

SECTION –VI

CONTROL, METERING AND PROTECTION SYSTEMS

6.1 SCOPE OF SUPPLY AND DESIGN CRITERIA

Design, manufacture, testing, commissioning of control, metering and protection system which includes Electrical protection by conventional relay; manual control and metering of the Power House.

6.2 DESIGN CRITERIA

The control panels will have provision for start, stop,, manual synchronizing, all the 4 (four) machines in the power house and Mai Ph-I MHP with Mai –II and Tago SHP also protection metering and emergency stop.

Common tripping relays for similar functions shall be provided with lock-out facilities. All these relays shall have potential free contacts for trip and alarm purposes and externally hand reset type of flag indicators. They should preferably be housed in drawout type of cases with tropical finish.

All the protective equipment will be housed in the Power Plant control room. The details of C.T.'s for all the unit protection and metering shall be subject to approval by purchaser.

C.T.s and P.T. may be mounted on switchgear panels alongwith indicating meters like ammeter, voltmeter and kW meters etc.

6.2.1 C.T.s/VTS and general surge protection equipment

All current and voltage transformers required for protection system of the unit shall have adequate VA burdens, knee point voltage, instrument safety factor and characteristics suitable for the application, and shall be subject to approval of the owner. 11 kV and 33 kV CTs are detailed in separate sections.

CTs/VTs used for different applications shall have following accuracy class:

| | | |
|----|--------------------------------------------------------------------------|------------|
| a) | Protection CTs | Class 5P15 |
| b) | Generator AVR/metering CTs for generator circuit | Class 0.2 |
| c) | Metering CTs for 33 kV and 415 volts switchgear | Class 0.2 |
| d) | CTs for performance testing and low forward power relay core balance CTs | Class 0.2 |
| e) | Core balance CTs | Class PS |
| f) | Protection VTs | Class 3P |
| g) | VTs for generator metering, AVR synchronization | Class 0.5 |
| h) | VTs for performance testing and low forward power relays | Class 0.2 |

6.2.2 Details of Switchgear, Control and Relay Panels

Floor mounted, sheet steel simplex type control and relay panels with the following equipment mounted on them shall be supplied for Turbine, Generator Transformer and feeder control and protection.

The LT switchboard will be sheet steel enclosed cubicle of 3 mm sheet for doors and 2 mm sheet for rest of the panel, free standing, floor mounting type dust and vermin proof for operating at 415 V, 3 Phase, 4 wire, 50 Hz AC having alluminium bus bar of rating 2000 A and neutral of half the rating generally duly fitted and wired as required.

Turbine/ Generator Control/ Relay panels

| Sl.No | Description |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Generator & turbine control panels for 4 (four) incoming feeders and 4 (four) outgoing feeders to switchyard each equipped with: |
| 2 | 415 Volts ACB for incoming and outgoing feeders of suitable rating with all accessories, electro magnetic trip releases complete with shunt trip and under voltage coils. |
| 3 | Generator Bus Bars to be provided with the Bus Couplers |
| 4 | Ammeter of suitable range, flush mounting type with 3 way ammeter selector switch having off position for incoming panels and outgoing panels as required. |
| 5 | Voltmeter range 0-500V, flush mounting type with 3 way voltmeter selector switch having off position. |
| 6 | Power factor meter range 0.5-1-0.5 flush mounting type. |
| 7 | Reed type frequency meter range 45-50-55 Hz flush mounting type. |
| 8 | Kw meter range 0-600 KW flush mounting type size suitable for 3 phase, 3 wire system for incoming panels and 0-800 KW for out going panels as required. |
| 9 | Kwh meter flush mounting type suitable for 3 phase, 4 wire system micro processor based trivector meters of an accuracy class of 0.2 or better. |
| 10 | KVAR meter flush mounting type suitable for 3 phase, 4 wire system. |
| 11 | Triple pole over current relay, Earth fault relay. |
| 12 | Negative phase sequence relay. |
| 13 | Over voltage relay . |
| 14 | Under voltage relay. |
| 15 | Check Synchronizing relay. |
| 16 | Field failure relay. |
| 17 | Governor load oil pressure protection |
| 18 | Differential protection relay. |
| 19 | Reverse power relay. |
| 20 | Stator Earth fault. |
| 21 | Rotor Earth fault. |
| 22 | Any other relay required to make the system more safe and reliable. |
| 23 | Temperature meters |
| 24 | 8 points micro processor based temperature scanner for generator stator winding and generator bearing temperature with alarm and trip setting. |
| 25 | Window for annunciation shall be provided for following fault Annunciation System Differential relay trip, under voltage relay trip, field failure relay trip, stator earth fault relay trip Rotor earth fault relay trip, stator winding temp high, bearing temp high, Over current relay trip Reverse power trip Over voltage relay trip Negative phase sequence relay trip Generator bearing temp. trip Generator stator winding trip Over speed trip Governor oil pressure low Emergency shut down Spare window |
| 26 | Provision should be made to operate the Power station in isolated as well as in synchronization with the grid and other Hydel Stations. |

Controls

The following controls will be provided:

- a) Switches
- b) Emergency push button (mechanical).
- c) Generator anti-condensation heater ON & OFF switch.
- d) Panel heater ON and OFF switch.
- e) Alarm acknowledge push button.
- f) Healthy trip circuit test push button.
- g) Reset push button.
- h) Guide vane opening/ closing switches
- i) Breaker ON/OFF push buttons.
- j) Voltage raise/lower spring return switch.

NB : Necessary arrangements in the corresponding equipments will also be made

Indication Lamps

The following indications will be provided on the control panel:

Unit circuit breaker on
 Unit circuit breaker off
 Auto trip-electrical fault
 Auto trip-mechanical fault
 Governor low oil pressure
 Healthy trip circuit
 DC supply fail
 Turbine bearing temperature high
 Generator anti-condensation heater ON

The control panels for trans formers will normally have following provisions:

| Quantity | Description |
|----------|-------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Panel heater with suitable thermostat. |
| 1 | Breaker ON/OFF Switch |
| 1 | Breaker ON/OFF Indication |
| 1 set | Indicating instruments for current, voltage and winding / oil temperature (Necessary provision to be made in the transformers also) |

The following provisions will also be made:

Transformer Control Panels

| | |
|--------|---------------------------------------------------------------------------------------------------|
| 3 Nos. | 800 kVA 0.415 kV/ 33 kV transformer control panels each equipped with: |
| 1 | Ammeter of suitable range A, flush mounting type, with 3 way selector switch having off position. |
| 1 | Relays as required |
| 1 | Annunciations System |

33 kV feeder control panel for remote operation – 2 Nos. each equipped with

| Quantity | Description | Quantity | Description |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------------------------------|
| 1 set | Ammeter Volt meter, kW, kWh export import meters with selection switches etc. (energy meters shall be micro processor based trivector meters of an accuracy class of 0.2 or better) | 1 | Switch for ON & OFF of breaker |
| 1 set | Over current/ Earth fault relays, Reverse power relays, any other relay as required. | 1 | ON & OFF indication of breaker |
| | | 1 | Healthy trip Circuit indication |
| 1 set | Annunciations System | 1 | DC supply tail indication |

6.2.3 Synchronising Bracket

The synchronizing bracket will be mounted on left hand side of the panel and shall be of swinging type and will have following provisions:

| Quantity | Description |
|----------|-------------------------------------------------|
| 1 | Synchroscope |
| 1 | Double voltmeter |
| 1 | Double frequency meter |
| 1 | Synchronising check relay (25) with guard relay |
| 1 | Synchronising selector switch |
| 1 set | Auxiliary relays |
| 1 | Synchronising lamp |
| | (.) |

6.2.4 415 VOLTS AC DISTRIBUTION BOARD FOR UTILITIES

- i) 1 No. 100 Amps TPN Switch Fuse unit complete with necessary protection through HRC Fuses and all other accessories for receiving incoming supply from main Power Control Panel Board i/c 2 Nos. energy meters (electronic static).
- ii) 1 No. 100 Amps. 4 Pole Change Over Switch to select incoming power from Turbo Generating Power Control Panel and utility DG Set or any other source.
- iii) 1 No. MCB distribution board having following arrangement :-
 - (a) 2 Nos. 32 Amps. Outgoing feeders provided with 32 Amp. SPN Motor duty MCBs.
 - (b) 2 Nos. 32 Amps. Outgoing feeders provided with 32 Amp. 4 Pole Motor duty MCBs
 - (c) 6 Nos. 10 Amps. Outgoing feeders provided with 63 Amps. 4 Pole Motor duty MCBs.
 - (d) Necessary indicating and metering instruments including indication lamps.

- (e) Any other item / equipment required to make the system complete (KW meter, Voltmeter, Ampere meter).
- (a) The distribution board shall be completely wired. The scope of power and control cables is also included.
- (b) This distribution boards shall be attractive in design, mechanically strong, robust in construction and shall be totally enclosed in a mild steel cabinet of 3 mm. thickness. It shall have specified sets of MCBs and shall be vermin and dust proof complete with double door, lock and key arrangement. The doors shall be properly hinged. Cable entry shall be through suitable conduit pipe. The interior and exterior shall be painted with two coats of red oxide primer after 7 tank treatment and two coats of approved colour paint as per IS: with a minimum thickness of 60 microns. This distribution board shall be suitable to be mounted on concrete wall/columns or it may be mounted inside the wall so that its top surface is flush with the wall as the case may be. Suitable fixing arrangement such as nuts, bolts, washer, anchors shall be provided at suitable places for its proper fixing.
- (c) The isolator / MCBs units shall be of reputed make only and shall be complete and fully comply with latest edition of IS:2516-1977, IEC 157-1983. The operating handle shall be properly insulated from the live portion of MCCBs/MCBs and shall always be easily accessible. The MCCBs/MCBs used for A.C. supply and D.C. supply shall be designed for a fault level of 10 KA for 1 second. These S.D.B.'s shall be suitable for voltage variations as per latest relevant I.S.S. Suitable earthing arrangement shall also be provided with sub distribution boards.

N.B. The Control Panel shall also have the provision of synchronizing Mai Phase –I Power station with Mai-II and Tago Power stations and with the Grid.

The above description is indicative and a broad outline of the control, metering and protection system required for the power station..

Drawing of the above control panel showing layout arrangement of various measuring, indicating, protection equipments and annunciation system shall have to be got approved from the Engineer-in-Charge prior to its manufacture. Contractor shall have detailed discussion with the competent authority and Engineer-in-Charge about the actual functional requirements of the panel board before designing the control panel boards.