sectional area shall be used. For power supply to instruments, multi-stranded copper conductor of 1.5 mm sq. cross sectional area shall be used. 4.0 mm2 PVC insulated stranded Cu-conductor for termination on the earth bus inside panel shall be used. The properties and construction of copper conductors shall be as per IS:8130-1976, where as the physical and electric requirements for PVC insulator and sheath shall be as per IS:5831-1984.
- 150. Terminal blocks shall be cage clamp type. For signal wiring, 2.5mm2 size & for power wiring, 4.0mm2 size terminals shall be used. A minimum of 20% spare terminals shall be provided in each terminal block. Distance between the edges of two adjacent terminal strips shall be minimum 100 mm.
- 151. Separate terminal strips shall be provided for 24 V DC, 240/110 VAC and intrinsically safe terminals. Power supply terminals (e.g. 240VAC or 110VAC or 24VDC) shall be labeled. Distance between cable gland plates & bottom of terminal strips shall be minimum 300 mm.
- 152. In case a bus bar is used for power supply distribution, the bus-bar shall be shrouded with a transparent Bakelite plate.





- 153. All internal wiring shall be housed in covered, non-flammable plastic raceways. Separate wiring raceways shall be used for power supply wiring, signal wiring and intrinsically safe circuits' wiring.
- 154. An inscription plate (with white letters on a black background) containing the tag no. & application shall be provided below each instrument / item mounted on the panel, both front & inside. Panel shall also have identification plate at the panel front top.
- 155. Panels or cabinets shall be provided with a power socket (of 240V AC, 15W rating) for soldering, etc., A pair of earthing bolts inside panel for power earthing, A copper bus-bar (of size 25x3mm.) mounted on an insulated base inside the panel with holes and nut-bolts, for instrument signal earthing.
- 156. Overall dimensions of the nameplates shall be decided by the text of legend, maintaining overall consistency and clarity and avoiding size variations.
- 157. Junction boxes shall be weather-proof. Enclosure degree of protection shall be minimum IP 55 as per IS 12063. Construction and testing shall conform to IS-2147. Material shall be die cast aluminum (LM-6 alloy) of minimum 3 mm thickness. Suitable other materials like high quality thermo-plastic also can be considered, depending on suitability.
- 158. Weather proof junction boxes shall have hinged type doors with door handle.
- 159. Terminal shall be spring loaded, vibration proof, clip-on type, mounted on nickel plated steel rails complete with end cover and clamps for each row. All terminals in JB shall be suitable for accepting minimum 4.0 mm2 copper conductors.
- 160. Sizing shall be done with due consideration for accessibility and maintenance in accordance with the following guidelines :
  - 50 to 60 mm between terminals and sides of box parallel to terminals strip for up to 50 terminals and additional 25 mm for each additional 25 terminals.
  - 100 to 120 mm between terminals for up to 50 terminals and additional 25 mm for each additional 25 terminals.





- Bottom/top of terminals shall not be less than 100 mm from bottom/top of the junction box.
- 161. All junction boxes shall be provided with external earthing lugs.
- 162. Junction boxes shall be provided with adequate supporting/fixing arrangement with nuts, bolts, washers, brackets etc, as required for installation on wall /structures.
- 163. All junction boxes shall be provided with 20% spare cable entries (minimum 1 no.) and terminals. All spare holes shall be covered with plugs.
- 164. For outdoor installation of JBs, cable glands and plugs shall be of SS 316/304 material and nickel plated brass material for indoor installations.
- 165. All junction boxes shall be provided with double compression glands and will be threaded to junction boxes.
- 166. JB shall have provision for keeping terminal detail's of JB inside the junction box.
- 167. Transmitter cabinets/ enclosures/ canopies shall be made of 2 mm thick MS sheet and provided with external earthing lugs.
- 168. All cabinets shall be provided with external earthing lugs.
- 169. Sizes of cabinets/ enclosures/ canopies, as approved by purchaser / consultant, shall only be supplied and outside colour of panel shall be as per IS –5, shade –631 and inside white.
- 170. Enclosure/ canopies shall be suitable to protect the instrument from direct exposure to sun & rain water.
- 171. Cabinets shall be provided with lockable door-handles.
- 172. All equipment inside the cabinet shall be located in such a manner that their terminals and adjustments are readily accessible.
- 173. Cabinets shall be dust and vermin proof. Suitable gaskets shall be provided.
- 174. Cabinets shall be supplied in finish-painted, as per standard practice, completely wired and tested condition.
- 175. Cabinets shall have lifting hooks on the top at the four corners, for ease of transportation.





- 176. An inscription plate (with white letters on a black background) containing the tag no. & application shall be provided below each instrument.
- 177. Pressurised local cabinets shall be installed in dusty areas. Pressurisation shall be achieved inside the cabinet by introducing clean (i.e., dust-free) air.
- 178. Impulse pipe shall be either schedule 40/80 seamless carbon steel pipes (depending on pressure rating) as per ASTM A106 Gr.B with threaded/ socket weld type forged fittings of material cadmium plated ASTM A105 of minimum rating of class 3000 or shall be fully annealed, seamless and cold drawn 316SS tube as per ASTM A269 with compression fittings as per standard practice & guidelines. Tube wall thickness shall be 0.065" unless otherwise specified.
- 179. Carbon steel Fittings shall be as per ANSI B16.11. SS tube Compression Fittings shall be as per ISA RP 42.1. Fittings shall be flare less compression type and of three piece construction with ferrule, nut and body suitable for use on SS tube conforming to ASTM A269 TP316, hardness not exceeding RB 80. Hardness of ferrules shall be in the range of RB 85-90 so as to ensure minimum hardness difference of 5 to 10 between tube & fittings for better sealing. Threaded ends of fittings shall be NPT as per ANSI B1.20.1.
- 180. Impulse pipes shall be provided with condensate traps, expansion loops, isolating valves, equalizing valves, drain valves at suitable places and shut off valves at tappings points wherever applicable.
- 181. The impulse line isolation and drain valves shall be forged gate/ ball/ globe valves with inside screwed bonnets. For steam application, gate valves of suitable rating shall be used and 3-piece ball valves for other applications. CS/ SS valve material shall be used depending on process requirement.
- 182. For SS valves, body and trim material shall be ASTM A182 Gr. F316. For CS valves body material shall be ASTM A105 Gr.II and trim material shall be ASTM A182 Gr. F316.
- 183. For screwed valves packing material shall be teflon only. However, for socket-weld valves packing material shall be grafoil only.





- 184. Valve hand-wheel material shall be cadmium or nickel plated steel.
- 185. Minimum valve rating shall be 800 class.
- 186. Impulse pipe/ tube shall be laid following standard engineering practice.
- 187. All instruments shall be calibrated as per manufacturer's instructions prior to installation. The same shall be recalibrated as and when required.
- 188. For installation of any kind of special type of instrument/ sensor manufacturer's recommendation for installation shall be followed. Bidder's scope shall also include arrangement of competent technical persons of respective Instrumentation manufacturer at site, as & when required to meet the project schedule.
- 189. All the equipment required for erection shall be brought by Bidder to site, on returnable basis. All the required testing & calibration equipment shall be brought by Bidder to site, on returnable basis, for testing & calibration work at site.
- 190. The erection, testing & commissioning of the instrumentation system for this package shall be carried out in accordance with good engineering practice & applicable International and Indian Standards.
- 191. Colour code applicable for the plant as per relevant standard / Purchaser's choice shall be followed for instrumentation pipelines, lamps, cables, panels, etc.
- 192. Erection of instrumentation items shall generally be carried out in compliance with the installation/ hook-up drawings as to be finalised for this project. For installation of transmitters, installation/ hook-up drawings shall be prepared and erection shall be carried out considering transmitters located above pipeline for gas service & below for liquid service. However, this shall be finalised as per site condition & if otherwise, alternate drawings shall be prepared and followed.

Erection materials & hardware required for this job shall be worked out & supplied based on the finalised installation drawings and also as per actual requirement at site.





#### 193. Earthing:

- All junction boxes, local cabinets, field mounted instruments (having 110 V AC & above power supply) shall be connected to the nearby earth bus bar through 6 mm<sup>2</sup> (min.) stranded copper conductor with green sleeve.
- 2. Earthing network shall be realized with earth electrodes and/or buried bare conductors.
- 3. Two types of earthing system shall be generally provided -
  - I. Main earthing system (ME).
  - II. Electronic earthing system (EE).
  - III. The electronic earth system shall be separate and independent from main earthing system. Electronic earthing system will be suitably designed to meet the requirements of automation/instrumentation systems, as per manufacturer's recommendations.
- 4. In general, the earth conductor between EE busbar of cabinets/ marshalling rack up to the earth pit shall be 16 mm2 insulated copper conductor.
- 5. The following shall be applicable for earthing:
  - The metallic housing of electronic equipment/junction box /panel shall be connected to the main earthing system.
  - The active electronic parts of electronic equipment shall be connected to the electronic earth (EE).
  - The shield of the shielded cable shall be earthed to electronic earth at one end only i.e. at control room end.
- 6. For shielded compensating cable the shield shall be earthed near the point of the circuit ground. For grounded junction thermocouples, this


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means at the thermocouple head. For ungrounded junction thermocouples this means at the control room end.

# 194. UPS:

Industrial graded 2 X 100% parallel redundant UPS with SSVS shall be sized by the bidder to cater to power for the bidder furnished loads such as plant control, monitoring system. Min. capacity shall be considered as 5 KVA as required basis. 240 VAC operated instruments, Annunciation System, PLC/DCS system peripherals such as Work stations, Printers, Network switches, etc. shall be operated on UPS power. While computing the base capacity of the UPS, inrush requirements of connected loads shall be duly considered. The inrush shall be taken as 300% of steady state load lasting for 100 milli seconds. The base capacity shall be computed by bidder on above basis and to provide for at least 10% variation to cater to changed load requirements during detailed engineering stage. Bidder shall detail in the technical bid, the steady state as well as inrush requirements of each of the loads furnished by him and justify the selection of UPS capacity duly satisfying the requirement of 10% design margin. This base capacity shall be guaranteed at 240 V AC, 50 Hz single phase output at 50 deg.C. Ratings other than standard ratings of the manufacture shall not be acceptable. Number of distribution feeders in completely redundant configuration shall be offered to suit the load distribution as decided during engineering. Spare feeders of at least 20% of the total number of feeders shall be built in. No adjustment in contract price is admissible on account of number or variation in size of feeders during detailed engineering.



**SECTION- "C"** 



# DAMODAR VALLEY CORPORATION (DVC) MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



# IP BASED CLOSED CIRCUIT VIDEO MONITORING (CCVM) SYSTEM

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## 1.0 Introduction

The intent of this specification is to provide a new IP Based Closed Circuit Video Monitoring (CCVM) System in the Maithon Hydel Station.

The CCVM system called for in the specification shall be designed for reliable and smooth operation with minimum intervention of the operating personnel. The CCVM system shall be IP based with the latest state of the art technology. Bidder shall design, develop and configure the system for safe and trouble-free operation.

Technical specifications and documents shall be thoroughly read and understood by the Bidder. Bidders are required to check and satisfy themselves about the adequacy of the information provided and shall stand guarantee for the performance of the system as whole.

It is not the intent to completely specify all details of design and construction features herein. Nevertheless, the systems / equipment and their installation shall conform to standards of engineering design and workmanship in all respects.

# 2.0 Scope Of Work & Services

The scope of work and services shall include the following:

- 1. Design, engineering, procurement, testing at manufacturer's works, supply, packing, forwarding to site, unloading, storage, handling, erection, testing, commissioning and handing over of complete IP based CCVM system with its associated hardware, software, accessories and all necessary installation materials to complete the quantum of work.
- 2. Bidder shall provide minimum Ten (10) nos. of HD IR IP fixed PoE Camera and minimum 2 Nos. of IP PTZ PoE camera. Supports / frames required for mounting camera shall also be provided by the Bidder.
- 3. Bidder shall provide required number of Managed 8 port PoE Switch with required SFP port and modules along with necessary networking components.
- 4. Bidder shall provide 1 No. Network Video Recorder (NVR) of 16 channel capacity with necessary VMS software for recording, configuring, controlling & monitoring of CCVM System.



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- 5. Bidder shall provide Network rack of minimum 9U for mounting the NVR and other networking components.
- 6. Bidder shall provide 1 Nos. of 32" LED display monitor and the same shall be connected to the NVR for monitoring of CCTV System.
- 7. Supply, laying and termination of Cat6 cables from camera to Ethernet switch and to NVR is in the scope of the Bidder. For longer distance OFC cable shall be laid between the network switches to connect with control room NVR.
- 8. Distribution of power to all CCTV components with necessary power cabling and utility power socket is in the scope of the Bidder, using 220V UPS power supply.
- 9. Supply of RJ45 outlet box shutter type, PVC conduits, casings, connectors, etc., erection hardware & accessories required for installation of the CCVM System shall be provided by the Bidder.
- 10. Minor civil works such as small chipping, making holes and filling or closing the gaps, etc. wherever required during erection of equipment is in Bidder's scope.
- 11. Bidder shall arrange and bring their tools & tackles, special testing equipment, consumables and any spares required for erection and commissioning activities.
- 12. Submission of documents as mentioned in the clause "Drawings and Documents".
- 13. The Bidder shall provide skilled technical personnel for the erection, testing and commissioning of the CCVM system.
- 14. Bidder shall train the purchaser's personnel on the CCVM system for acquaintance, installation, operation and maintenance.
- 15. Items not specifically mentioned but considered necessary for completion of the job in all respect will be treated as included in the scope of work of the Bidder. The same will be indicated by the Bidder.

# 3.0 Instructions To The Bidder

- 1. Design criteria for equipment shall be as indicated / mentioned in this specification.
- 2. The Bidder shall replace the wrong/defective equipment supplied by them or any damages caused to equipment during transportation free of cost. In case of any

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dispute, decision of purchaser shall be final. The Bidder shall depute their representative to site for replacement/rectification work without implication to purchaser.

- 3. All name plates and inscriptions of equipment, operating and maintenance manuals, technical catalogues, test certificates, explanatory notes in drawings etc. will be in English language.
- 4. All equipment shall be supplied from the make list provided. All CCVM equipment shall be of CE/UL certified.

## 4.0 Guarantee

The equipment and system supplied shall meet the guaranteed performance specified in the specification when operated at the rated / specified conditions. The acceptance of the equipment and system shall be subject to satisfying these parameters during shop test at vendor's works and at site installation in complete assembled condition.

The Bidder shall stand guarantee for the trouble free operation and satisfactory performance, of all the equipment and system supplied. The guarantee shall also cover faulty design or materials or workmanship. The Bidder shall do all rectification or replacement under the guarantee period free of cost. The guarantee period shall be for one year commencing from the day, owner takes over the system.

### 5.0 Inspection And Testing

The test reports for the equipment shall be submitted for review / clearance by the Purchaser.

If the equipment and / or parts thereof are found to be defective at site, even after manufacturer's / contractor's inspection and purchaser's dispatch clearance, the manufacturer/contractor shall bear the sole responsibility of replacing all defective parts / equipment without any implication to the purchaser.



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# 6.0 Detailed Technical Specification

# 6.1 Closed Circuit Video Monitoring System

Closed Circuit Video Monitoring System (CCVM) shall be provided for comprehensive round the clock surveillance with recording, control, viewing and monitoring of different locations of Maithon Hydel station.

The CCVM system shall be IP based comprise of IP cameras with mounting accessories, Network Video recorder, LED display monitors, networking components and cables. The system should be latest available at the time of supply.

The cameras shall be installed in areas like Security gate, inside power house area, entry tunnel area, entry to office building.(as per enclosed **Annexure**)

The NVR of CCVM system to be located in the control room.

All the cameras will be connected through Network switches to the Network Video Recorder (NVR). The recording of cameras are stored for minimum of 30 days.

For monitoring of CCTV System, one of 32" LED video displays shall be located at the control room. Necessary interfacing networking components (hardware & software) along with cables shall be provided by the Bidder.

# CCVM system shall comply following requirement:

- i. The CCVM system shall be IP based with superior quality IP cameras and IP based Network Video Monitoring/Control/Recording system.
- ii. CCVM system shall be able to provide viewing and monitoring of various premises / areas of the office.
- iii. CCVM system shall be Underwriters Laboratories (UL) certified.
- iv. From keyboard / mouse of the control station, it shall be possible to select any camera and display the picture on the monitors.
- v. Operator shall be able to control all cameras functions remotely from the keyboard / mouse of the control station.
- vi. All network equipment shall be selected to ensure minimum 1Gb bandwidth network and frame transmission speed of 25/30 FPS minimum and full camera resolution.



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- vii. The CCVM system should have software based with minimum of 16 cameras connection facility.
- viii. The cameras located in the dusty environment shall be provided with camera housing along with wiper arrangement

## 6.2 Camera

# A. HD IR IP Vari Focal PoE fixed Dome/ Bullet Camera:

*	Image Device	1/3" or better CCD / CMOS image sensor
*	Signal Processing	Digital Signal Processing
*	Signal format	NTSC / PAL
*	Scanning System	Progressive
*	Resolution	Min. 2 Megapixels, HD
*	Lens	3-12mm vari-focal lens
*	Focus	Auto with manual override
*	Sensitivity	0.05 lux Color / 0.01 lux Mono / 0 Lux w/IR
*	Iris	Auto Iris. Auto with manual override
*	Clear visibility	10m Minimum
*	IR LED	Around the lens. Minimum 20m IR visible range
*	Day/Night Operations	Yes, True Day/Night Operations. Day IR cut filter
*	Image settings	<ul> <li>Auto Sharpness Integrated &amp; Selectable</li> </ul>
		Auto Exposure Integrated & Selectable
		Electronics Image Stabilization Integrated & Selectable
		Video Motion detection Integrated & Selectable
		<ul> <li>Automatic White Balance with manual override</li> </ul>



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- Digital Wide Dynamic Range
- Backlight compensation Integrated & Selectable
- Color, brightness, contrast, hue adjustment Integrated & Selectable
- Integrated & Selectable Mirror/Flip, Privacy Masks, Text, Date-Time overlay
- \* Video Encoding MPEG4, H.264 high, main, base profile
  - Profile has CBR, VBR, frame rate setting
  - Video streaming Simultaneously multi-profile streaming
  - Frame Rate & Bit rate: 8Mbps or better Resolution
    - Frame rate: 25fps/30fps.
    - Resolution: upto Megapixels
  - Interface ONVIF profile S & G
- \* Power Supply PoE IEEE 802.3af compliant
- \* Output RJ45 Ethernet TCP/IP
- \* Ingress Protection IP65
- \* Certification UL, CE

### B. Specifications for IP Speed Dome PTZ Camera

\* Image Sensor 1/3" CMOS/MOS, WDR for Day & Night with Colour or B/W output
\* Resolution Full HD (1920 x 1080) @25 fps or better
\* Optical Zoom 26x Optical Zoom or better
\* Digital Zoom 1 to 12x variable
\* Iris Auto iris



MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3 (ELECTRICS AND C&I)



* Minimum Illumination	Colour 0.2 lux, 0.02 lux at B/W mode or better. IR with100m range or better	
* White Balance	Auto /Manual	
* Wide Dynamic Range	True WDR 120 db or better	
* Signal to noise ratio	50 db.	
* Automatic gain control	Yes	
* Video Compression	H.264/H.265 or better	
* Video Output	RJ-45	
* Configuration	Through web Access and Video Management Software/NVR	
* Pan movement	360° endless	
* Tilt Range	+/- 0-90°	
* Pre-set	Min 64 positions	
* Network Protocols	IPv4 & IPv6,TCP/IP,UDP, IGMP(Multicast)DHCP Client, HTTP, HTTPs	
* Minimum Features	Face Detection, Motion Detection	
	Video Motion detection -Integrated & Selectable	
	Automatic White Balance with manual override	
	Digital Wide Dynamic Range	
	Backlight compensation -Integrated & Selectable	
	Color, brightness, contrast adjustment -Integrated & Selectable	
	Mirror/Flip, Privacy Masks, Text, Date-Time overlay- Integrated & Selectable	
* Power supply	PoE 802.3 af and also supports local power supply	



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*	Operating Conditions	Environmental	The camera shall be able to operate satisfactorily in the following conditions
			(a)Operating Temperature range of 00C to 500C
			(b)Relative Humidity up to 90% (Non –Condensing)
*	Alarm		Minimum 2 input, 1 output or higher
*	Build in Memor	y support	Minimum 128 GB Memory card (provided with camera) for automatic recording when network fails
*	Ingress Protect	tion	IP66, Vandal proof
*	Surge Protection	on	To be provided as per BS6651
*	Interface		ONVIF profile S &G
*	Certification / A	pprovals	UL, CE

# 6.3 Network Video Recorder (NVR)

Network Video Recorder shall receive live video data from any/all camera sources, store live video in the storage hard disk, playback and control. NVR shall be ONVIF compliant.

Sr. No	Feature	Parameters
1	Main Processor	Intel Core i7 or Better(latest generation at the time of supply)
2	Operating system	Windows 10 or latest
3	Database	Embedded Server latest edition
4	IP Cameras supported	Minimum 16 channel or higher
5	Hard Disk	8 TB SATA HDD slots, expandable to 16 TB for the storage of min 30 days recording
6	Network	2 x Gigabit Ethernet (RJ-45) 16 port (RJ-45) for termination of camera input
7	Functions	Live View, Recording, Play back, Backup



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8	License	Minimum 16 IP Channels video channels & License for user clients with monitoring and control of Camera along with VMS software
9	Support	Privacy masking, Camera title, Motion detection, time function, recording, Video loss, Camera lock, alarm, Scheduling
10	Control mode	USB Mouse, Keyboard, Network
11	Encoding/Compression	H.264/H.265,MJPEG, MJPEG-4
12	Camera resolution supported	2 MP ,1080p ,720p; D1; CIF or better
13	Display	1 VGA, 1 HDMI, Display port
14	USB port	Min 2 Nos. USB 2.0 port and 2 Nos. USB 3.0 port
15	Monitor	22 inch LED Monitor
16	Input Voltage	100-240 VAC, 50 Hz
17	Cabinet	Rack / desk-mountable chassis
18	Operating Temperature	10° to 35° C
19	Operating Relative Humidity	10% to 85% non-condensing
20	Compliance	ONVIF (to support third-party network cameras)
21	Regulatory compliance	UL, FCC, CE

### 6.4 Network Components

## 6.4.1 Network Rack

Network Rack of min. size 9 U shall host the NVR and networking components. The rack shall be of wall/ floor mounted as per the site requirement and shall also be provided with required power sockets, cooling fan, cable manager and mounting frames.



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The rack shall be made from steel sheet of 1.6mm thick and powder coated. Front shall be glass door with lock and key. Legend plates, cable entries and earthing shall be provided.

## 6.4.2 Ethernet Switch

All the cameras will be connected through 8 port PoE Network switches to the Network Video Recorder (NVR).

The network switches and its networking components shall be mounted in suitable industrial type enclosure as per the site condition.

- i. Fully managed 8 port PoE switch
- ii. Layer 2 and 3 switching capabilities
- iii. 8 No. RJ-45 autosensing 10/100/1000/10000 PoE port, Full & / Half Duplex
- iv. Minimum 1 No. RJ-45 10/100/1000/10000 port (uplink)
- v. IEEE 802.3af Power over Ethernet to provide power for PoE compliant device.
- vi. Power budget available to all PoE ports to suite cameras.
- vii. Rack-mountable
- viii. LEDs: Power, Fault, Per-port LEDs to view of status, activity
- ix. Physical security Front-panel buttons to disable reset and clear buttons on front panel for added security
- x. Certification: CE & UL
- xi. Temperature: 10° to 35° C; Relative Humidity: 20% to 80% (noncondensing); Voltage: 110V~230V AC

### 6.4.3 Cables

Cat6 UTP cable shall have 23 AWG 4 Pair bare solid copper conductor, CAT-6 UTP Cable, Channel optimized to 250 Mhz.



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Power Cable shall be 3 core 2.5 mm<sup>2</sup> copper conductor with PVC insulation and PVC sheath. Cable shall be ISI certified.

PVC conduits used for cable laying shall confirm to IS-14787 or IS-12231, Type1 rating / IS-4985 Class2 thickness.

Single Mode OFC cable for interconnection between switches and further the signal is transferred to control room for monitoring.

## 7.0 Erection, Testing, Commissioning

The testing and acceptance of the system shall be carried out on the mutually agreed procedures and criteria based on these guidelines and vendor standard procedures.

## 7.1 Installation And Testing

Bidder's responsibility at site shall include all activities necessary to be performed to complete the job including:

- i. Receipt of hardware / software and checking completeness of supplies.
- ii. Installation of the system including free supply equipment if any.
- iii. Cable termination and inter cabinet cabling and termination.
- iv. Check out equipment installation
- v. Checking of interconnections, hardware and software configuration, overall system functioning etc.
- vi. Loop checking.
- vii. Commissioning and online debugging of the system.
- viii. Performance Guarantee and Final Acceptance Test.

Integrated system test shall be carried out after completion of initial trial run of the system / equipment.

### 7.2 Final Acceptance Test

The final acceptance test involves successful uninterrupted operation of the total integrated system for a minimum period of 72hrs. In case of failure during the test, Bidder shall rectify and repeat the test for the same duration.

The owner will take over the system from the Bidder after successful completion of the final acceptance test.

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## 8.0 Drawings And Documents

Bidder shall submit the drawing and documents at various stages in sufficient sets.

- a) Bidder shall provide the following along with the offer:
  - \* Details of the CCVM system with cameras, NVR and capabilities along with Literature, Catalogues of offered model.
- b) The successful Bidder shall furnish the following drawings and documents of the system in hardcopy.
  - \* CCVM System Configuration / Schematic diagram
  - \* Datasheets with catalogues and Bill of Material for CCTV System
- c) The successful Bidder shall furnish the following drawings and documents in hardcopy one sets with softcopy in CD for reference:
  - i. Technical particulars
  - ii. Spare part list and drawings
  - iii. Catalogues/literatures
  - iv. Operation and maintenance manual.
  - v. Test and calibration certificates
  - vi. Guarantee / Warrantee certificates



# DAMODAR VALLEY CORPORATION (DVC) MAITHON HYDEL STATION TECHNICAL SPECIFICATION FOR R&M OF UNIT # 1 & 3

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# Annexure

# Tentative location detail of CCTV Camera

SI No.	Location	Qty
1	Inside Power house (fixed Camera)	3
2	Entry to tunnel of power house (PTZ Camera)	1
3	Security gate (fixed Camera)	2
4	Entry of Office building (PTZ Camera)	1
5	Draft tube area zone (fixed camera)	2
6	Entry to tunnel of power house towards tunnel end (fixed Camera)	1
7	Power house basement floor (fixed camera)	2