VOLUME IV-B

SECTION – 5

ELECTRICAL CONTROL & RELAY PANELS

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CONTENTS

CLAUSE NO.	DESCRIPTION
1.0	SCOPE OF SUPPLY
2.0	SYSTEM CONCEPT
3.0	SPECIFIC REQUIREMENTS
4.0	TESTS
DATASHEET-A	ELECTRICAL CONTROL & RELAY PANELS
ANNEXURE–A	LIST OF MINIMUM PROTECTIONS
ANNEXURE–B	LIST OF ANNUNCIATIONS TO BE INCLUDED IN DDCMIS/ EDMS FOR GENERATOR, GEN. TRANSFORMER, ST. TRANSFORMER, UNIT TRANSFORMER& ICTS
ANNEXURE–C	INDICATIVE LIST OF ANNUNCIATION TO BE PROVIDED IN EDMS FOR INPLANT POWER DISTRIBUTION
ANNEXURE–D	LAPTOP CONFIGURATION OF COMPAQ NOTEBOOK 327

1.0 SCOPE OF SUPPLY

1.1 Electrical Relay Panels as listed below, in accordance with this specification

	Control & Relay Panels	Type	Quantity	Location
1.1.1	Generator, Generator Transformer (GT), Unit Transformer (UT1 & UT2) & Station Transformer (ST1 & ST2) Relay Panel	Simplex	One (1) for each equipment	Control Room
1.1.2	Back-up Control Panel (ECP)	Mosaic Desk cum PANEL	One (1) Set	Control Room.

1.2 Supply, mounting and wiring of all equipment, devices and accessories.

1.3 Floor channel sills, vibration damping pads and kick plates for Panels complete with holding down bolts and nuts.

1.4 Mandatory spares.

2.0 SYSTEM CONCEPT

2.1 The system concept and plant control philosophy has been described in general elsewhere in this specification. Bidder shall develop 'Detail Plant Operation and Control philosophy' in line with advance power plant practice and submit for Owner's/Purchasers approval.

2.2 Main plant electrical system shall be controlled and monitored from Station DDCMIS/EDMS through dedicated operator's consoles. However one Back up electrical control panel for unit shall also be provided in the control room. The back-up control panel shall be stand-alone in mosaic grid configuration consisting of Generator manual

synchronizing equipments, HT Switchgear manual synchronizing equipment, governor and excitation control, metering equipment, breaker control switches for GTs, 11kV,3.3 kV & 415V Unit / Station switchgear incomers, tie and outgoing non-motor feeder breakers, synchronizing selector switches, Auto-Manual, Remote-Local and other selector switches as required along with annunciation windows, indications and mimic diagram (from 400kV level to 415V level). Cooler control for Generator Transformers, Unit Auxiliary transformer, Station auxiliary transformer, Cooler control & Tap changer control for Station Transformers and Unit Transformers in Remote- Manual mode shall also be provided in the Back-up Control Panel. DGs shall also be control from DDCMIS/EDMS as well as Electrical control panel. OTI & WTI of GT, ST, UT, SAT and UAT shall also be repeated in Back up control panel in addition to EDMS/DDCMIS.

2.3 Operation, control and monitoring of the following Switchgears and associated transformers are not to be included in the Back-up control panel located in control room.

(a) 11 kV & 3.3 kV CHP Switchgear.

(b) 11 kV & 3.3 kV Raw Water Switchgear.

(c) 11kV & 3.3 kV AHP Switchgear.

(d) EHV sub-station (Generator bay breakers and station transformer bay breakers), AHP, CHP, Plant water system.

(e) The metering available on the back-up control panels shall include but not be limited to the following:

(i) GT HV Current and voltage, ST HV Current and voltage, Generator Watt, VAR, Frequency, Negative Sequence current, R-Y-B phase current, Power Factor and Digital Tri- Vector meter, MEAA meters.

(ii) Winding / Oil temperature for Generator Transformers, Unit transformers, Station transformers and 11kV/3.3kV Unit and

Station Auxiliary Transformers. Tap poison of GT,UT, UAT, ST, SAT shall also be made available on ECP

(iii) Line voltage, line current and power for each, 400kV switchyard Bus 11kV and 3.3 kV and 415 V incomer breakers of Unit and Station boards. Metering shall be done through MEAA meters as per CEA guideline.

(iv) Current of outgoing non-motor feeder breakers of Unit and Station boards

(v) Voltage for each 11kV, 3.3 kV and 415 V bus of Unit and Station boards / ESP Boards.

(vi) Voltage for DC and UPS system.

(vii) DG set parameters.

(viii) Excitation console, Synchronsing console.

(ix) Two separate synchronizing consoles shall be provided for
a. Generator & tie breaker.
b. All 11kV, 3.3kV breakers

2.4 The status of at least the following shall be monitored. Indicating lamps / alarm windows as applicable, shall be provided

(a) Status (ON, OFF and Trip) of 400 kV GT & ST breakers & associated isolators.

(b) Status (ON, OFF & Trip) of all 11 kV, 3.3kV and 415V breakers, except breakers for motor feeders of Unit and Station boards.

(c) Status (ON, OFF & Trip) of UPS & DC system

(d) Status (ON, OFF & Trip) of Generator Field breaker

(e) Excitation system status and Exciter abnormal conditions

(f) Operation of all protection relays (including trip circuit supervision relay) for 11 kV, 3.3 kV and 415 V breakers of Unit and Station boards except for motor feeder breakers.

(g) Operation of under voltage relays / fuse fail relays of bus and line PTs for 11kV and 3.3 kV and 415 V Unit and Station boards.

(h) Operation of protection relays of Generator, Generator Transformer, Unit Transformers, Station Transformer, Unit Auxiliary Transformer, Station Auxiliary Transformer.

(i) Operation of protections connected to CTs mounted on bushing of GT 400kV.

(j) Operation of transformer protections mounted on Generator Transformers, Unit Transformers, Station Transformers and all HT and LT Unit and Station auxiliary transformers including OLTC/ cooler trouble.

(k) Status (ON, OFF, Auto, Manual) of Generator Transformer and Unit Transformer, Station Transformer cooling fans and pumps.

(l) Auto change-over status (successful, fail, incomplete) of 11 kV, 3.3 kV and 415 V Unit and Station boards

Grouping of alarms are subject to approval of Owner / Owners engineer, Bidder shall prepare and submit detail Control, metering and annunciation scheme for the equipment controlled/monitored by back-up control panels for review and approval of Owner.

3.0 SPECIFIC REQUIREMENTS

3.1 CONSTRUCTION

3.1.1 The Control and Relay Panels shall be totally enclosed, floor mounted, free-standing, dead-front assemblies conforming to IP-52 degree of protection. The Back-up control panel shall be Mosaic grid type. Control Panels shall be desk cum panel type, consisting of a line up of panels with control switches mounted on the desk part. Instruments/meters shall

be mounted on the vertical portion with annunciator windows on the top. All control switches, selector switches etc. shall be suitable for mounting on mosaic grid.

3.1.2 Design, material selection, and workmanship shall be such as to present a neat appearance outside and inside with no welds, rivets, screws or bolt heads apparent from the exterior surface of the Boards. The boards shall have a smooth and uniform matt finish, free from scratches, dents and other imperfections.

3.1.3 The panels shall be liberally sized so as to provide spacious layout of equipment and devices with sufficient working space in between.

3.1.4 Each panels may consist of a number of panels mounted side-by-side, in which case, these shall be bolted together to form a compact unit. Where two panels meet, the joints shall be smooth, close-fitting and unobtrusive.

3.1.5 The panels shall be of folded sheet steel construction, assembled on channel/angle base plates with anti-vibration mountings.

3.1.6 The panels shall be fabricated of minimum 2 mm thick sheet steel, free from all surface defects. The boards shall have sufficient structural reinforcement to ensure a plane surface, to limit vibration, and to provide rigidity during shipment and installation.

3.1.7 All doors and removable covers shall be provided with neoprene gaskets all around and latches sufficiently strong to hold them in alignment when closed. The door operating handle shall have locking arrangement.

3.1.8 All control panels shall have rear door with concealed type hinges and pad-locking arrangement. Doors shall be grounded by flexible copper braid.

3.1.9 The panels shall be complete with vibration damping pads, stainless steel kick plates, floor channel sills, anchor bolts, and other necessary hardware for mounting.

3.2 EQUIPMENT MOUNTING

3.2.1 All instruments, relays, switches, etc. mounted on the front face of the panels shall be flush or semi-flush type.

3.2.2 No equipment shall be mounted on panel door.

3.2.3 All equipment shall be so mounted that removal and replacement may be accomplished individually without interruption of service to others.

3.2.4 All equipment inside the panels shall be so located that their terminals and adjustments are readily accessible for inspection or maintenance.

3.2.5 In case cut-outs are provided on any panel for future mounting of equipment, the same shall be properly blanked off.

3.3 NAME PLATE

3.3.1 Nameplates shall be provided on each panel and on each instrument or device mounted in the panel.

3.3.2 The material of the nameplates shall be lamicoid or approved equal, 3 mm thick, with white letters on black background.

3.3.3 The nameplates shall be held by self tapping screws. The size of nameplate shall be approx. 20 mm x 75 mm for equipment and 40 mm x 150 mm for panels.

3.3.4 Nameplates for panels shall be provided both on the front and the rear.

3.3.5 Nameplates for all devices shall be located below the respective devices.

3.3.6 Instrument and devices mounted on the face of the control boards shall also be identified on the rear with the instrument or device number. The number may be painted on or adjacent to the instrument or device case.

3.4 ILLUMINATION, SPACE HEATING AND RECEPTACLES

3.4.1 Each panel shall be provided with interior fluorescent tube with door switch, space heater with thermostat and switch and 5A, 3 pin receptacle with plug. Third pin of the socket shall be effectively grounded through the metallic structure.

3.4.2 Tube, heater and receptacle circuits shall be suitable for available A.C. supply and furnished with individual ON-OFF switch.

3.4.3 The tube shall be located at the ceiling and guarded with protective cage. Space heater shall be located near the floor so as not to pose any hazard to service personnel.

3.5 AC/DC POWER SUPPLY

3.5.1 Necessary A.C and D.C supplies to each control board, as required for control and service, shall be arranged by the bidder. Single feeder may be arranged for A.C supply but duplicate feeders shall be arranged for D.C supply. These switches shall be mounted inside the panel.

3.5.2 Alarm relays with reverse flag shall be provided to annunciate failure of main incoming A.C and D.C supplies and annunciation D.C supply in each panel.

Lamp indications shall be provided individually for main D.C supply-1 fail, main D.C supply-2 fail, and panel annunciation D.C supply fail. A common A.C electric bell shall be provided to give an audible alarm in case of failure of D.C supply-1/D.C supply-2/annunciation D.C. supply in any panel. A common push-button shall also be provided for cancellation of lamp indication and audible alarm.

3.5.3 Isolating switch fuse units/ MCB shall be provided for the incoming AC/DC power supplies. Bus wires shall be run for power distribution to different panels. Power supply isolation switches shall be 4-pole, single throw, for A.C. (considering single feeder) and 2-pole, double throw with OFF, for D.C.

3.5.4 Fuse and link shall be provided for individual circuits for protection and also for isolation from bus wire without disturbing other circuits.

3.5.5 The fuse requirements in each panel shall be grouped in easily accessible fuse blocks or distribution panel. The groupings shall be done in a neat and orderly fashion.

3.6 WIRING

3.6.1 The boards shall be fully wired at the factory to ensure proper functioning of control, protection and metering schemes. When panels are arranged to be located side-by-side, all inter-panel wiring shall be carried out by longitudinal troughs extending the full length of the board.

3.6.2 All spare contacts of relays and switches shall be wired up to terminal blocks.

3.6.3 Wiring shall be done with flexible, heat resistant, 1100V grade, PVC insulated, switch board wires with stranded copper conductor. The minimum size of the wires shall be 2.5 Sq. mm. for current circuits and 1.5 Sq. mm. for control and voltage circuits.

3.6.4 Each wire shall be ferruled by plastic tube with indelliable ink print at both end having terminal block no., terminal no. as per approved wiring diagram.

3.6.5 All wire terminations shall be made with insulated sleeve, solderless type tinned copper lugs. Wire shall not be tapped or spliced between terminals.

3.6.6 Wiring shall be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on the termination.

3.7 TERMINAL BLOCK

3.7.1 Terminals shall be box-clamp and clip-on type, suitable for terminating up to two wires of minimum 2.5 sq. mm. cross section and provided with marking strips. Terminals for CT secondary leads shall have built-in disconnecting links with facility for shorting. Terminals for CT leads should

have adequate cross section for terminating associated CT leads. Terminal box for generator protection and switch yard panel shall be box spanner driven stud type.

3.7.2 Not more than two wires shall be connected to one terminal. If necessary, a number of terminals shall be jumpered together to provide wiring points.

3.7.3 Each terminal shall be identified with designation as per approved schematic. At least 20% of the total number of active terminals shall be furnished as spare in each panel.

3.7.4 The wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

3.7.5 The terminal blocks shall be located to allow easy access and also to suit floor openings for cable entry.

3.7.6 Terminal blocks shall generally be mounted vertically with adequate spacing (not less than 100 mm) between adjacent rows.

3.7.7 The bottom of the terminal blocks shall be at least 200 mm above the incoming cable gland plate.

3.8 CABLE ENTRY

3.8.1 The panels shall have provision of cable entry from the bottom. Bottom plate shall be provided to make entry dust-tight.

3.8.2 The panels shall have provisions inside for fixing the multi-core cable glands. Cable glands shall be double compression type. Cable gland support plate shall be 4 mm thick and mounted not less than 200 mm above floor level.

3.9 GROUNDING

3.9.1 50 x 6 mm TINNED COPPER ground bus shall be provided in each panel, extending along the entire length of the assembly.

3.9.2 The ground bus shall have two-bolt drilling with GS bolts and nuts at each end and shall be suitable for connection to 50 x 6 mm G.S. flat.

3.9.3 The ground bus shall be bolted to the panel structure and effectively ground the entire assembly. The cases of meters, relays and switching devices shall be grounded through the steel structure.

3.9.4 Whenever a circuit is grounded, a single wire from the circuit shall be run independently to the ground bus and connected to it.

3.9.5 Potential and current transformer neutrals shall be grounded only at the terminal blocks where they enter the control boards from the transformers.

3.10 PAINTING

3.10.1 Inside of all boards shall be painted white. The outside surface shall be finished with two coats of synthetic enamel paint, the shade of which shall be subject to approval by the Purchaser. Base frames shall be painted black. Paint shade shall be RAL7032.

3.11 MIMIC DIAGRAM

3.11.1 Mimic diagram of electrical connections shall be furnished on the front face of Back-up control panels.

3.11.2 Mimic buses shall be at least 3 mm thick and 10 mm in width colour coded to denote different voltages.

3.11.3 The mimic representation, colour and size of diagram shall be subject to approval of the Owner.

3.11.4 Semaphore indicators shall be provided for remote indication of isolator/earthing switch position. The indicator shall be suitable for semi-flush mounting with only the front disc projecting out and with terminal connection from the rear.

3.11.5 Semaphore indicators shall be such that when the supervised object is closed, the pointer of the indicator shall take up a position in line with the

mimic busbars and when the supervised object is open, the pointer shall take up a position at right angles to the mimic busbar. In case of supply failure, the pointer shall take up an intermediate position.

3.12 SWITCHES

3.12.1 Switches shall be dust protected, heavy duty, switchboard type, complete with escutcheon plate. Contacts shall be silver surfaced and rated minimum 10A at operating voltage. Miniature switches suitable for mounting on mosaic grid shall be provided for back-up control panel.

3.12.2 The switch details and type of handle shall be as given below:

Sr. No.	Application		Switch type
(a)	Breaker	:	120 Deg., 3-position (TRIP/NORMAL / CLOSE) Control Switch spring return to normal, non-lockable, device, l pistol grip handle.
(b)	Auto/Manual Selector Switch	:	120 Deg., 2-position (AUTO / MANUAL), stay-put type, non-lockable, spade handle.
(c)	On-Off Switch / Local-remote Selector Switch	:	90 Deg., 2-position (ON/OFF OR LOCAL / REMOTE) stay-put type, non-lockable, spade handle.
(d)	Synchronizing Selector Switch for Swgrs.	:	120 Deg., 4-position (OFF / INCOMER-1 / BUS-SECTION / INCOMER-2), stayput type, pistol grip handle.
(e)	Trip Selector	:	120 Deg., 3-position (INCOMER-1 / BUS-SECTION / INCOMER-2), stayput type, pistol grip handle

Sr. No.	Application		Switch type
(f)	Meter Selector Switches	:	4-position (OFF/R/Y/B for ammeter selector switch and OFF/RY/YB/RB for voltmeter selector switch), maintained contact, Stayput type, knob handle. Ammeter selector switches shall have make-before-break contacts. For in-plant power distribution panel miniature version shall be provided
	NOTE: The above switches and any other type, if found necessary during detail engineering, shall be subject to approval of the purchaser and shall have to be provided by the bidder to adhere to good engineering practice.		

3.13 PUSH BUTTONS

3.13.1 Push buttons shall be oil tight, heavy duty, push to actuate type, with coloured button and inscription plate marked with its function. The colour of ON and OFF push buttons shall be RED and GREEN respectively. All RESET push buttons shall be black.

3.13.2 Each push button shall have minimum 2 NO + 2 NC contacts, rated 10A at operating voltage.

3.13.3 Push button shall be shrouded type except for emergency trip button which shall be mushroom type for easy identification.

3.14 LAMPS

LED lamp shall be made in accordance with InP Technology (Aluminium Indium Gallium Phosphide Technology). The body shall be made of Poly Carbonate Unbreakable Lens. LED shall be protected by inbuilt fuse with surge suppressor or leakage voltage glow protection. LED circuit shall be PCB mounted. Intensity shall be greater than 200 mcd.

3.15 OPERATING RANGE

Generally, all instruments and relays shall be suitable for operation on 1A or 5A C.T. secondary circuits and/or 110V V.T. secondary circuit. Meters in mosaic type back-up control panels shall be suitable for 4-20mA input from transducers.

3.16 METERS

3.16.1 Indicating instruments (96 x 96 mm) shall be switchboard type, with 240-degree scale, anti-glare glass and accuracy class of ± 1% full scale. Each meter shall have zero adjuster on the front. Meters shall have provision for zero-adjustment from front of the panel. All indicating instruments shall be enclosed in dust-tight cases suitable for tropical use.

Motor ammeter shall have extended suppressed end-scale range to indicate starting current (6-8 times full load).

3.16.2 Metering for Energy Audit & Accounting

(a) On Generator terminal, HV side of GT,HV and LV side of ST & UT, 11/ 3.3kV side for LT Auxiliary transformers, 11kV tie busduct (one side), all outgoing feeders, incomers for HT switchboards, I/C of LT switchboards, energy accounting and audit meters shall be installed as per latest CEA Regulation on Installation and Operation of Meters.

The meters shall be of 0.2S accuracy class and the associated CTs shall be of 0.2S accuracy class and PTs shall be of 0.2 accuracy class.

The meters for EHV side of ST shall be located on ECP and LV side of ST shall be located on Incomer panel of respective switchgears.

For UT, meters for HV side shall be located on the ECP at control room and the meters for LV side shall be located on incomer panel of respective switchgears.

For LT Auxiliary Transformers the meters for HV side shall be located on outgoing feeder panel of the HV switchgear. For all LT switchboards, MEAA meters shall be located on I/C panel of respective switchboard.

(b) Energy meter shall be three phase multifunction, digital type with communication port for DDCMIS interface. The energy meter shall be located in respective switchgear cubicle of all incomers and outgoing feeders, motor feeders.

(c)

(i) The energy accounting and audit meters shall be suitable for measurement, recording and display of cumulative active energy with date and time.

(ii) The energy accounting and audit meters may also have the facility to measure, record and display one or more of the following parameters depending upon the energy accounting and audit requirement. All parameters excluding instantaneous electrical parameters shall also be stored in memory.

a. Apparent power

b. Phase wise kilowatt at peak kVA

c. Phase wise kVA (reactive) at peak kVA

d. Phase wise voltage at peak kVA

e. Power down time

f. Average power factor

g. Line currents

h. Phase voltages

i. Date and time

j. Tamper events

(iii) The energy accounting and audit meter shall have data storage capacity for at least 35 days in a non-volatile memory for the data (ii) a to j indicated above

(iv) Energy accounting and audit meters shall have facility to download the parameters through meter reading instruments as well as remote transmission of data over communication network

(v) The meters shall have a non-volatile memory in which the following shall be automatically stored:

a. Average frequency for each successive 15-minute block, as a two digit code (00 to 99 for frequency from 49.0 to 51.0Hz).

b. Net Wh during each successive 15-minute block, upto second decimal, with plus/minus sign.

c. Cumulative Wh at each midnight, in six digits including one decimal.

d. Cumulative VArh for voltage high condition, at each midnight, in six digits including one decimal.

e. Cumulative VArh for voltage low condition, at each midnight, in six digits including one decimal.

f. Date and time blocks of failure of VT supply on any phase, as a star (*) mark.

(vi) The meters shall store all the above listed data (from (v) a to f) in their memories for a period of at least ten days. The data older than ten days shall get erased automatically. Each meter shall have an optical port on its front for tapping all data stored in its memory using a hand held data collection

device. The meter shall be suitable for transmitting the data to remote location using appropriate communication medium.

(vii) The active energy (Wh) measurement shall be carried out on 3-phase, 4-wire principle, with an accuracy as per class 0.2 S of IEC 687/IEC-62053-22. The energy shall be computed directly in CT and VT secondary quantities, and indicated in watt-hours.

(viii) The VAr and reactive energy measurement shall also be on 3- phase, 4-wire principle, with an accuracy as per class 2 of IEC-62053- 23 or better. The VAr and VArh computation shall be directly in CT and VT secondary quantities. There shall be two reactive energy registers, one for the period when average RMS voltage is above 103% and the other for the period the voltage is below 97%.

(ix) The meters shall also display (on demand), by turn, the following parameters :

a. Unique identification number of the meter

b. Date

c. Time

d. Cumulative Wh register reading

e. Average frequency of the previous 15-minute block

f. Net Wh transmittal in the previous 15-minute block, with +/- sign.

g. Average percentage voltage.

h. Reactive power with +/- sign

i. Voltage-high VArh register reading

j. Voltage-low VArh register reading.

(x) The three line-to-neutral voltages shall be continuously monitored, and in case any of these falls below 70%, the condition shall be suitably indicated and recorded. The meters shall operate with the power drawn from the VT secondary circuits, without the need for any auxiliary power supply. Each meter shall have a built-in calendar and clock, having an accuracy of 30 seconds per month or better.

(xi) The meters shall be totally sealed and tamper-proof, with no possibility of any adjustment at site, except for a restricted clock correction. The harmonics shall be filtered out while measuring Wh, Var and VArh, and only fundamental frequency quantities shall be measured/computed.

All coal mill feeders shall be provided with indicative type MW meters.

3.16.3 DC ammeters, wherever required, shall be provided with external shunt if the current exceeds 5A. The rated voltage drop for the shunts shall be 75 mV.

3.16.4 The range of frequency meters shall be from 45 to 55 HZ, with 50 HZ. at the centre of the scale.

3.16.5 The range of power factor meters shall be from 0.5 lag to 0.5 lead, with unity power factor being at the centre of the scale.

3.17 <u>INTEGRATING METERS</u>

3.17.1 Integrating meters such as Watt-hour Meters, VAR Meters, Polyvector Meters, and Maximum Demand Indicating (MDI) Meters etc shall be static type, 2 element type, suitable for 3 phases, 3 wire connections, CT & VT operated. These meters shall preferably be furnished in draw out type cases. If furnished in non-draw out cases necessary test blocks with CT - shorting and CT/VT isolation facilities shall be furnished. All watt-hour meter shall be provided with pulse output for DDCMIS interfacing.

3.18 RELAYS

3.18.1 Relays shall be furnished in rectangular /square dust tight, drawout or rugged plug in type, flash /semi flash mounting cases. Test blocks shall be provided for all protective relays

3.18.2 The hardware design for protection and associated equipment shall use latest State–of–the-art technology and shall generally be integrated numerical/digital, modular in nature. Where design is based on microprocessor technology adequate self testing/ monitoring/diagnostic facilities shall be provided.

3.18.3 The design of the integrated generator protection shall be based on numerical techniques. 2x100% integrated numerical protection along with other standard protections shall be provided. Separate numerical relay shall be provided for overall differential protection (87OA) of Generator, Generator transformer and Unit transformer. All the analogue signals will be converted into digital data, using analogue-to- digital conversion circuit. The data will be processed by a microprocessor, which will perform digital signal processing and executes various protection algorithms. The relay shall be provided with one no. Laptop-PC (as per detail in Annexure-F) for user interfaces, monitoring, testing facility etc. In addition to above an unitized PC based with 21" colour monitor shall be provided for configuration and diagnostics of all the numerical relays. Such Station shall be complete with Licensed version of all software for analysis and retrieval of disturbances occurred in the system/equipment. Data/Signal from numerical relays shall go to station DDCMIS through communication protocol and shall be time synchronized through the same. All the data from the numerical relay shall be communicated to DDCMIS. Generator transformer, station transformers and unit transformers shall also be provided with integrated numerical protection relays 1 x 100% and shall have the features specified above. The protections shall be divided in two independent groups.

3.18.4 Generator MW, PF, MVAR, MWH and MVARH meter shall be provided in Electrical Control Panel.

3.18.5 The relay shall be designed to perform satisfactorily under highly noisy electrical environment. Sufficient degree of high frequency disturbance

immunity and impulse voltage withstand capacity shall be built into electronic designs as stipulated in relevant standards.

3.18.6 Relay characteristics shall be coordinated for proper functioning in conjunction with associated relays. The bidder shall co-ordinate the characteristics of all relays to suit the system and equipment parameters. Relay ranges and settings shall be selected accordingly. Some of the relays for generator and generator transformer protection may be back-up for switchyard relays and the settings of these relays shall be properly coordinated with the settings of the later.

3.18.7 The relays shall function satisfactorily being located in non-AC physical environment.

3.18.8 All protections shall be furnished compete with necessary auxiliary, supervisory, lock out etc, relays. Suitably separate sets of single phase auxiliary C.T with multiple taps shall be provided with relay whenever required

3.18.9 Visual and audible alarm annunciation shall be initiated in the event of operation of protective/supervisory relay.

3.18.10 D.C circuits shall be supervised by relays.

3.18.11 Tripping shall be done through High-speed lock out relays.

3.18.12 Required protections have been generally been indicated in Annexure-C for Bidder's reference.

3.18.13 All the trip coils of the H.T. breakers shall be supervised. (Breakers in switchyard.)

3.19 <u>AUXILIARY DEVICES</u>

3.19.1 The bidder shall furnish, install, and wire-up all auxiliary devices such as interposing current or voltage transformers, timing/ switching/ lockout/ auxiliary relays as required for the proper functioning of the schemes offered.

3.19.2 Disturbance Recorder

3.19.3 In addition to disturbance recorder available with numerical relays, a separate stand alone disturbance recorder with numerical protection relay shall be provided.

3.20 ANNUNCIATION SYSTEM

3.20.1 Each control panel shall be provided with an annunciator window board. The annunciator boards shall be back-connected and suitable for semi-flush mounting.

3.20.2 The annunciation system shall be solid state type with optical isolation for input signals. The functional requirements shall be as per Annexure-B.

3.20.3 Each annunciator group shall be independent, complete with its own power supply, audible alarms, acknowledge-reset-test buttons and other necessary accessories.

3.20.4 The annunciator shall be non-integral type with hardware box mounted separately for easy access and maintenance.

3.20.5 Hooters with distinctly different tones shall be used for trip, non-trip, and ring back annunciations.

3.20.6 The window size shall be same as existing control panel. The Character height shall be 5 mm.

3.20.7 The annunciation system shall be suitable for operation from both NO and NC type initiating contacts.

3.20.8 Minimum 20% annunciation channels and window facia shall be provided as spare on each panel, with a minimum of two (2).

3.20.9 The annunciations to be provided on each control board shall be as per enclosed annexures and subject to approval of the Purchaser.

3.20.10 For annunciator, details input shall be given during detail engineering stage by owner/purchaser.

3.21 TRANSDUCERS

Transducers shall be provided for conversion of AC electrical quantities such as voltage, current and power. Transducers shall be of low burden type having 4 – 20 mA DC linear galvanically isolated output compatible with secondary indicating instrument. Transducer shall be dual channel type. Transducers shall be suitable for 220V DC auxiliary supply. Accuracy class of transducer shall be 0.2.

3.22 GENERATOR SYNCHRONISATION

3.22.1 Generator Synchronizing shall be done manually through synchronizing relays. Synchronizing equipments as detailed under from electrical Control Panel provided in control room for control of Electrical Auxiliary System. Also auto synchronizer shall be provided for synchronizing of Generator in ATRS system. For other LT Boards synchronizing facility to be provided on respective LT SWBDs. In addition to that synchronizing facility to be provided for other plant auxiliary H. T. breakers.

3.22.2 The hardware to be mounted on electrical control panel shall necessarily include dual voltmeters, dual frequency meters, synchroscope, synchroscope cut IN / cut OUT switch, Double White Lamp for bright lamp synchronization, Green lamp for synchronism in limit indication, Amber lamp for operation with / without synchronization relay.
Two separate synchronizing consoles shall be provided for
a. Generator & tie breaker.
b. All 11kV, 3.3kV breakers

4.0 TESTS

4.1 Each panel shall be completely assembled, wired, adjusted, and tested at the factory prior to shipment.

4.2 ROUTINE TESTS

4.2.1 The tests shall include wiring continuity tests, insulation tests before and after high voltage test, and functional tests to ensure operation of the control / protection / metering schemes and individual equipment.

4.2.2 All switches, meters, relays and other devices shall be tested and calibrated in accordance with relevant IEC/IS standards.

4.2.3 Type test certificate on any equipment, if so desired by the Purchaser, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

4.3 TEST WITNESS:

Test shall be performed in presence of Owner/Purchaser's representative so desired by the Owner/Purchaser. The Contractor shall give at lest fifteen (15) days advance notice of the date when the tests are to be carried out.

ELECTRICAL CONTROL & RELAY PANELS

DATA SHEET – A

SR.NO.	ITEM	
1.0	**A.C./D.C. POWER SUPPLY**	
1.1	SYSTEM VOLTAGES	
	All systems shall be designed for satisfactory operation on the following power supply :	
1.1.1	A.C. Supply	415/240V, 3 Phase, 50 Hz, 4 Wire, effectively ground system.
		Fault level 50 kA rms symmetrical.
1.1.2	D.C. Supply	220V, 2 Wire, ungrounded.
		Fault level 25 kA. Indicative only; actual value will be decided by the Bidder, after substantiating the same by calculation.
1.2	PERMISSIBLE VARIATION	
	Equipment and accessories shall be suitable for operation over the entire range of voltage/frequency variation as listed below:-	
1.2.1	A.C. Supply	
(a)	Voltage	± 10%
(b)	Frequency	± 5%
(c)	Combined Voltage & Frequency	± 10% (absolute sum)

SR.NO.	ITEM	
1.2.2	D.C. Supply	
(a)	Voltage	± 10%

LIST OF MINIMUM PROTECTIONS

ANNEXURE – A

The purpose of this sub-section is to describe the design criteria to be used in the selection and application of a protective relaying system for the electrical generation and distribution power system.

The following general requirements apply to all protective relaying applications:

1.0 The protective relay system shall be designed to remove or alarm abnormal operating occurrences occurring on equipment designed for electrical power generation, voltage transformation, energy conversion, and transmission and distribution of electrical power. The system shall operate as rapidly as possible, consistent with maintaining proper discrimination, to minimize damage to equipment and disturbance to the electrical system as a whole.

2.0 To limit damage to faulted equipment.

3.0 Minimize possibility of fire or explosion.

4.0 Minimize hazard to personnel.

5.0 The protective relaying system shall be a coordinated application of either individual relays, multi-function relays, or a combination of individual and multifunction relays. Numerical microprocessor based protective relays with redundant processors. For each monitored abnormal condition, there shall exist a designated primary device for detection of that condition. A failure of any primary relay shall result in the action of a secondary over lapping scheme to detect the effect of the same abnormal occurrence. The secondary relay may be the primary relay for a different abnormal condition. Alternate relays may exist which detect the initial abnormal condition but which have an inherent time delay so that the alternate relays shall operate after the primary and secondary relays. Similar to secondary relays, the alternate relays may be primary relays for other abnormal conditions. All protective relays shall be selected to coordinate

with protective devices supplied by manufacturers of major equipment and the thermal limits of electrical conductors and electrical equipment, such as transformers and motors.

6.0 Auxiliary relays, supervision relays, timers etc as required for completeness of the scheme shall be provided. For lockout relays, necessary supervision shall be provided.

7.0 Minimum accuracy class shall be as follows:

7.1 Current Transformer

(a) Class PS for differential relaying

(b) Class 5P20 for other relaying

(c) Class 0.2S, 5 Amps and ISF <5 for metering.

(d) For EHG performance testing, Lower forward power protection (37) and Reverse Power protection (32), CT shall be 0.2S class accuracy class.

7.2 Voltage transformer

(a) Class 0.2 for metering

(b) Class 3P for protection

(c) For EHG performance testing, Lower forward power protection (37) and Reverse Power protection (32), VT shall be 0.2 class accuracy class.

8.0 **UNIT PROTECTION PHILOSOPHY (INCLUDING GT & UT)**

The protection of each generator shall be divided into two groups. Both groups shall be, physically and electrically separated into two separate and independent systems realized using two nos. Integrated numerical relays. Each group shall be receiving all AC and DC signals from two separate sets of devices. Similarly, these two groups will derive DC

supply from two separate feeders. The trip relays in each group shall be tripping the respective circuit breakers through both trip coils I & II. Dead machine protection shall receive their D.C power supply from station DCDB.

The Generator, GT and UT protections will be classified to initiate the following three classes of tripping:

(a) CLASS-A trip mode for critical electrical faults in the Generator system.

(b) CLASS-B trip mode for non-critical electrical faults in the Generator system.

(c) CLASS-C trip mode for abnormal operating conditions and system disturbances.

(a) CLASS -A TRIP

Class A group shall operate on all electrical faults which need the complete shutdown of both the turbine and generator simultaneously and instantaneously. It trips out the generator transformer breaker, de-excites the unit and initiates auto changeover from unit to station auxiliary supply for 11 / 3.3 kV unit auxiliaries and trips out certain nonessential 11 /3.3 kV auxiliaries.

(b) CLASS-B TRIP

In this mode of tripping, the turbine is shut down first and the generator is tripped subsequently by the low forward power relay or reverse power relays. This is to ensure that the unit does not over speed on tripping due to the trapped steam in the turbine. This mode of tripping is adopted for all mechanical faults and noncritical electrical faults, which are considered safe to afford the time delay.

(c) CLASS-C TRIP

In this mode of tripping, the generator is isolated from the power

system by tripping the circuit breaker connecting the state grid. The set runs with HP/ LP bypass system and generator continues to run on house load to feed unit auxiliaries through Unit Transformer. All necessary relays, auxiliary relays, etc for the same shall be considered. The successful bidder shall establish and submit the logic diagram of class A, B & C trips. For house load, operation the grid condition or abnormalities in addition to machine requirements shall be considered. The protections envisaged in GRP are listed below. Also main one line diagram indicating the various protections envisaged is attached for reference. Both the list and the drawing shall be considered complementary to each other and all the protections indicated shall be provided. Contractor shall include any additional protections deemed needed by him for the equipment offered even if not indicated in the list and the drawings. Numerical relays shall be provided for main protections of Generator, GT and UT. However, static relays are only required where multifunction numerical relays does not cover dead machine and any other protection.

The following are the minimum specified protection functions are required for Generator, Generator transformer and Unit transformer. The protections shall be furnished with accessories like timers, auxiliary relays, interposing CTs & VTs, tripping relays etc. as required to fulfil the functional requirement of control, indication, interlock & protection.

SR. NO.	PROTECTION FUNCTION	DEVICE NO.
8.1	INTEGRATED GENERATOR AND GENERATOR TRANSFORMER PROTECTION	
8.1.1	Generator Differential Protection	87G
8.1.2	Dual Zone phase distance protection (minimum impedance) for phase back-up(Pre-Synchronizing and Post synchronizing)	21G-1 & 2
8.1.3	Generator Low Forward Power protection	37G
8.1.4	Generator Overload protection	51G

SR. NO.	PROTECTION FUNCTION	DEVICE NO.
8.1.5	Generator Over Voltage protection	59G
8.1.6	Generator 95% Stator Earth Fault protection	64G1
8.1.7	Generator 100% Stator Earth Fault protection	64G2
8.1.8	Generator Stator Inter-turn fault protection	87GI
8.1.9	Generator Loss of excitation protection	40G
8.1.10	Generator Under Voltage Relay	27G
8.1.11	Generator Negative Sequence protection	46G
8.1.12	Generator Reverse Power protection	32G
8.1.13	Generator Pole Slipping Protection	78G
8.1.14	Generator Over Frequency protection	81O
8.1.15	Generator Under Frequency protection	81U
8.1.16	Generator Rotor Earth Fault protection Two Stage Insulation Monitoring Type	64R
	Note: Rotor Earth fault Balance Bridge method not acceptable.	
8.1.17	Dead Machine Protection	50 GDM
8.1.18	Generator Thermal Over Load protection	49G.
8.1.19	Over fluxing protection	99G.
8.1.20	Stator earth fault protection (95% and 100%)	64S
8.1.21	Stator Stand By Earth Fault Relay	51NS
8.1.22	Overhead line differential protection	87HV
	Note: Stator and rotor earth fault protection based on low frequency voltage injection shall be considered (relay based on third harmonic principle is not acceptable).	

SR. NO.	PROTECTION FUNCTION	DEVICE NO.
8.2	LOCK OUT RELAYS FOR GENERATOR FOR BOTH GROUPS (GR1 AND GR2)	
8.2.1	Overall Differential Protection including generator, generator transformer, unit transformer and 400 kV line from GT upto switchyard.	87 OA
8.2.2	Generator V.T. Primary and Secondary Fuse Failure Relays.	60G
8.2.3	Master Unit Trip Lockout Relay (Class A)	86 GA-1/ 86 GA-2
8.2.4	Synchronizing Check Relay with Accessories	25
8.2.5	Master Trip Lockout Relay (Class B) Master Trip Lockout Relay (Class C)	86 GB-1/ 86 GB-2 86 GC-1/ 86 GC-2
8.2.6	Back up voltage operated earth fault Relay	64 B-G
8.2.7	Master Trip Relay and necessary auxiliary relay for Turbine Lockout	86T, 86TX
	Note: (A) High speed trip relays (86 GA/GB/GC) : adequate number of high speed trip relays for each class of tripping and separately for each groups shall be provided for the protection of the unit. The quantity of the trip relays shall also consider the requirement due to the following: 1. Contact requirements for various systems covered under the scope of this contract. 2. Contacts from each category of tripping relay for annunciation, data acquisition, sequential event recorder and fault disturbance recorder.	

SR. NO.	PROTECTION FUNCTION	DEVICE NO.
	3. Contacts for control, protection and interlock in system viz. 400 Kv circuit breakers tripping/ close permissive, 11 /3.3 kV aux. Supply breakers trip / close permissive, transformer cooler circuit interlocks, LBB protection etc. 4. 10% spare contacts (both N/O and N/C) 5. Trip coil supervision relays-Supervision relays for all master trip relays & trip coils of Generator circuit breaker 52A & 52B shall be provided. 6. Multiple generator lockout relays shall be used to receive signal inputs from protective relays and to provide the contacts needed to initiate protective action and alarms. Protective relays shall trip lockout relays based on functional redundancy. All lockout relays shall have a manual reset feature, which shall require an operator to manually reset the lockout relay prior to returning the affected equipment to service.	
8.3	<u>GENERATOR TRANSFORMER PROTECTION</u>	
8.3.1	Transformer H.V side Restricted E/F Protection.	64RGT
8.3.2	Transformer H.V. side Stand By E/F IDMT Protection.	51NGT
8.3.3	Generator transformer differential protection	87GT
8.3.4	Generator transformer HV side O/C back up Protection with timer	50/51GT,2
8.3.5	Local Breaker back up protection with its run trip relay	50 Z1 & 50 Z2

SR. NO.	PROTECTION FUNCTION	DEVICE NO.
8.3.6	GT HV & Overhead line connection differential protection	87HV
8.3.7	Volts /Hz. Over fluxing Protection	99GT
8.3.8	Buchholz Relay	
8.3.9	Winding Temperature	
8.3.10	Oil Temperature	
8.3.11	Pressure Relief Device operation	
8.3.12	Master Trip Relay	86
8.3.13	Tripping relays for protection devices of Generator Transformer (GT) and 63X / 49X for multiplying the contacts of protections.	
(a)	For trip function	63X1/49X1
	(i) GT buchholz II stage	63TX
	(ii) GT winding temperature very high	49 WTX
	(iii) GT oil temperature very high	49 OTX
	(iv) GT pressure relief device operated	63 PTX
	(v) GT fire protection trip	FRTX
	(vi) GT sudden pressure relay trip	63SPR
(b)	For annunciation function	63X2/49X2
	(i) GT Buchholz I stage	63AX
	(ii) GT winding temperature high	49 WAX
	(iii) GT oil temperature high	490AX
	(iv) GT oil level low	OLAX

SR. NO.	PROTECTION FUNCTION	DEVICE NO.
	(v) Cooler supply failure	
	(vi) Cooler trouble	
8.4	DISCRETE MISC. / AUXILIARY RELAYS (FOR GT PROTECTION)	
8.4.1	Auxiliary relays for transformer accessories	30
8.5	UNIT TRANSFORMER PROTECTION	
8.5.1	Transformer Differential Protection.	87UT
8.5.2	Transformer H.V. side back-up IDMT over Current protection with high set instantaneous unit.	50/51 UT
8.5.3	Transformer L.V winding restricted earth fault protection.	64R UT
8.5.4	Transformer L.V neutral back-up definite time earth fault protection.	51N UT
8.5.5	Buchholz Relay	
8.5.6	Winding Temperature	
8.5.7	Oil Temperature	
8.5.8	Pressure Relief Device operation	
8.5.9	OLTC surge protection.	
8.5.10	Master Trip Relay	86
8.5.11	Tripping relays for protection devices of Unit Transformer (UT) and 63X / 49X for multiplying the contacts of protections	
(a)	For trip function	63X1/49X1
	(i) UT buchholz II stage	63TX
	(ii) UT winding temperature very high	49 WTX

SR. NO.	PROTECTION FUNCTION	DEVICE NO.
	(iii) UT oil temperature very high	49 OTX
	(iv) UT pressure relief device operated	63 PTX
	(v) UT fire protection trip	FRTX
	(vi) OLTC Surge Protection	
(b)	For annunciation function	63X2/49X2
	(i) UT Buchholz I stage	63AX
	(ii) UT winding temperature high	49 WAX
	(iii) UT oil temperature high	490AX
	(iv) UT oil level low	OLAX
	(v) Cooler supply failure	
	(vi) OLTC trouble	
	(vii) OLTC Surge Protection	
8.6	DISCRETE MISC. / AUXILIARY RELAYS (FOR UT PROTECTION)	
8.6.1	Auxiliary relays for transformer accessories	30
8.6.2	Master trip Lockout Relay.	86 UT
8.7	STATION TRANSFORMER PROTECTION	
8.7.1	Differential protection	87 ST
8.7.2	IDMT Phase overcurrent with Instantaneous unit	50/51
8.7.3	Restricted earth fault for HV and LV1, LV2 separately	64R ST
8.7.4	Back up Earth Fault protection for HV and LV1, LV2 separately.	51NST

SR. NO.	PROTECTION FUNCTION	DEVICE NO.
8.7.5	Instantaneous earth fault	50N
8.7.6	Local Breaker Back up	50 Z1 & 50 Z2
8.7.7	Over fluxing	99
8.7.8	Transformer Buchholz	63
8.7.9	OLTC surge protection	
8.7.10	High winding temperature	
8.7.11	High oil temperature	
8.7.12	Pressure relief device operation.	
8.7.13	Master Trip Relay	86
8.7.14	Tripping relays for protection devices of Station Transformer ST) and 63X / 49X for multiplying the contacts of protections.	
(a)	For trip function	63X1/49X1
	(i) ST buchholz II stage	63TX
	(ii) ST winding temperature very high	49 WTX
	(iii) ST oil temperature very high	49 OTX
	(iv) ST pressure relief device operated	63 PTX
	(v) ST fire protection trip	FRTX
	(vi) OLTC Surge Protection	
(b)	For annunciation function	63X2/49X2
	(i) ST Buchholz I stage	63AX
	(ii) ST winding temperature high	49 WAX

SR. NO.	PROTECTION FUNCTION	DEVICE NO.
	(iii) ST oil temperature high	490AX
	(iv) ST oil level low	OLAX
	(v) Cooler supply failure	
	(vi) OLTC trouble	
	(vii) OLTC Surge Protection	
8.8	UNIT AUX TRANSFORMER /STATION AUX TRANSFORMER PROTECTION	
8.8.1	Differential protection	87T
8.8.2	Transformer H.V. side back-up IDMT over current protection with high set instantaneous unit.	50/51
8.8.3	Transformer L.V winding restricted earth fault protection.	64R
8.8.4	Transformer L.V neutral back-up definite time earth fault protection.	51N
8.8.5	Buchholz Relay	
8.8.6	Winding Temperature	
8.8.7	Oil Temperature	
8.8.8	Pressure Relief Device operation	
8.8.9	Master Trip Relay	86
8.8.10	Tripping relays for protection devices of UAT/SAT and 63X / 49X for multiplying the contacts of protections	
(a)	For trip function	63X1/49X1
	(i) UT buchholz II stage	63TX
	(ii) UT winding temperature very high	49 WTX

SR. NO.	PROTECTION FUNCTION	DEVICE NO.
	(iii) UT oil temperature very high	49 OTX
	(iv) UT pressure relief device operated	63 PTX
	(v) UT fire protection trip	
	(vi) FRTX	
(b)	For annunciation function	63X2/49X2
	(i) UT Buchholz I stage	63AX
	(ii) UT winding temperature high	49 WAX
	(iii) UT oil temperature high	49OAX
	(iv) UT oil level low	OLAX
	(v) Cooler supply failure	
	(vi) Cooler trouble	
	Transformer WTI / OTI / OIL LEVEL/ Pressure Relief / OLTC Surge Protection / Tap Changer Trouble etc. shall be provided through auxiliary relays in generator protection panel.	
	Legend `H.V.' - High Voltage GT - Generator Transformer `L.V.' - Low Voltage UT - Unit Transformer G - Generator ST - Station Transformer UAT - Unit Aux. Transformer SAT - Station Aux Transformer	
	NOTE 1. The data of all the protection relays (Generator, Generator Transformer, Unit Transformer, Station Transformer, HT switchgear etc) shall be communicated to DDCMIS. All necessary hardware including FO cable, special cables. Ethernet switches, data concentrator, with suitable communication ports etc and relevant software for the same should be	

SR. NO.	PROTECTION FUNCTION	DEVICE NO.
	in bidder scope 2. The protection philosophy indicated above is for general guidance and represents the minimum requirement only. Additionally protection of electrical equipment shall also meet the requirement of CBIP publication no. 274.	

ELECTRICAL CONTROL & RELAY PANELS

ANNEXURE – B

SR. NO.	ITEM	
1.0	**INDICATIVE LIST OF ANNUNCIATIONS TO BE INCLUDED IN DDCMIS/EDMS FOR GENERATOR, GENERATOR TRANSFORMER & UNIT TRANSFORMER**	
1.1	LIST OF ANNUNCIATIONS	
1.1.1	Generator Differential	Operated
1.1.2	Generator Inter-turn fault protection	Operated
1.1.3	Generator Overall Differential	Operated
1.1.4	Generator Under Frequency (trip unit)	Operated
1.1.5	Generator Under Frequency (alarm unit)	Operated
1.1.6	Generator Over Frequency (trip unit)	Operated
1.1.7	Generator Over Frequency (alarm unit)	Operated
1.1.8	Generator Thermal O/L	Operated
1.1.9	Generator Pole slipping	Operated
1.1.10	Generator Back up Impedance protection	Operated
1.1.11	Generator Rotor first earth fault (alarm)	Operated
1.1.12	Generator Rotor second earth fault (trip)	Operated
1.1.13	Generator Over-Voltage	Operated
1.1.14	Generator Loss of excitation & under voltage	Operated
1.1.15	Generator Loss of excitation	Operated

SR. NO.	ITEM	
1.1.16	Generator Stator E/F (0-95%)	Operated
1.1.17	Generator Stator E/F (95-100%)	Operated
1.1.18	Generator Over/Under frequency time Totaliser	Alarm
1.1.19	Generator V.T/PT fuse	Failed (individually for all V.Ts)
1.1.20	Generator Low forward power	Operated
1.1.21	Generator Reverse power	Operated
1.1.22	Generator IDMT Overload	Operated
1.1.23	Generator Negative sequence (alarm unit)	Operated
1.1.24	Generator Negative sequence (trip unit)	Operated
1.1.25	Generator Dead Machine protection	Operated
1.1.26	Generator Lockout (86G1)	Operated
1.1.27	Generator Lockout (86G1)	Circuit Unhealthy
1.1.28	Generator Lockout (86G2)	Operated
1.1.29	Generator Lockout (86G2)	Circuit Unhealthy
1.1.30	Generator Field Breaker	Tripped
1.1.31	Unit lockout (86 U1)	Operated
1.1.32	Unit lockout (86 U1)	Circuit Unhealthy
1.1.33	Unit lockout (86 U2)	Operated
1.1.34	Unit lockout (86 U2)	Circuit Unhealthy
1.1.35	Generator Transf. H.V Back-up E/F	Operated
1.1.36	Generator Transf. H.V Back-up Over current	Operated

SR. NO.	ITEM	
1.1.37	Generator Transf. H.V Restricted E/F	Operated
1.1.38	Generator Transf. Overfluxing	Operated
1.1.39	Generator Transf. Overfluxing (alarm unit)	Operated
1.1.40	Generator Transf. Bucholz	Alarm
1.1.41	Generator Transf. Winding Temperature	High
1.1.42	Generator Transf. Oil Temperature	High
1.1.43	Generator Transf. Conservator Oil level	Low
1.1.44	Generator Transf. OLTC Surge Protection	Operated
1.1.45	Generator Transf. Tap Changer Trouble	Operated
1.1.46	Generator Transf. Cooler bank oil flow	Low
1.1.47	Generator Transf. Cooler bank fan	Fail
1.1.48	Generator Transformer Cooler bank pump	Fail
1.1.49	Generator Transformer Cooler power/control supply	Fail
1.1.50	Generator Transformer trouble	Trip
1.1.51	Group alarm for Buchholz /Winding Temp./Oil temp. /Pressure Relief Device / OLTC Surge Protection / Tap Changer Trouble	
1.1.52	Generator Transformer 400 kV circuit breaker	Trip
1.1.53	Generator Transformer 400 kV tie circuit breaker	Trip
1.1.54	Generator Transformer 400 kV circuit breaker pole-discrepancy	Operated
1.1.55	Generator Transformer 400 kV tie circuit breaker pole-discrepancy	Operated

SR. NO.	ITEM	
1.1.56	Generator Transformer 400 kV circuit breaker LBB /bus differential	Operated
1.1.57	Generator Transformer 400 kV tie circuit breaker LBB /bus differential	Operated
1.1.58	Generator Transformer 400 kV circuit breaker SF6 gas pressure	Low
1.1.59	Generator Transformer 400 kV tie circuit breaker SF6 gas pressure	Low
1.1.60	Generator Transformer 400 kV circuit breaker SF6 gas pressure	Very Low
1.1.61	Generator Transformer 400 kV tie circuit breaker SF6 gas pressure	Very Low
1.1.62	Generator Transformer 400 kV circuit breaker trip circuit	Unhealthy
1.1.63	Generator Transformer 400 kV tie circuit breaker trip circuit	Unhealthy
1.1.64	Transformer yard fire protection relay	Operated
1.1.65	Turbine Lockout relay (86T1)	Operated
1.1.66	Turbine Lockout relay (86T1) circuit	Unhealthy
1.1.67	Turbine Lockout relay (86T2)	Operated
1.1.68	Turbine Lockout relay (86T2) circuit	Unhealthy
1.1.69	Turbine Lockout auxiliary relay (86TX1)	Operated
1.1.70	Turbine Lockout auxiliary relay (86TX1) circuit	Unhealthy
1.1.71	Turbine Lockout auxiliary relay (86TX2)	Operated
1.1.72	Turbine Lockout auxiliary relay (86TX2) circuit	Unhealthy

ELECTRICAL CONTROL & RELAY PANELS

ANNEXURE – C

SR. NO.	ITEM	
1.0	**INDICATIVE LIST OF ANNUNCIATIONS TO BE INCLUDED IN EDMS FOR INPLANT POWER DISTRIBUTION**	
1.1	FOR UNIT AUXILIARIES	
1.1.1	11 kV Unit Switchgear	Incomer-Breaker Trip
1.1.2	11 kV Unit Switchgear	Tie Incomer Breaker Trip
1.1.3	11 kV Unit Switchgear	Non-motor Feeder -Breaker Trip (individual annunciation for each outgoing feeder breaker)
1.1.4	11 kV Unit Switchgear	Auto Change-over - Fail
1.1.5	11 kV Unit Switchgear	Bus Under-Voltage - Alarm
1.1.6	11 kV Unit Switchgear	Slow Change-over - Carried out
1.1.7	11 kV Unit Switchgear	Fast Change over - Carried out
1.1.8	11 kV Unit Switchgear	Bus V.T fuse - Fail
1.1.9	11 kV Unit Switchgear	Transfer - Incomplete
1.1.10	11 kV Unit Switchgear	Incomer Breaker Trip Circuit - Unhealthy
1.1.11	11 kV Unit Switchgear	Tie Incomer Breaker Trip Circuit - Unhealthy
1.1.12	11 kV Unit Switchgear	Outgoing feeders Breaker Trip Circuit - Unhealthy(group alarm for all feeders)
1.1.13	3.3 kV Unit Switchgear	Incomer-Breaker Trip

SR. NO.	ITEM	
1.1.14	3.3 kV Unit Switchgear	Bus coupler Breaker Trip
1.1.15	3.3 kV Unit Switchgear	Non-motor Feeder Breaker Trip (individual annunciation. for each outgoing feeder breaker)
1.1.16	3.3 kV Unit Switchgear	Auto Change-over - Fail
1.1.17	3.3 kV Unit Switchgear	Bus Under-Voltage - Alarm
1.1.18	3.3 kV Unit Switchgear	Auto Change-over - Carried out
1.1.19	3.3 kV Unit Switchgear	Bus V.T fuse - Fail
1.1.20	3.3 kV Unit Switchgear	Normal Incomer Breaker Trip Circuit - Unhealthy
1.1.21	3.3 kV Unit Switchgear	Bus coupler Breaker Trip Circuit - Unhealthy
1.1.22	3.3 kV Unit Switchgear	Outgoing feeders Breaker Trip Circuit - Unhealthy(group alarm for all feeders)
1.1.23	Unit Transformer	Trouble(group alarm for Buchholz trip / OLTC trip / Winding Temperature trip / Oil Temperature trip / Pressure Relief Device trip)
1.1.24	Unit Transformer	Buchholz relay - Alarm
1.1.25	Unit Transformer	OLTC Buchholz relay - Alarm
1.1.26	Unit Transformer	Winding Temperature - High
1.1.27	Unit Transformer	Oil Temperature - High
1.1.28	Unit Transformer	Main tank/OLTC tank Oil level - Low
1.1.29	Unit Transformer	OLTC Mechanism - Stuck
1.1.30	Unit Transformer	Cooler bank 1/2 Fan - Fail

SR. NO.	ITEM	
1.1.31	Unit Transformer	Cooler Power/Control Supply - Fail
1.1.32	Unit Transformer	H.V Phase Inst. Over current relay-Operated
1.1.33	Unit Transformer	H.V Back-up Over current relay-Operated
1.1.34	Unit Transformer	L.V. Stand by Earth-fault relay - Operated
1.1.35	Unit Transformer	L.V. Side Restricted Earth-fault relay - Operated
1.1.36	Unit Transformer	Differential relay - Operated
1.1.37	UNIT HV Aux. Transformer	Trouble (group alarm for Buchholz/Winding Temperature/Oil Temperature/Pressure Relief Device/OLTC Surge Protection/Tap Changer Trouble)
1.1.38	UNIT HV Aux. Transformer	Buchholz relay - Alarm
1.1.39	UNIT HV Aux. Transformer	Winding Temperature - High
1.1.40	UNIT HV Aux. Transformer	Oil Temperature - High
1.1.41	UNIT HV Aux. Transformer	Conservator Oil level - Low
1.1.42	UNIT HV Aux. Transformer	Cooler bank 1/2 Fan - Fail
1.1.43	UNIT HV Aux. Transformer	Cooler Power/Control Supply - Fail
1.1.44	UNIT HV Aux. Transformer	H.V Back-up Overcurrent relay - Operated
1.1.45	UNIT HV Aux. Transformer	L.V. Stand by Earth-fault relay - Operated
1.1.46	UNIT HV Aux. Transformer	L.V. Side Restricted Earth-fault relay - Operated

SR. NO.	ITEM	
1.1.47	UNIT HV Aux. Transformer	Differential relay - Operated
1.1.48	Unit LT AUX. Transformer (Dry Type)	HV side High Set Inst. Relay - Operated
1.1.49	Unit LT AUX. Transformer (Dry Type)	HV back up over current relay - Operated
1.1.50	Unit LT AUX. Transformer (Dry Type)	HV earth fault relay – Operated
1.1.51	Unit LT AUX. Transformer (Dry Type)	Winding Temperature - High
1.1.52	Unit LT AUX. Transformer (Dry Type)	Winding Temperature - Very High
1.1.53	Unit LT AUX. Transformer (Dry Type)	Door open
1.1.54	415V Unit PMCC	Incomer-1 Breaker - Trip
1.1.55	415V Unit PMCC	Incomer-1 Under - voltage - Trip
1.1.56	415V Unit PMCC	Incomer-1 Breaker Trip Circuit - Unhealthy
1.1.57	415V Unit PMCC	Incomer-2 Breaker - Trip
1.1.58	415V Unit PMCC	Incomer-2 Under - voltage - Trip
1.1.59	415V Unit PMCC	Incomer-2 Breaker Trip Circuit - Unhealthy
1.1.60	415V Unit PMCC	Bus - Tie breaker - Trip
1.1.61	415V Unit PMCC	Bus-Tie Breaker Trip Circuit - Unhealthy
1.1.62	415V Unit PMCC	Outgoing non-motor feeder breaker – Trip (individual annunciation. for each outgoing feeder breaker)

SR. NO.	ITEM	
1.1.63	415V Unit PMCC	Outgoing feeder breaker Trip Circuit - Unhealthy (Group alarm)
1.1.64	415V Unit PMCC	Bus-A/B V.T Fuse – Fail/(Group alarm)
1.1.65	415V Unit PMCC	Bus-A Under voltage
1.1.66	415V Unit PMCC	Bus-B Under voltage
1.1.67	415V Unit PMCC	Auto change-over - Fail
1.1.68	415V Unit PMCC	Auto change-over - Successful
1.1.69	415V Emergency MCC	Normal Incomer Breaker - Trip
1.1.70	415V Emergency MCC	Standby Incomer (from D.G) Breaker - Trip
1.1.71	415V Emergency MCC	Outgoing Feeders-Breaker Trip (group alarm for all outgoing feeders)
1.1.72	415V Emergency MCC	Bus-Section Breaker - Trip
1.1.73	415V Emergency MCC	Normal Incomer Breaker- Trip Circuit Unhealthy
1.1.74	415V Emergency MCC	Standby Incomer (from D.G) -Breaker Trip Circuit Unhealthy
1.1.75	415V Emergency MCC	Bus-tie Breaker - Trip Circuit Unhealthy
1.1.76	415V Emergency MCC	Outgoing Feeders - Breaker Trip Circuit Unhealthy (group alarm for all outgoing feeders)
1.1.77	415V Emergency MCC	Bus Transfer - Fail
1.1.78	220V Unit Battery	Earth Fault - Detected
1.1.79	220V Unit Battery	Charger - Trouble
1.1.80	UPS	Trouble

SR. NO.	ITEM	
	Note : The above list is applicable for all Transformers, Switchgears, PCC/PMCC and Battery and charger for the Unit System including ESP Switchboard and transformers.	
1.2	STATION AUXILIARIES	
1.2.1	11 kV Station Switchgear	Incomer- Breaker Trip
1.2.2	11 kV Station Switchgear	Tie Incomer - Breaker Trip
1.2.3	11 kV Station Switchgear	Non-motor feeders - Breaker Trip (individually for all outgoing feeders) Incomer - Breaker Trip Circuit Unhealthy
1.2.4	11 kV Station Switchgear	Tie Incomer - Breaker Trip Circuit Unhealthy
1.2.5	11 kV Station Switchgear	Outgoing feeders - Breaker Trip Circuit Unhealthy (Group alarm for all outgoing feeders)
1.2.6	11 kV Station Switchgear	Bus V.T Fuse - Fail
1.2.7	11 kV Station Switchgear	Bus Under - voltage
1.2.8	11 kV Station Switchgear	Auto Change-over - Fail
1.2.9	11 kV Station Switchgear	Auto Change-over - Carried out
1.2.10	3.3 kV Station Switchgear	Incomer-Breaker Trip
1.2.11	3.3 kV Station Switchgear	Bus coupler Breaker Trip
1.2.12	3.3 kV Station Switchgear	Non-motor Feeder Breaker Trip (individual annunciation. For each outgoing feeder breaker)

SR. NO.	ITEM	
1.2.13	3.3 kV Station Switchgear	Auto Change-over - Fail
1.2.14	3.3 kV Station Switchgear	Bus Under-Voltage - Alarm
1.2.15	3.3 kV Station Switchgear	Auto Change-over - Carried out
1.2.16	3.3 kV Station Switchgear	Bus V.T fuse - Fail
1.2.17	3.3 kV Station Switchgear	Normal Incomer Breaker Trip Circuit - Unhealthy
1.2.18	3.3 kV Station Switchgear	Bus coupler Breaker Trip Circuit - Unhealthy
1.2.19	3.3 kV Station Switchgear	Outgoing feeders Breaker Trip Circuit – Unhealthy (group alarm for all feeders)
1.2.20	Station Transformer	Trouble (group alarm for Buchholz trip /OLTC trip/ Winding Temperature trip/Oil Temperature trip/Pressure Relief Device trip)
1.2.21	Station Transformer	Buchholz relay - Alarm
1.2.22	Station Transformer	OLTC Buchholz relay - Alarm
1.2.23	Station Transformer	Winding Temperature - High
1.2.24	Station Transformer	Oil Temperature - High
1.2.25	Station Transformer	Main tank/OLTC tank Oil level - Low
1.2.26	Station Transformer	OLTC Mechanism - Stuck
1.2.27	Station Transformer	Cooler bank 1/2 Fan - Fail
1.2.28	Station Transformer	Cooler Power/Control Supply - Fail
1.2.29	Station Transformer	H.V. Phase Inst. Over current relay- Operated
1.2.30	Station Transformer	H.V. Back-up Over current relay - Operated

SR. NO.	ITEM	
1.2.31	Station Transformer	L.V. Stand by Earth-fault relay - Operated
1.2.32	Station Transformer	L.V. Side Restricted Earth-fault relay - Operated
1.2.33	Station Transformer	Differential relay - Operated
1.2.34	Station LT AUX. Transformer (Dry Type)	Winding Temperature - High
1.2.35	Station LT AUX. Transformer (Dry Type)	Winding Temperature - Very High
1.2.36	Station LT AUX. Transformer (Dry Type)	Door open
1.2.37	415V Station PMCC	Incomer-1 Breaker - Trip
1.2.38	415V Station PMCC	Incomer-1 Under - voltage - Trip
1.2.39	415V Station PMCC	Incomer-1 Breaker Trip Circuit - Unhealthy
1.2.40	415V Station PMCC	Incomer-2 Breaker - Trip
1.2.41	415V Station PMCC	Incomer-2 Under - voltage - Trip
1.2.42	415V Station PMCC	Incomer-2 Breaker Trip Circuit - Unhealthy
1.2.43	415V Station PMCC	Bus - Tie breaker - Trip
1.2.44	415V Station PMCC	Bus-Tie Breaker Trip Circuit - Unhealthy
1.2.45	415V Station PMCC	Outgoing non- motor feeder breaker – Trip (individual annunciation. for each outgoing feeder breaker)
1.2.46	415V Station PMCC	Outgoing feeder breaker Trip Circuit – Unhealthy (Group alarm)

SR. NO.	ITEM	
1.2.47	415V Station PMCC	Bus-A/B V.T Fuse – Fail/(Group alarm)
1.2.48	415V Station PMCC	Bus-A Under voltage
1.2.49	415V Station PMCC	Bus-B Under voltage
1.2.50	415V Station PMCC	Auto change-over - Fail
1.2.51	415V Station PMCC	Auto change-over - Successful
1.2.52	220V Station Battery	Earth Fault - Detected
1.2.53	220V Station Battery	Charger - Trouble

Note :

1. The above list is applicable for all Transformers, Switchgears, PCC/PMCC, Battery, and charger for the Station System.

2. List mentioned above is indicative. If additional annunciations are required same shall be provided by the bidder.