BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

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TYPE OF DOC.	**TECHNICAL SPECIFICATION**			**NAME**	**AA**	**VK**	**VK**
TITLE				**SIGN**	-Sd-	Sd-	Sd-
SUBSTATION AUTOMATION SYSTEM				**DATE**	**19-09-15**	**19-09-15**	**19-09-15**
				GROUP	TBEM	**W.O. No**	
CUSTOMER	ONGC						
PROJECTS	**66kV GIS -CCCPP at Hazira plant , Gujarat**						

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SECTION I
SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

This technical specification covers the requirements of design, manufacture and assembly , testing at manufacturer's works, packing and dispatch of Substation Automation System at Hazira Station complete with accessories as listed below. Testing and Commissioning of all SAS equipments including Protective relays shall be done by the OEM Engineer along with on site, training to Customer's engineers as specified in respective sections.
The fitments offered shall be of Customer approved make or its subsequent approval from Customer shall be bidder's responsibility, with no commercial implications to BHEL. If any of the make offered by the bidder is not acceptable to Customer, the bidder has to supply alternate Customer approved make, meeting the specification, with no commercial implications to BHEL.
All auxiliary relays, timers, counters, aux CTs, switches etc required for completeness of the scheme & good engineering are deemed to be included in the offer and no claim whatsoever shall be entertained at contract stage.

In case of any conflict between the technical details mentioned in this section and the remaining sections of this document, then Section-1 shall prevail and is to be considered as binding requirement.

1.1 The equipment is required for the following Project.

Name of customer : ONGC

Consultant : FITCHNER CONSULTING ENGINEERS INDIA PVT LTD

Name of the Project : 66KV GIS FOR 51MW CCPP AT HAZIRA UNIT , GUJARAT

Refer Section - 3 for Project Details and General Specifications.

2.0 SPECIFIC TECHNICAL PARTICULARS

A) The electrical control & monitoring of 66kV, 11kV & 415V system will be through SAS .

I. Substation Automation system (SAS) function for 66kV system shall consist of following:-
   a) Bay controller units (BCU) for each 66kV GIS.
   b) Fully dual redundant communication bus.
   c) SAS I/O Cabinets, marshalling panels.
   d) Transducers for transmitting electrical analog quantities (Voltage, Current, active & reactive Power, frequency etc.)
   e) All necessary Remote Terminal units (RTU), HMI, engineering work stations at the GIS control room.
   f) One Remote HMI at Central control room along with connectivity and printers. Remote HMI shall also be duplicated at new GIS control room. The new SAS system shall have provision to communicate with the proposed plant SCADA system of ONGC and also with the new DCS system for the new power plant.
   g) All required printers, scanners and consumables like paper, toners, and printer ribbons shall be supplied.

Refer the 66 kV GIS SAS configuration Dwg No: 10-5111168-E-204 for Further details.

II. Following functions are envisaged from SAS for 11kV System :

a) 11kV switchboards shall be controlled (closing & tripping) from remote (SAS) only under service conditions. Only test closing shall be possible from switchgear Level. Breaker signals, protection relay operated condition and necessary current, voltage and power signals shall be routed to SAS .
b) Display of summated power consumption of individual 11kV Aux. feeders of the CCPP.
c) The proposed SAS shall have provision to interface with clients existing SCADA for monitoring of existing plant electrical system.

III. Following functions are envisaged from SAS for 415V System :

a) All 415V Power Control Centres (PCC) / Emergency Motor Control Centre (MCC) Breakers shall be controlled from SAS/ DCS.
b) Local / Remote selector switch shall be provided in switchboard. Remote selection shall enable starting from DCS / SAS
c) DG Set Control from SAS:
- Manual control of engine speed and generator voltage shall be provided through Raise / lower control from SAS.
- When DG Sets are in Auto-Main Failure Mode of Operation: This shall be effective in auto position of Auto / manual selector switch located in control panel. The generator set shall normally be at rest. Upon failure of plant normal supply, an impulse shall be extended from DCS / SAS. Upon receipt of this impulse, generator set shall be started automatically and voltage brought to rated speed and generator voltage brought to rated value.
- Stopping of the generator set in all cases for a normal shut down shall only be done manually by means of push button in either local control panel or automatically through the SAS / DCS.

IV. SAS shall be interfaced to DCS through redundant communication link.

V. The Substation Automation System (SAS) shall have provision for interfacing with remote RLDC (Regional Load Dispatch Centre) through suitable gateways with adequate number of ports along with modems at substation level.

VI. Generator Remote Automation System Control Facilities through SAS:
Refer annexureto Section-II for details.

VII. Please refer the key protection SLD attached along with annexures to Section-II for Protection requirments of the project.

3.0 TECHNICAL QUALIFYING REQUIREMENTS:

The manufacturer whose Control, Relay & Protection System (Control & protection Intelligent Electronic Devices (IEDs)), and Sub-station Automation are offered should have designed, manufactured, tested, installed and commissioned Control, Relay & Protection system along with Sub-station Automation System which must be in satisfactory operation for atleast 2 (two) years on the date of bid opening.

4.0 TRAINING :

Please refer attached annexure to Section-II for details on training.

Note: Charges for Tutorials & other training materials for the trainees shall also be included in the price quoted by the bidder.

5.0 Pre-commissioning Tests , Commissioning

Please refer Annexure to Section-II for details.

The respective dates of commencement of erection, pre-commissioning, commissioning and trial –run activity by BHEL will be intimated to the equipment manufacturer from time to time , so that arrangements for supervising the activity can be made accordingly by the manufacturer .

6.0 BILL OF QUANTITY:

S. No.	Description	Unit	Total Quantity
1.	Control & Relay Panel for GTG-3 66kV Bay	Set	1
2.	Control & Relay Panel for GTG-4 66kV Bay	Set	1
3.	Control & Relay Panel for Incomer-1 66kV Bay	Set	1
4.	Control & Relay Panel for ST-1 66kV Bay	Set	1
5.	Control & Relay Panel for Bus Coupler 66kV Bay	Set	1
6.	Control & Relay Panel for ST-2 66kV Bay	Set	1
7.	Control & Relay Panel for STG-1 66kV Bay	Set	1
8,	Control & Relay Panel for Incomer-2 66kV Bay	Set	1
9.	Control & Relay Panel for Existing Grid Transformer GT-1 66kV Bay	Set	1
10.	Control & Relay Panel for Existing Grid Transformer GT-2 66kV Bay	Set	1
11.	Control & Relay Panel for Spare Transformer Feeder 66kV Bay	Set	1
12	Bus Bar Protection Panel (Numerical)	Set	1
13	BCU for controlling & monitoring of Auxiliary System for 66kV GIS	Set	1
14	Islanding Scheme for 66kV GIS	Set	1

15	Energy Management System	Set	1
16	Load Shedding System	Set	1
17	Substation Automation System (SAS) : a) Station HMI (Including all necessary softwares) as per Technical Specification requirement. b) Industrial Grade station Server (Dual redundant along with necessary softwares) as per technical Specification requirement . c) Disturbance recorder work station (including necessary softwares) as per technical specification requirement. d) A3/A4 colour laser Printer as per technical specification requirement e) Video Copier at control room f) Dot matrix printer as per technical specification requirement. g) Bay level Ethernet Switches as per technical specification requirement. h) Station Level Ethernet Switches as per technical specification requirement. i) Armoured Fibre Optic cable system for SAS j) Gateway to RLDC /SLDC along with required cables as per technical Specification. k) Necessary hardware and software for interface with RLDC/SLDC l) Gateway to Plant DCS as per technical Specification m) Gateway to Existing Plant SCADA as per technical Specification n) Gateway for existing 11kV system o) Time synchronization equipments (GPS) along with master synchronizing clock , slave clocks and all necessary interfaces and connecting cables / wires. p) Inverter/UPS -working on station battery back-up. q) Furniture - Necessary elegant and ergonomic furniture required for server, operator console table ,Desk with drawers and chairs, printer table.	Lot	1
18	<u>Services :</u> (66kV Bay Wise) :- Supervision of Testing and Commissioning of protection relays and complete Substation automation system at site. Scope shall be as follows : a) Testing & commissioning of main protection relays and Numerical Busbar protection including Relay parameterization and configuration . b) Testing & commissioning of SAS system including termination of network/optical cables (complete with all end connectors, tees etc as required) .	Lot	11

	c) For network/optical cables which are in the bidder's scope, the laying of cables shall be in BHEL scope. However, Optical cable will be laid under bidder's supervision. Splicing and Termination shall be in bidder's scope. d) Site acceptance Tests(SAT) as per Technical Specification. e) Arranging all necessary tools , tackles and equipment for protection and communication testing including automatic relay test kit shall be bidder's responsibility.		
19	Services: Testing & Commissioning of remote HMI at RLDC/SLDC	Lot	1
20	Services: Training Charges	Lot	1
21	**MANDATORY SPARES**		
21.1	**SAS**		
21.1 a)	All modules in SAS (10% of each type and range , Subject to Minimum of 2Nos)	Lot	1
21.1 b)	All computers and peripherals in SAS (10% of each type and range , Subject to Minimum of 2Nos)	Lot	1
21.1 c)	All components in SAS (10% of each type and range , Subject to Minimum of 2Nos)	Lot	1
21.2	**66kV Control & Relay Panel**		
21.2 a)	Push Button of each type (min 10% of Installed quantity or 2 Nos whichever is greater)	Lot	1
21.2 b)	Local/Remote selector switch (min 10% of Installed quantity or 2 Nos whichever is greater)	Lot	1
21.2 c)	Voltmeter selection switch of each type	No.	1
21.2 d)	Indicating lamp of each type (min 30% of Installed quantity or 2 Nos. whichever is greater)	Lot	1
21.2 e)	Fuses of each rating	No.	10
21.2 f)	Auxiliary relays of each type (20% of installed quantity or 2 Nos. whichever is greater)	Lot	1
21.2 g)	Test Terminal Blocks for meters	No.	2
21.2 h)	Test Terminal Blocks for relays	No.	2

Note: i) If any additional item as per the specification for Substation Automation System is

required to be supplied for completion of the system over and above the items indicated above, the same shall be indicated clearly in the offer. Otherwise, the same shall be deemed to be included in the offer.

ii) Proper sizing of inverter to be done by bidder, which shall be approved by PGCIL / BHEL.

iii) The scope for relay setting shall be as follows:

a) Conducting the relay setting calculations and determination of the recommended relay settings shall be in bidder's scope. The relay settings shall be submitted in the OEM's format alongwith supporting calculations for approval of Customer during contract stage.

b) Co-ordination with the customer for all the inputs pertaining to protection relay settings shall be in BHEL scope.

iv) Necessary site visits for collecting inputs for interfacing with the existing sub-station are included in the bidder's scope for this tender.

v) Necessary software and hardware is required to up/ down load the data (DR data, Relay configuration data etc) to/ from relay from/to personal computer installed in the substation. The price for the same is deemed to be included in the offered price. No claim shall be entertained on account of hardware/ software at contract stage.

vi) Wherever bidder offers any spare in lieu of the same being "Built-in feature" of any relay/ fitment or the same being "Not applicable" is subject to approval by Customer. No price implication will be entertained by BHEL at contract stage if any separate item is insisted by customer to meet the contract requirement.

vii) Bidder to note that the GTP, Make & type of fitments, Bill of material of the offered Control & Relay Panels and their mandatory spares are subject to Customer approval at the contract stage. No price implications will be entertained by BHEL at contract stage.

7.0 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

The equipments supplied shall be type tested as per type tests specified in relevant standards.

The type testing requirements shall be in line with details specified in Annexure to Section II of this technical specification.

8.0 DEVIATIONS :

The bidder shall list all the deviation from the specification separately. Offers without specific deviation will be deemed to be totally in compliance with the specification and NO DEVIATION on any account will be entertained at a later date.

9.0 MANUFACTURING QUALITY PLAN:

Bidder has to follow ONGC approved Manufacturing Quality Plan , SAT /FAT procedure at contract stage.

10.0 DRAWINGS and SCHEME

The documentation requirements detailed under Section-III shall be submitted to BHEL at various stages of contract. Softcopy of the drawings and schemes are to be submitted at contract stage. Preparation of AS- BUILT drawings is also in the scope of the bidder.

11.0 DOCUMENTS REQUIRED WITH OFFER

a) Clause-wise confirmation/ comments.
b) Bill of Material.
c) Un-priced schedule as per BOQ at clause 6.0
d) Filled up Guaranteed Technical Particulars
e) Catalogue and Technical Leaflets for the offered Equipments

12.0 Documents being submitted as Annexure to Section-II

a) SLD of 66kV GIS
b) Key Protection SLD
c) SCADA Architecture
d) Generator Remote Automation System Control
e) SAS Write-up
f) Electrical Control Philosophy
g) SAS-Plant Control Interface
h) 11kV SLD(New)
i) 11kV SLD (Existing)
j) Other technical requirement Annexure.

SECTION-II

DETAILED TECHNICAL SPECIFICATION - ELECTRICAL

SUB-SECTION - 3.6.3

66 kV GIS SUBSTATION AUTOMATION SYSTEM (SAS) & PROTECTION

VOLUME - III

SUB-SECTION - 3.6.3
66kV INDOOR GIS
SUBSTATION AUTOMATION SYSTEM (SAS) & PROTECTION

1.0.0 **SCOPE**

1.1.1 The scope includes design engineering, software development, manufacturing, testing at works, supply, delivery, erection, configuring, on site testing and commissioning of a modern state of the art microprocessor based Substation automation system (SAS) associated with the new CCCPP. 66kV GIS and the station auxiliary electrical power HV & LV distribution switchgear circuits.

1.1.2 The SAS system shall provide controls and acquire real time data from the various circuits of the HV and LV electrical power system and present readily understood information to the electrical substation control engineer.

1.1.3 All elements of the SAS system shall be based on a real time multitasking operating system. The system shall be user friendly and allow easy access for maintenance, testing and repair.

1.1.4 The SAS system shall be based on a distributed architecture and all components shall be of approved and reliable design with highest attainable attributes for uniformity, interoperability and interchangeability. The design shall be modular to facilitate easy maintenance, fault diagnosis and repair of components and to support installation and incremental expansion. It shall be possible to alter, extend or upgrade any element of the substation by simple addition of hardware with necessary software augmentation and configuration. SAS shall be based on integrated automation solution which shall not just be limited to usual control and monitoring but shall be based on incorporation of features offering solution to serve as aid to operator in terms of automatic operation of normal functions and the other repeated security checked sequential switching, supply restoration after fault location and segregation of healthy and faulted sections.

1.1.5 Dual redundant servers with requisite software (MASTER STATION) connected by redundant communication links to distributed microprocessor based dual redundant Remote Terminal Units (RTU's – one for 66 kV GIS and other for the plant auxiliaries) with controllers for performing the required SAS functions including data collection, monitoring, operation, control, load shedding, events recording, energy management system for the 66 kV GIS, New CCCPP station auxiliary power distribution HV & LV circuits and existing three nos. GTGs, existing load connected to existing 11kV switchgear.

1.1.6 New SAS system shall have energy management & load shedding modules. For energy management purpose all the parameters of the existing gas turbine generator (GTG-1,2 & 3) shall also be considered and for load shedding purpose all the existing & new 11kV switchgear outgoing plant feeders control & monitoring are to be considered in the SAS system. Any modifications/additions in the existing system for achieving this requirement like contact multiplication, providing digital multifunctional meters in the existing feeders (GTG-1, GTG-2, GTG-3, Grid transformer-1 & grid transformer-2) necessary cabling etc shall be considered in EPC contractor's scope. Logic to be adopted for load shedding purpose & feeders for load shedding shall be identified in consultation with ONGC during detailed engineering.

1.1.7 HMI at various locations in the form of dual Operator Console, Supervisory Console and each of their associated furniture's (desk with drawers and chair), plus Engineering Workstations (EWS). The consoles shall be PC based complete with colour monitors, industrial grade CPU, key board, mouse and printer.

1.1.8 The Engineering Work Station (EWS) shall be provided as one laptop PC that can be shared for use at each of the adjacent RTUs associated with the 66 kV GIS network along with a fixed EWS for all RTU.

1.1.9 Control Room Printers and Control room Video Copier.

1.1.10 Dual redundant distributed RTU for the GIS. The RTUs shall be designed as special purpose computers/controllers comprising control and data acquisition functions, analogue to digital converters (ADC), digital to analogue converters (DAC), and digital inputs (status) and output (controls). The RTU outputs shall be controlled by software's that shall be resident in the RTU as well as via remote command from the SAS system Master Computer. The RTU shall be complete with I/O module interface, interposing relays, I/O cards, processing units and communication processors as required.

1.1.11 Redundant Fibre optic links between SAS servers and various RTUs.

1.1.12 Clock and GPS satellite clock module with cable and antenna for time synchronization of the SAS.

1.1.13 SAS I/O or Marshalling Rack as required.

1.1.14 All control, protection cables and optical fiber / ethernet cable as a communication medium between the Numerical protection / control units, RTUs and the central components.

1.1.15 All software for functional completeness and integrity.

1.1.16 All special tools and tackles as required.

1.1.17 All necessary testing/diagnostic tools (including software) for comprehensive system (hardware and software) testing. On line and off line debugging aids shall be provided for software testing.

1.1.18 All necessary transducers, interposing relays, switches and indicators mounted in the interfacing cabinets to meet the requirements, including all other necessary hardware to make the system functionally complete in all respects.

1.1.19 The SAS shall utilize all features of the IEC 61850 standards that shall include:

a) **Data Modelling** -- Complete functionality of the substation shall be modelled into different standard logical nodes which can be grouped under different logical devices with logical nodes for data/functions related to the logical device (LLN0) and physical device (LPHD) and other functions as appropriate.

b) **Reporting Schemes** -- Various reporting schemes (BRCB & URCB) for reporting data from server through a server-client relationship which shall be triggered based on pre-defined trigger conditions.

c) **Fast Transfer of events** – Use of Generic Substation Event (GSE) for fast transfer of event data for a peer-to-peer communication mode, which is subdivided into GOOSE & GSSE.

d) **Setting Groups** – Use of the Setting Group Control Blocks (SGCB) defined to handle the setting groups so that user can switch to any active group according to the requirement.

e) **Sampled Data Transfer** – Adoption of schemes defined to handle transfer of sampled values using Sampled Value Control blocks (SVCB).

f) **Commands** -- Various command types shall be supported by IEC 61850 which include direct & SBO commands with normal and enhanced securities.

g) **Data Storage** — Adoption of SCL (Substation Configuration Language) for complete storage of configured data of the substation in specific formats.

2.0.0 LIST OF CONTROLS SIGNALS

In general the SAS interface with the switchgear circuits for the SAS control and data acquisition shall include the following that shall be wired to RTU's as minimum. However during detailed engg. it can be reworked.

2.1.0 Controls

- Control i.e. Trip or Close of circuit breaker of each of the 66 kV incoming + 66kV outgoing + bus coupler and outgoing transformer circuits, 11HV Switchgear incomer + outgoing + buscoupler, Black start DG breaker + LV PMCC incomer + Outgoing + bus coupler & All LV MCCs incomer + Outgoing + bus coupler circuits.
- Control i.e. Trip or Close of disconnectors of each of the 66 kV circuits.
- Raise or Lower taps of each transformer with on load tap changers.
- Resetting of electrically reset type trip relays, as applicable.

2.2.0 Circuit Wise Alarms And Annunciation

- Main protection trip.
- Back-up protection trip (over current, earth fault, connected to one common alarm circuit).
- Transformer Urgent trip (All Buchholz, Winding Temperature High, Oil Temperature High, Pressure Relief, Low Oil Level URGENT TRIP ALARMS)-Applicable only for transformers.
- Transformer Non-Urgent trip (All Buchholz, Winding Temperature High, Oil Temperature High, Pressure Relief, Low Oil Level ALARMS)-Applicable only for transformers.
- Auto relcose initiated (Applicable for Overhead lines where applicable only).
- Auto relcose lockout. (Applicable for Overhead lines where applicable only).
- Circuit breaker inoperative.
- Circuit breaker fail protection.
- Trip circuit 1 & 2 fail.
- VT fail (where applicable).
- Protection or SAS communication channel fail.
- Intertrip receive and send.
- Switchgear 110V DC supplies fail.
- SAS fail.
- Space for 5 future alarms.

2.3.0 **General Alarms and Annunciation**

- Main busbar protection trip.
- Transfer busbar protection trip.
- Busbar protections fail.
- LV AC supply to battery charger fail & LV AC supply fail.
- Alarm DC supply fail & Battery alarm.
- Under frequency scheme operated.
- Space for 5 future alarms.

"ON / OFF" INDICATIONS FOR: -

- Circuit breaker.
- Busbar disconnectors.
- Line disconnectors.
- Line earth switches.
- CP or SAS / supervisory control in service.
- Local or remote i.e. CP control in service
- Line fault locator fault location indication.

FOR EACH TRANSFORMER

- Control selection ("master / follower")
- Control selection ("supervisory / remote")
- Tap change in progress
- Tap change incomplete alarm
- Tap changer out-or-step
- Tap position indication ("Potential free" contacts on multi position stepping switch)
- Space for 5 future alarms or indications.

3.0.0 **GIS CONTROL AND MONITORING LEVELS**

- The GIS control and monitoring system shall allow for three levels of Human Machine Interface (HMI). The number of levels includes GIS level, substation level (control room) and SAS level. Provision shall be made for future implementation of a higher level of monitoring from grid/load dispatch control centre via SAS.

- In all cases, however, only one control point shall be capable of carrying out the control functions at any given time but it shall be possible to view the CCCPP GIS/station auxiliary power distribution system status, metering indications, control targets and other parameters from any of the control levels.

- Selection between bay or substation control shall be from the bay control point on an individual equipment basis. Selection between station or SAS control shall be from the station control panel location on a per circuit basis.

- The substation operator shall control and monitor the performance of the GIS/substation using the SAS system. However under emergency it shall be possible to open or trip circuit from the control panels (CP) irrespective of the SAS or CP mode of operation. All bay level monitoring shall be affected from SAS irrespective of the selection of any of the three levels of control.

- A GIS control and relay room to be established at appropriate location in the steam turbine generator control building shall accommodate protective relay panels, control panels, and the SAS panels. All SAS servers, printers shall be in this room.

- The SAS and the relay rooms will be air-conditioned. Additional space shall be provided in the electrical room for accommodating future extension of GIS. However, all the equipment shall be designed for successful trouble free continuous operation even if air conditioning system fails.

- The details of station control level HMI/Mimic/Alarm Annuciation shall be as specified in appropriate sections of this specification.

4.0.0 SAS EQUIPMENT ENCLOSURE

- The SAS equipment shall be installed in sheet steel cabinets. The equipment shall be rack mounted. The thickness of sheet steel shall be 1.6 mm (RITTAL Make). Enclosure material shall be cold rolled sheet steel. Cabinets shall be complete with all internal wiring and connections.

- All cables, wiring, lugs and terminals in the cabinets shall be tagged or identified with labels as per approved drawings of manufacturer. Wires shall be terminated using crimping type copper cable lugs. Wires shall be ferruled and colour coded. Terminals in cabinet shall be clip on type and shall be mounted on DIN Rail. DIN rail shall have a mechanical locking mechanism for holding terminals firmly at both ends of terminal strip. For termination of electronic wiring appropriate type of terminals with suitable markings shall be provided.

- Cabinet shall be naturally ventilated type. Each cabinet shall be provided with thermostatically controlled anti-condensation heaters and illumination lamp. However if enclosure cooling fans are employed then these shall be with replaceable filter units.

- All equipment in cabinets shall be clearly identified by means of nameplates as per approved drawings and documents.

- Enclosures shall have a degree of protection not less than IP 42. The degree of protection shall be in accordance with IEC 60529.

- The floor shall not be considered as forming a part of the enclosure.

5.0.0 **HARDWARE AND SOFTWARE**

5.1.0 **Hardware**

- The system shall be designed such that the failure or removal of a single component shall not result in inadvertent operation of the GIS switching devices.
- The SAS shall be provided with self supervision features. The system offered shall provide reliable, safe and efficient operation of the substation plant items at all times with an availability figure of 99.98 percent.
- The design in so far as concerns capacity and expandability, shall meet the following requirements:-
- Equipped capacity: - the equipment as initially supplied and installed shall be capable of performing all functions to the stated capacity. A further 10% spare capacity shall be supplied and installed.
- Extension capacity: - the equipment as initially supplied and installed shall be capable of 25% extension of all functions simply by addition of plug-in modules for which all necessary wiring shall be provided. The design shall allow expansion, modification and testing with the minimum of disruption.
- Terminations: - all input/output cables shall be terminated within the cubicle on terminal blocks which incorporate removable links.

5.2.0 **Software**

- The software shall be of modular construction and developed using structured design techniques, where possible standard library software modules shall be utilised.
- The software shall be pre-programmed and verified by simulation before despatch. There shall be facilities for on board re-programming. Reprogramming shall be carried out using a portable engineering PC.
- The programming language shall be graphical / user-friendly. The control programmes shall be modular in structure.
- The software shall guide the user, step-by-step, through each sequence by identifying, preferably via a visual technique on the workstation, the remaining valid entries.

5.3.0 SAS Functionality 66kV System Control: - P & Q & Voltage Load Flow Monitoring & Analysis, Status Monitor/Control.

These shall include:-

- Bus Voltage & Angle, Branch P & Q Load Flow Monitoring & Analysis.
- Fault Analysis.
- State Estimation From Real Time Measurements.
- Real Time Online study Mode (PAS i.e. Power Application Software) based on data originating from the network that will be utilized with results directly relate to actual situation & Offline Mode Analysis.
- Status Monitoring & Metering.
- Status Change & Violations Monitoring.

- Circuit Mode Monitoring Local, Remote Or Supervisory.
- 66 kV Electrical System Circuit Control.
- Contingency Analysis To Identify Overload & Load shedding/ Overload Monitoring.
- Each Branch Load Management With Demand Side Load Control.
- For each feeder variables such as bus voltage, transformer tap position and loading, voltage regulator status, feeder/transformer/branch amperage, loading, losses and voltage drops, cumulative voltage drops.
- Grid & Generator transformer & station transformer load management using data from transformer monitoring equipment to assess short term overload capability of transformers during emergences to allow evaluation of load balancing/allocation between transformers.

SAS Main System Functions:

These shall include:-

- HMI as per specification.
- Network Control & Monitoring as per specification.
- Disturbance Data Processing For Pre & Post Fault Analysis.
- Energy Accounting.
- Historical Data processing.
- Intelligent Alarm Management.
- Enhanced Information-Safety/ Permit To Work Tagging.
- Enhanced Presentation Of Network With Topology Network Colouring.
- Supervisory Control-Interlocking/Seq Switching / Select Before Operate.
- Advanced Monitoring-AVR, Governor & Relay Parameter Sets Handling For Checking/Changing/Uploading Or Downloading.
- Hand Dressing Or Manual Updating.
- Others As Per Spec,

SAS Communication Functions:

These shall have standardization with openness of Interfaces & Protocols with data rate, speed and band width suitable for data exchanges between,

Retrieving Data & Downloading Set Points/Data To All Circuit Numerical Control & Protection Devices,

- Retrieving Data & Downloading Set Points/Data to all Governors,
- Retrieving Data & Downloading Set Points/Data to all AVR's,
- Retrieving Data & Downloading Set Points/Data to all Transformer Tap Changer,

  Controllers Retrieving Data & Downloading Set Points/Data to all RTUs,
- Retrieving Data & Downloading Set Points/Data to all RIO's,

6.0.0 COMMUNICATION NETWORK

6.1.0 General

The physical media for the communication bus can be Ethernet cable (electrical) or fibre optic cable or a combination of both, based on the distances between various nodes. Procedure of data transmission, error control and recovery shall be as per acceptable standards. Connectors and splices as possible shall be used. Connectors shall only be used to connect equipment in patch panels.

6.2.0 Printers

Each workstation shall be provided with high performance hard copy Laser-jet colour printer along with additional black and white dot matrix type of robust construction suitable for continuous duty utilizing fanfold paper. The dot matrix printers shall support a minimum print carriage width of 80 columns with a minimum resolution of 360 dpi.

The devices shall contain off-line self-test systems that provide the capability of adjustment and maintenance without interfering with the remainder of the computer system.

Printer consumables shall be readily available.

The printing shall have a redundant facility, and in the event of a failure, the design should enable a switchover to a standby printer, both automatic and manual. The switchover shall provide both audible and visual alarms on the HMI's.

6.3.0 Digital and Analogue Annunciators

Standalone digital and analogue annunciators with a sufficient number of inputs (at least 64 windows) shall be provided for acquisition for general station alarms of the conventional type (e.g. fire fighting equipment operated, station ac/dc supply failure, HVAC failure, non-numerical devices, etc.), and for measuring transformer oil and winding temp, station outdoor and indoor temperature, dc system loads etc. the annunciators shall have the ability to time-stamp all the events with a resolution of 1 ms and shall be suitably integrated into the SAS system.

6.4.0 Global Positioning System (GPS) Receiver

GPS satellite receiver modules in redundant configuration with optical ports shall be provided with antenna cable. The module shall provide time synchronization of the SAS and protection equipment in order to guarantee a system wide accuracy of time related data of better than 1ms and also shall have facility for extending the GPS synchronization to other internal equipment clocks.

6.5.0 Substation Clock

A substation clock system shall be provided to update the substation control system with accurate date/time information. Updating shall take place automatically at start up and regularly thereafter to ensure that the error between the substation clock time and the substation control system does not exceed 1 ms. The equipment shall be supplied with sufficient outputs of the correct type to meet these operating requirements.

The clock system shall ensure connectivity to global time references such as GPS satellite receivers. The system shall receive UTC GPS time signals to provide accurate date/time information to maintain the crystal controlled.

7.0.0 ISLANDING SCHEME

Islanding scheme shall be provided for the entire 66kV GIS as below :

The grid isolation relay shall operate based on either or all of the following principles:

- Multistage under frequency unit with adjustable time delay features.
- Multistage under voltage unit with adjustable time delay features.
- Voltage vector shift and / or rate change of frequency (df/dt) feature.

System shall have a separate dedicated islanding trip relay for each of the EHV breaker including future bays as per switchyard SLD.

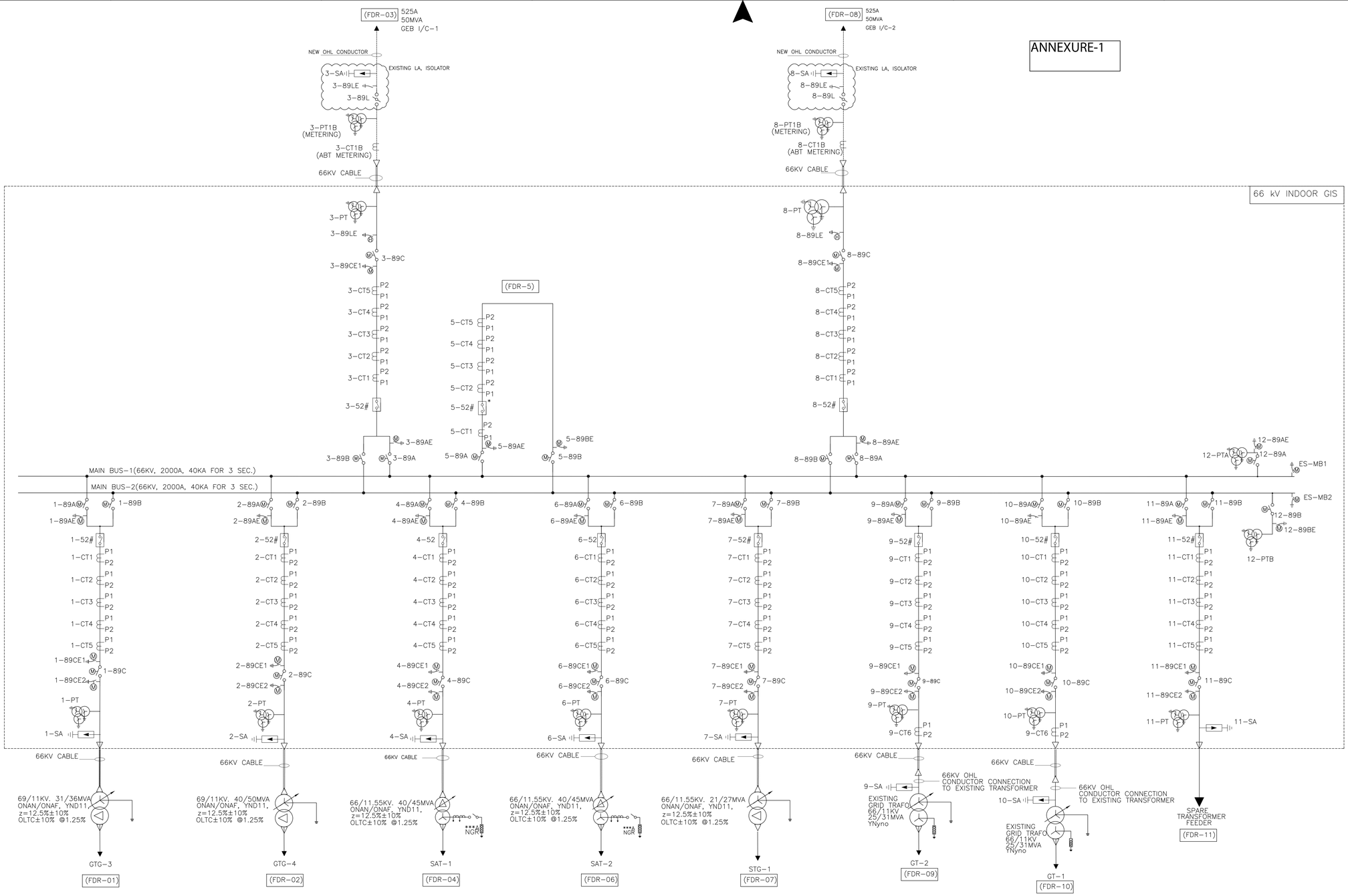
The grid isolation relay shall be fast acting and shall be unaffected by harmonics.

System shall employ two out of three channels for high reliability.

Each of the three channels of islanding scheme shall be independent from each other, starting from the VT measuring core, control cables, DC supplies, under frequency or df / dt measuring relay, etc. till the islanding trip relay of the breaker.

Separately fused 110V DC supplies shall be employed.

ANNEXURE-1



CLIENT:

OIL AND NATURAL GAS CORPORATION LTD.
AT HAZIRA PLANT, GUJARAT.

EPC CONTRACTOR:

BHARAT HEAVY ELECTRICALS LTD
TRANSMISSION BUSINESS GROUP

REV	DATE	DESCRIPTION	AA/MM	VK	AS
01	10.08.15	DRG REVISED AS PER ONGC/FE COMMENTS DATED 02.06.2015 ALL LINE/TRFR CHANGED TO 66KV CABLE. 66KV SA PROVIDED IN GIS.	DRN.	CHKD	APPD

FICHTNER
Consulting Engineers (India) Private Limited
Chennai, Bangalore.

DRN.	CHKD	APPD	DATE
DM	MM	AS	7/8/15

PROJECT:
1x51 MW COMBINED CYCLE COGENERATION CATIVE POWER PLANT

TITLE
SLD FOR 66KV GIS

SIG. | DWG NO.: TB-0-383-510-001 | SHEET: 01 OF 02 | SCALE: | REV.01

CT PARAMETERS OF GTG#3, GTG#4 TR BAY

Core No.	Current Ratio	Accuracy Class	Min. Burden	Min kPV	Max RCT at 75 Deg	Max Im at kPV /2	Purpose
1	500 / 1	PS	-	700 V	5 Ohms	30 mA	87O & 50/51
2	500 / 1	PS	-	700 V	5 Ohms	30 mA	87T / 64REF/64S
3	500 / 1	0.2S , ISF<5	30 VA	-	-	-	BCU/Tariff Matering
4	500 / 1	PS	-	700 V	5 Ohms	30 mA	SPARE
5	500 / 1	PS	-	700 V	5 Ohms	30 mA	87B

CT PARAMETERS OF SAT#1, SAT#2 BAY

Core No.	Current Ratio	Accuracy Class	Min. Burden	Min kPV	Max RCT at 75 Deg	Max Im at kPV /2	Purpose
1	500 / 1	PS	-	700 V	5 Ohms	30 mA	87T , 64REF
2	500 / 1	PS	-	700 V	5 Ohms	30 mA	50/51
3	500 / 1	0.2S , ISF<5	30 VA	-	-	-	BCU/Tariff Matering
4	500 / 1	PS	-	700 V	5 Ohms	30 mA	51G/SPARE
5	500 / 1	PS	-	700 V	5 Ohms	30 mA	87B/50LBB

CT PARAMETERS OF GT#1(EXISTING),GT#2(EXISTING)

Core No.	Current Ratio	Accuracy Class	Min. Burden	Min kPV	Max RCT at 75 Deg	Max Im at kPV /2	Purpose
1	300 / 1	1	30 VA	-	-	-	Metering (Existing)
2	300 / 1	5P10	50 VA	-	-	-	51, 51N , 67, 67N (Existing)
3	300 / 1	PS	-	700 V	3 Ohms	30 mA	87GT (Existing)
4	500 / 1	PS	-	2000 V	20 Ohms	30 mA	SPARE
5	500 / 1	PS	-	2000 V	20 Ohms	30 mA	87B

Core No.	Current Ratio	Accuracy Class	Min. Burden	Min kPV	Max RCT at 75 Deg	Max Im at kPV /2	Purpose
1	300 / 1	PS	-	700 V	5 Ohms	30 mA	Differential Protection

CT PARAMETERS OF INCOMER#1,INCOMER#2
OUTDOOR CT:– (GETCO SPECIFICATION)

Core No.	Current Ratio	Accuracy Class	Min. Burden	Min kPV	Max RCT at 75 Deg	Max Im at kPV /2	Purpose
1	600 / 1	0.2s	5 VA	-	-	-	Metering (Tariff)

INDOOR GIS CT:–

Core No.	Current Ratio	Accuracy Class	Min. Burden	Min kPV	Max RCT at 75 Deg	Max Im at kPV /2	Purpose
1	600 / 1	0.2s	30 VA	-	-	-	Metering (Tariff)
2	600 / 1	PS	-	700 V	5 Ohms	30 mA	Line Main Protection – Distance
3	600 / 1	5P20	15 VA	-	-	-	Line Backup Protection
4	600 / 1	0.2	30 VA	-	-	-	SAS Metering / Digital MFM
5	600 / 1	PS	-	700 V	5 Ohms	30 mA	87B

CT PARAMETERS OF STG#1,SPARE TRAFO.

Core No.	Current Ratio	Accuracy Class	Min. Burden	Min kPV	Max RCT at 75 Deg	Max Im at kPV /2	Purpose
1	300 / 1	PS	-	700 V	5 Ohms	30 mA	87O
2	300 / 1	PS	-	700 V	5 Ohms	30 mA	87T , REF
3	300 / 1	0.2s	30 VA	-	-	-	Metering (Tariff)
4	500 / 1	PS	-	2000 V	20 Ohms	30 mA	SPARE
5	500 / 1	PS	-	2000 V	20 Ohms	30 mA	87B

CT PARAMETERS OF BUS COUPLER

Core No.	Current Ratio	Accuracy Class	Min. Burden	Min kPV	Max RCT at 75 Deg	Max Im at kPV /2	Purpose
1	2000 / 1	PS	-	2000V	20 Ohms	30 mA	87BB2
2	2000 / 1	PS	-	2000V	20 Ohms	30 mA	87BB1
3	2000 / 1	5P20	15 VA	-	-	-	51, 51N , 50Z
4	2000 / 1	0.2s	30 VA	-	-	-	Metering/ Ammeter
5	2000 / 1	PS	-	2000 V	20 Ohms	30 mA	SPARE

SL. NO.	FEEDER DISCRIPTION	FEEDER NO.	RATING	QTY.
1.	GTG–3	01	630A	01
2.	GTG–4	02	630A	01
3.	GEB I/C–1	03	630A	01
4.	SAT–1	04	630A	01
5.	BUS COUPLER	05	2000A	01
6.	SAT–2	06	630A	01
7.	STG–1	07	630A	01
8.	GT–2	08	630A	01
9.	GEB I/C–2	09	630A	01
10.	GT–1	10	630A	01
11.	SPARE TRFR FEEDER	11	630A	01
12.	BUS VT		–	02

PARAMETERS OF GIS PT

CORE NO.	RATIO	ACCURACY	BURDEN (VA)
CORE–1	$\frac{66KV/\sqrt{3}}{110V/\sqrt{3}}$	3P	100
CORE–2	$\frac{66KV/\sqrt{3}}{110V/\sqrt{3}}$	0.2	100

METERING PT PARAMETERS OF INCOMER#1,INCOMER#2 (PT1B)
OUTDOOR PT (GETCO SPECIFICATION)

CORE NO.	RATIO	ACCURACY	BURDEN (VA)
CORE–1	$\frac{66KV/\sqrt{3}}{110V/\sqrt{3}}$	0.2	10

LEGEND

S.N.	EQUIPMENT DESCRIPTION	kV	SYMBOL	LEGEND
1.	CIRCUIT BREAKER (3–PH),	72.5		52
2.	CIRCUIT BREAKER (3–PH), WITH SYNCHRONISING FACILITY	72.5		52#
3.	ISOLATOR	72.5		89A, 89B, 89C
4.	HIGH SPEED EARTH SWITCH	72.5		89LE
5.	MAINTENANCE EARTH SWITCH	72.5		89AE, 89CE
6.	BUS EARTH SWITCH	72.5		ES
7.	CURRENT TRANSFORMER	72.5		CT
8.	POTENTIAL TRANSFORMER	72.5		PT
9.	SURGE ARRESTOR	60		SA
10.	66 KV XLPE CABLE TERMINATION	72.5		
11.	66 KV XLPE CABLE	72.5		
12.	66 KV SF6 TO AIR BUSHING	72.5		

NOTES:–

1. THE DETAILS OF GIS MAY CHANGE AS PER VENDOR'S STANDARD PRACTICE (LOCATION OF BUS EARTHING SWITCH, PT)
2. 3–CT1B, 8–CT1B, 3–PT1B, 8–PT1B, RATIOS MAY CHANGE AS PER GETCO GUIDELINES.
3. METERING CT & PT SHALL BE OUTDOOR TYPE.
4. RATING OF EQUIPMENTS IN SLD SHALL BE REVISED AFTER FINALIZATION /APPROVAL OF INDIVIDUAL EQUIPMENT RATING/SIZING CALCULATION .

– INDICATES CB WITH SYNCHRONISING FACILITY

REFERENCE DRAWING :–

1) KEY SINGLE LINE DIAGRAM BHEL PD DWG. NO. – 0–381–21–02259
1) 66KV SYSTEM SINGLE LINE DIAGRAM (TENDER DRG) DWG. NO. – 00–5111168–E–203

REV	DATE	DRN.	CHKD	APPD	SIG.
		DRG REVISED AS PER ONGC/FE COMMENTS DATED 02.06.2015 ALL LINE/TRFR CHANGED TO 66KV CABLE. 66KV SA PROVIDED IN GIS.			
01	10.08.15	MM/AA	VK	AS	

CLIENT:
OIL AND NATURAL GAS CORPORATION LTD.
AT HAZIRA PLANT, GUJARAT.

EPC CONTRACTOR:
BHARAT HEAVY ELECTRICALS LTD
TRANSMISSION BUSINESS GROUP

FICHTNER
Consulting Engineers (India) Private Limited
Chennai, Bangalore.

PROJECT:
1x51 MW COMBINED CYCLE COGENERATION CATIVE POWER PLANT

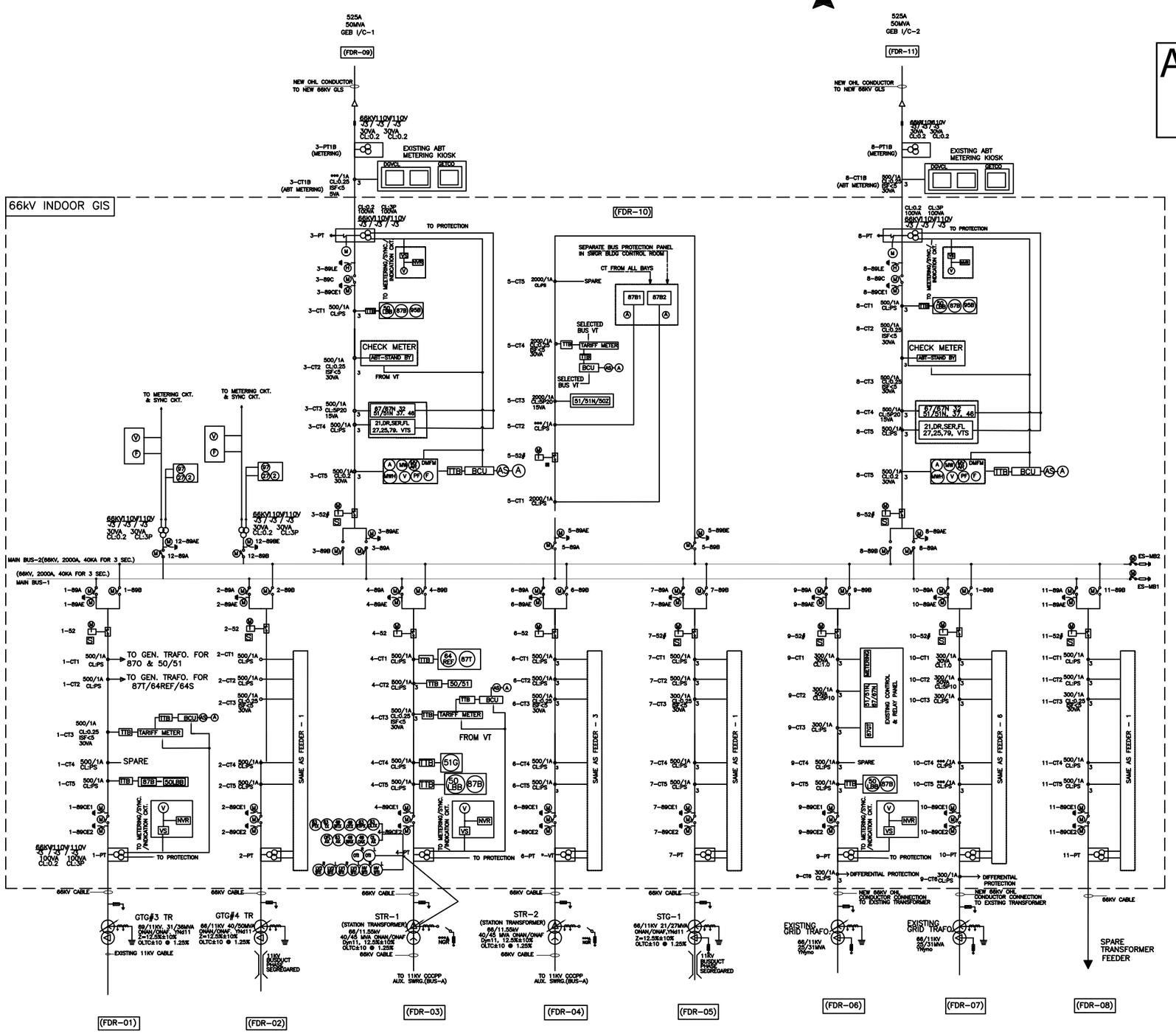
DRN.	CHKD	APPD	DATE
DM	MM	AS	7/8/15

TITLE
SLD FOR 66KV GIS

DWG NO.: TB–0–383–510–001 | SHEET: 02 OF 02 | SCALE: | REV.01

FICHTNER-A3

ANNEXURE-2



NOTE:-

1. Wherever required Aux CT/VT will be provided
2. Bushing CT Parameters for all the CT Taps are indicated in their respective R&D Plate Drawings.
3. All main protection relays shall be numerical type complying to IEC 61850 communication protocol
4. All Relays are mounted in SRP.
5. Disturbance Recorder shall be in-built in Main-1 Distance Protection Relay.

* LOCATION OF ADDITIONAL CHECK METER AS PER POINT NO. 7 OF CLAUSE NO. 23.2.0 OF SPECIFICATION TO BE INFORMED BY DGVCL/GETCO

** ZONE-1 AND ZONE-2 66kV BUS PROTECTION SHALL BE INCORPORATED IN A SEPARATE DEDICATED BUSBAR PROTECTION RELAY PANEL TO BE LOCATED IN SWGR BUILDING CONTROL ROOM

*** CT DETAILS TO BE GIVEN BY CUSTOMER

CLIENT:
OIL AND NATURAL GAS CORPORATION LTD.
AT HAZIRA PLANT, GUJARAT.

EPC CONTRACTOR:
BHARAT HEAVY ELECTRICALS LTD
HYDERABAD

FICHTNER
Consulting Engineers (India) Private Limited
Chennai, Bangalore.

PROJECT:
1x51 MW COMBINED CYCLE COGENERATION CATIVE POWER PLANT

DESCRIPTION	SIG.	DRN.	CHKD	APPD	DATE
		RK -sd-	VK -sd-		21.7.15

TITLE: KEY PROTECTION & METERING SINGLE LINE DIAGRAM

DWG NO.: TB-3-383-510-007 | SHEET: 1 OF 2 | SCALE: | REV.0

FICHTNER-A3

FEEDER NO.	FEEDER DISCRIPTION	BAY NO.	RATING	QTY.
1.	GTG-3	36MVA	380A	01
2.	GTG-4	50MVA	525A	01
3.	SAT-1	45MVA	475A	01
4.	SAT-2	45MVA	475A	01
5.	STG-1	27MVA	285A	01
6.	GT-2	31MVA	326A	01
7.	GT-1	31MVA	630A	01
8.	GEB I/C-1	50MVA	525A	01
9.	GEB I/C-2	50MVA	525A	01
10.	BUS COUPLER		2000A	01
11.	SPARE TRANSFORMER FEEDER			01

BUS AND LINE PT PARAMETERS

CORE NO	RATIO	ACCURACY	BURDEN (VA)
CORE-1	$\frac{66KV/\sqrt{3}}{110V/\sqrt{3}}$	3P	100
CORE-2	$\frac{66KV/\sqrt{3}}{110V/\sqrt{3}}$	0.2	100

METERING PT FOR INCOMERS# 1 & 2

CORE NO	RATIO	ACCURACY	BURDEN (VA)
CORE-1	$\frac{66KV/\sqrt{3}}{110V/\sqrt{3}}$	0.2	30
CORE-2	$\frac{66KV/\sqrt{3}}{110V/\sqrt{3}}$	0.2	30

CT PARAMETERS OF GTG#3, GTG#4, STR#1, STR#2 FEEDERS

	CT Ratio used	Min KPV	Imag	Min Burden	Acc Class	Rct at 75Deg	Purpose
CT-1	500	700V	30mA at KPV/2	-	PS	5	87O
CT-2	500	700V	30mA at KPV/2	-	PS	5	87T, 64REF, 50Z, 51, 51N, 25, 51NS
CT-3	500	-	-	30VA	0.2s	-	Metering (Tariff), A (AS)
CT-4	500	700V	30mA at KPV/2	-	PS		Spare
CT-5	500	700V	30mA at KPV/2	-	PS		87B

CT PARAMETERS OF STG#1.SPARE

	CT Ratio used	Min KPV	Imag	Min Burden	Acc Class	Rct at 75Deg	Purpose
CT-1	500	700V	30mA at KPV/2	-	PS	5	87O
CT-2	500	700V	30mA at KPV/2	-	PS	5	87T, 64REF, 50Z, 51, 51N, 25, 51NS
CT-3	300	-	-	30VA	0.2s	-	Metering (Tariff), A (AS)
CT-4	500	700V	30mA at KPV/2	-	PS		Spare
CT-5	500	700V	30mA at KPV/2	-	PS		87B

CT PARAMETERS OF GT#1(EXISTING).GT#2(EXISTING)

	CT Ratio used	Min KPV	Imag	Min Burden	Acc Class	Rct at 75Deg	Purpose
CT1	300	-	-	30VA	1	-	Metering (Existing)
CT2	300	-	-	50VA	5P10	-	51, 51N, 67, 67N (Existing)
CT3	300	700V	30mA at KPV/2	-	PS	3*	87GT (Existing)
CT4	500	700V	30mA at KPV/2	-	PS	5	Spare
CT5	500	700V	30mA at KPV/2	-	PS	5	87B
CT6	300	700V	30mA at KPV/2	-	PS	5	Differential protection

CT PARAMETERS OF INCOMER#1,INCOMER#2

	CT Ratio used	Min KPV	Imag	Min Burden	Acc Class	Rct at 75Deg	Purpose
CT-1	500	-	-	30VA	0.2s	-	Metering (Tariff)
CT-1	500	700V	30mA at KPV/2	-	PS	5	87B
CT-2	500	-	-	30VA	0.2s	-	Metering (Tariff)
CT-3	500	-	-	15VA	5P20	-	51, 51N, 67, 67N, 37, 32, 46
CT-4	500	700V	30mA at KPV/2	-	PS	5	21, DR, SER, FL, 27, 25, 79, VTS, 50Z, 59
CT-5	500	-	-	30VA	0.2	-	MW, MVAR, A, V, PF, F, MWH (MFM), To SAS metering

CT PARAMETERS OF INCOMER#1,INCOMER#2

	CT Ratio used	Min KPV	Imag	Min Burden	Acc Class	Rct at 75Deg	Purpose
CT1B	500	-	-	30VA	0.2s	-	Metering (Tariff)

CT PARAMETERS OF BUS COUPLER

	CT Ratio used	Min KPV	Imag	Min Burden	Acc Class	Rct at 75Deg	Purpose
CT-1	2000	2000V	30mA at KPV/2	-	PS	20	87B2
CT-2	2000	2000V	30mA at KPV/2	-	PS	20	87B1
CT-3	2000	-	-	15VA	5P20	-	51, 51N, 50Z, 25
CT-4	2000	-	-	30VA	0.2s	-	A (AS)
CT-5	2000	2000V	30mA at KPV/2	-	PS	20	Spare

LEGEND

S.N.	EQUIPMENT DESCRIPTION	Current (Ampere)	KV	SYMBOL
1.	CIRCUIT BREAKER (3-PH),	630	72.5	
2.	DISCONNECTING SWITCH WITH EARTH SWITCH		72.5	
3.	HIGH SPEED EARTH SWITCH		72.5	
4.	MAINTENANCE EARTH SWITCH		72.5	
5.	CURRENT TRANSFORMER		72.5	
6.	POTENTIAL TRANSFORMER	630	72.5	
7.	SURGE ARRESTOR	630	72.5	
	66 KV XLPE CABLE		72.5	

METERING DETAILS

LEGENDS	SYMBOL
(A)	AMMETER
(V)	VOLTMETER
(F)	FREQUENCY METER
VS	VOLTAGE SELECTOR SWITCH
AS	AMMETER SELECTOR SWITCH
PF	POWER FACTOR METER
MW	ACTIVE POWER METER
MVAR	MEGA VAR METER
MWH	MEGA WATT HOUR METER
BCU	BAY CONTROL UNIT

RELAYING

NEMA DEVICE No.	FUNCTION
50	INSTANTANEOUS OVER CURRENT RELAY
50N	INSTANTANEOUS EARTH FAULT RELAY
51	IDMT OVER CURRENT RELAY
51N	IDMT EARTH FAULT RELAY
63	AUXILIARY RELAY FOR TRANSFORMER
64R	TRANSFORMER RESTRICTED EARTH FAULT
67	DIRECTIONAL OVER CURRENT RELAY
67N	DIRECTIONAL EARTH FAULT RELAY
87T	TRANSFORMER DIFFERENTIEL
87O	OVERALL DIFFERENTIAL OF TRANSFORMER
87B	BUS BAR DIFFERENTIAL OF TRANSFORMER
50LBB	LOCAL BREAKER BACKUP PROTECTION
S	CIRCUIT BREAKER WITH SYNCHRONISING FACILITY
95	TRIP CIRCUIT SUPERVISION RELAY
95B	CT SUPERVISION RELAY
51G	BACK UP EARTH FAULT RELAY
86	HIGH SPEED TRIPPING RELAY
49-OAX/OTX	OIL TEMPERATURE HIGH ALARM/TRIP AUX. RELAYS
49-WAX/WTX	WINDING TEMPERATURE HIGH ALARM/TRIP AUX. RELAYS
63PRTX	AUX. RELAY FOR PRESSURE RELIEF DEVICE-TRIP
63-AX/TX	BUCHHOLZ RELAY, ALARM/TRIP AUX. RELAYS
63OLTX	OLTC OIL SURGE TRIP AUX. RELAYS
OLAX	OIL LEVEL LOW ALARM AUX. RELAYS
WTI L/R	WINDING TEMPERATURE INDICATOR-LOCAL/REMOTE
OFLAX	OIL FLOW LOW ALARM AUX. RELAYS
63RTPX	OLTC STUCK ALARM AUX. RELAYS
OTI L/R	OIL TEMPERATURE INDICATOR-LOCAL/REMOTE
NVR	NO VOLTAGE DETECTION RELAY
2	TIMER RELAY
25	CHECK SYNCHRONISING RELAY
21	DISTANCE PROTECTION RELAY

REFERENCE DRAWING :-

1) KEY SINGLE LINE DIAGRAM DWG. NO. -00-5111168-E-203 Rev B
2) 11KV CCCPP AUX. SWITCHGEAR SLD DWG. NO.- 1-381-21-02884 REV. 00
3) ENGINEERING DESIGN BASIS EIL DOC. NO. - 5111168-ME-SPC-100-001 R1

CLIENT:
OIL AND NATURAL GAS CORPORATION LTD.
AT HAZIRA PLANT, GUJARAT.

EPC CONTRACTOR:
BHARAT HEAVY ELECTRICALS LTD
HYDERABAD

FICHTNER
Consulting Engineers
(India) Private Limited
Chennai, Bangalore.

PROJECT:
1x51 MW COMBINED CYCLE
COGENERATION CATIVE POWER PLANT

DRN.	CHKD	APPD	DATE
RK -sd-	VK -sd-		21.7.15

TITLE
KEY PROTECTION & METERING SINGLE LINE DIAGRAM

DESCRIPTION	SIG.	DWG NO.: TB-3-383-510-007	SHEET: 1 OF 2	SCALE:	REV. 0

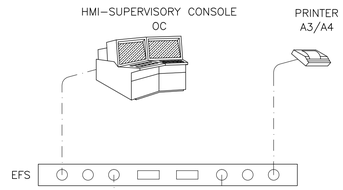
REV. B

DWG. NO. 10-5111168-E-204

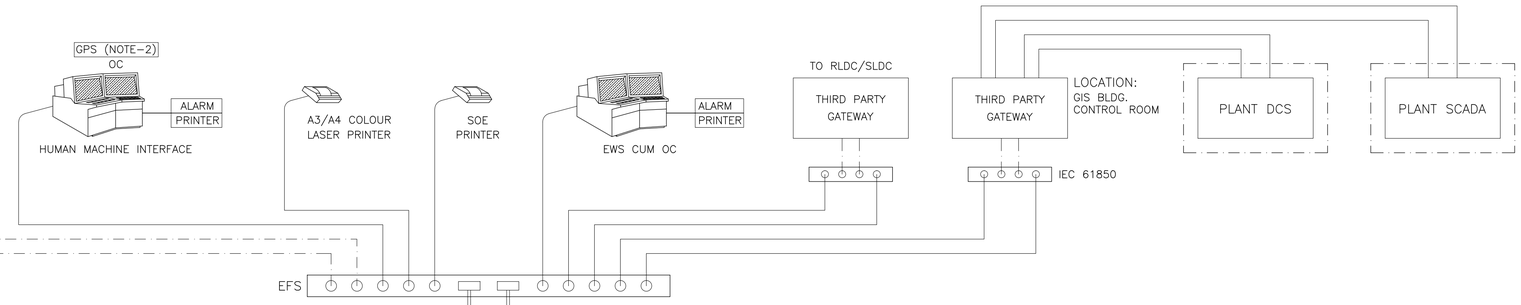
ANNEXURE-3

SUPERVISORY CONSOLE (SUPERVISOR'S OFFICE) GIS BLDG. CONTROL ROOM

(SAS level)

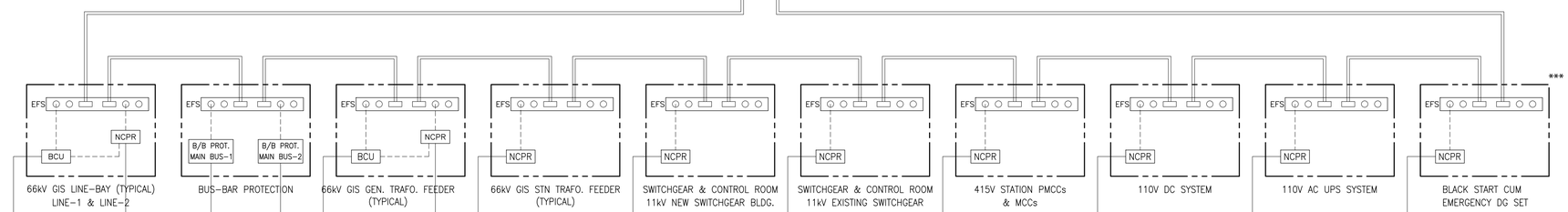


OPERATOR CONSOLE (MASTER STATION LEVEL) SWITCHGEAR BLDG. CONTROL ROOM



STATION LEVEL BAY CONTROL UNIT

(Sub-Station level)



66kV GIS CONTROL LEVEL

(GIS level)

66kV GIS / TRANSFORMER MARSHALLING PANEL (THROUGH LCC OF GIS)

LEGEND:–

———	HARDWIRED CABLES
═══	REDUNDANT FIBRE OPTIC CABLE TCP/IP RING(MULTI MODE)
– · – · –	FIBRE OPTIC CABLE (MULTI MODE)
- - - - - -	UTP CABLE RJ45 ETHERNET LINK
———	COPPER WIRE, RJ45, 2WIRE LINK
EWS	ENGINEERING WORK STATION
EFS	ETHERNET FIBER SWITCH
OC	OPERATOR CONSOLE
HMI	HUMAN MACHINE INTERFACE
SOE	SEQUENCE OF EVENTS
NCPR	NUMERICAL CONTROL & PROTECTION RELAY
BCU	BAY CONTROL UNIT
RTU	REMOTE TERMINAL UNIT
RLDC	REGIONAL LOAD DESPATCH CENTER
SLDC	STATE LOAD DESPATCH CENTER
FO	FIBER OPTIC

NOTES:–

1... THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE SPECIFICATION
2... GPS RECEIVER SHALL BE PROVIDED AS REQUIRED TO SYNCHRONIZE AND TIME STAMP AT GIS & STATION LEVEL.
3... THE ACTUAL NUMBER OF I/O'S SHALL BE ESTIMATED BY CONTRACTOR / SUPPLIER.
4... ALL NECESSARY SOFTWARE FOR HMI AND CONFIGURATION WITH REQUIRED LICENSE SHALL BE PROVIDED FOR PROTECTION, CONTROL MONITORING AND OPERATING OF SAS FROM HMI.
5... SAS SHALL HAVE THE FOLLOWING REDUNDANCY:
* POWER SUPPLY
* CONTROL PROCESSOR
* COMMUNICATION NETWORK
* HMI SERVER
6... CRITICAL SIGNALS FOR PROTECTION SHALL BE HARDWIRED TO THE SAS, THERE SHALL BE PROVISION IN SAS FOR SYNCHRONIZATION SIGNAL FROM THE MAIN PLANT MASTER CLOCK SYSTEM.
7... EACH ETHERNET FIBER SWITCH (EFS) TO BE PROVIDED WITH 2Nos. SPARE PORTS.

*** SHALL ALSO INCLUDE HARDWARE FOR-
A) ISLANDING SCHEME
B) LOD SHEDDING
C) ENERGY MANAGEMENT

FOR TENDER PURPOSE ONLY

REV.	DATE	DESCRIPTION	DRN.	STR.	MECH.	PROC.	ELEC.	INST.	APPD.
				CHECKED & CLEARED					
B	17.05.12	RELESED FOR TENDER PURPOSE ONLY	DRP	--	--	--			
				--	--	--	APK		AVD
A	23.04.12	PRELIMINARY FOR TENDER PURPOSE	SDK	--	--	--			
				--	--	--	APK		AVD

FICHTNER
Consulting Engineers (India) Private Limited
Mumbai

CLIENT
OIL AND NATURAL GAS CORPORATION LTD.
COMBINED CYCLE CAPTIVE POWER PLANT
AT HAZIRA PLANT, GUJARAT.

	SIGNATURE		DATE
DRAWN	RWV	RWV	24.03.12
DESIGNED		APK	24.03.12
CHECKED		HN	24.03.12
APPROVED		AVD	24.03.12
PROJ. MGR		SG	24.03.12

TITLE
SCADA ARCHITECTURE DIAGRAM

CLEARED (FOR RO ONLY)		SIGNATURE		DATE
	STRUCTURAL	--	--	--
	MECHANICAL	--	--	--
	PROCESS	--	--	--
	ELECTRICAL	--	--	--
	INST.	--	--	--

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4.9.0 **Generator Remote Automation System Control Facilities**

In addition to local controls of features stated below, each turbine driven generator set shall have features for interface with remote generator control/monitoring and remote automation system such as SAS / DCS.

These shall include:-

- Local / Remote or Auto selection switch with their status indication to remote system
- Initiation of remote generator auto synchronizing.
- Remote automatic and/or manual changeover of generating operating mode along with their remote status indication such as those associated with:-
  - Generator excitation / AVR control in either of the Voltage Control or Power Factor or Mvar control mode.
  - Generator Speed control in either of the droop or isochronous or isochronous load sharing or isochronous base load operation.
- Remote automatic and / or manual generator voltage and frequency control:-
  - Generator power reference setting/Speed raise and lower control
  - Generator voltage raise and lower control
  - Generator load acceptance and reduction rate change
- Remote automatic and/or manual equal or unequal load allocation/sharing between sets as required
- Remote annunciation of all generator fault and alarm signals
- Remote transfer of generator capability diagram and generator operating point on the capability curve for mimicking of generation capability and operating point at the HMI of the remote automation system

Generator and the generator control system supplier shall:-

- Include and list all analogue inputs, analogue outputs, digital inputs, digital outputs, transducer input / outputs, pulse control inputs required and incorporated by them for remote automation system control.

- Furnish details of communication protocol and access address of all analogue inputs, analogue outputs, digital inputs, digital outputs, transducer input / outputs, pulse control inputs as required for interface by the remote automation system supplier.

Substation Automation System

This document aims to explain the Functional design of Sub-Station Automation system (SAS) proposed for the project.

I. Introduction

The scope shall comprise of design , engineering , software development , manufacturing, testing at works , supply , delivery , erection , configuring , on site testing and commissioning of Sub-station Automation system associated with the CCCPP , 66kV GIS and the station auxiliary electrical power HV & LV distribution switchgear . The SAS confirms to the IEC 61850 standards and shall be based on a decentralized architecture.

II. System Design

Control & Monitoring Levels (Refer SCADA architecture 10-5111168-E-204,)
The control & monitoring of the GIS shall be structured into three levels-

a. GIS Level (Through GIS LCC)
b. Substation Level (Through BCU)
c. SAS Level (Through HMI)

II .1 GIS Level

- At GIS level, the Local Control Cubicle (LCC) located on the GIS shall provide the Bay Control & Indication functions like control & status indications.
- Each 66kV GIS LCC shall have a Mimic diagram of the associated bay as well as a Local/Remote Selector Switch (Local-GIS LCC & Remote-BCU/SAS). In local Mode following operations shall be possible from LCC-
  a. Control of the Circuit breaker.
  b. Open/Close of associated bay Disconnectors.
  c. Open/Close of associated bay Earth switches.
- A window type alarm annunciation shall be provided on the LCC of each Bay for annunciation of abnormal conditions.
- In case of generator feeder remote operation is envisaged from SAS/GCP.

II .2 Substation Level (Through BCU)

- Control & Monitoring at Sub-Station Level shall be through Bay Control Units and respective bay protection functions shall be through Bay Protection Units (BPU).

- At bay Level, the BCUs shall obtain Digital inputs for status indication & analog Outputs (Current & Voltage) and also facilitate the issue of command through digital outputs. Each BCU shall have an SLD of the respective Bay, on its screen.
- Each bay control unit is independent of the other and its functioning is not affected by any fault occurring in any of the other bay control units of the station.
- The bay level IEDs shall be located in the GIS control room. The selection between Substation Level or SAS level control shall be from each BCU.

- The data exchange among bay level IEDs shall be realized using IEC-61850 protocol with redundant managed Switched Ethernet communication protocol. The communication shall be made in a fault tolerant ring in redundant mode , excluding the links between individual bay IEDs to switch wherein the redundant connections are not envisaged . It shall be such that failure of one set of fibre shall not affect the normal operation of the SAS.
- In addition to BCUs for 66kV GIS , necessary BCUs shall be provided for the Plant Auxiliaries for control & monitoring purposes. Location of the same shall be either at the GIS control Building or at Plant Central Control room.

II.3 SAS Level (Through HMI)

- Station level comprises of control & monitoring operation by HMI PC located in the main control room through Bay Control Unit when embedded L/R switch (on BCU) is in Remote mode.
- At this level the entire station shall be controlled and supervised from the station HMI.
- Clear control priorities shall prevent operation of a single switch at the same time from more than one of the various control Levels. The priority shall always be on the lowest enabled control level.
- This level also contains the station oriented functions which cannot be realised at bay level/local level of control eg. Alarm list or event list related to the entire station, gateway for communication with remote control centres.
- An animated single line diagram of the electrical substation allow displaying the status of different equipments with their associated measurements and statuses. The position of each switchgear, e.g. circuit breaker, isolator, earth switch, transformer tap changer etc, shall be supervised continuously. Every detected change of position shall be immediately displayed in the single line diagram (SLD) on the station HMI screen, recorded in the event list, and a hard copy printout of the corresponding event (if configured for logging) shall be produced in the Dot Matrix printer. Alarms shall be initiated in case of spontaneous position changes.

III Functional Description

SAS functionality shall cater to following systems–

- 66kV GIS System
- 11kV System
- 415V System

III.1 66kV GIS System

When the control is in SAS mode following functions are envisaged–

- For 66kV Line Incomers , STR-1 , STR-2 & Bus Coupler –

a) Manual synchronization is envisaged at Bay / Station Level through BCU / HMI of SAS respectively.
b) Tripping of the Circuit breakers.
c) Open/close of associated isolator /earth switches
d) Raise/Lower taps of the Station transformer.

- For GTG-3, GTG-4 & STG-1–
  a) Auto-synch. of the 66kV generator breakers.
  b) Dead-bus synch. Of the 66kV generator breakers.
  c) Tripping of the generator breakers.
  d) Open/close of associated isolator /earth switches
  e) Raise/Lower taps of the Generator transformer.
  f) Remote changeover of generating operating mode along with their remote status indications such as those associated with –
     (i) Generator excitation/AVR control in either of the Voltage control or Power factor or MVAR control mode.
     (ii) Generator speed control in either of the droop or isochronous or isochronous load sharing or isochronous base load operation.

  g) Remote generator voltage and frequency control-

     (i) Generator power reference setting /speed raise and lower control.

     (ii) Generator voltage raise and lower control.

     (iii) Generator load acceptance and reduction rate change.

- For Existing grid Transformers –
  a) Manual synch. of grid transformers.
  b) Dead-bus synch. of grid transformers.
  c) Tripping of the circuit breakers.
  d) Open/close of associated isolator /earth switches

- Monitoring function of SAS :
  a) Status Indications of each breaker / isolator /earth switch
  b) Tap Position indication for transformers wit OLTC.
  c) Indication of respective bay Current / Voltage and MW,MVAR & MVA values .
  d) Indication of Bus voltage and frequency.
  e) Alarm/ fault / discrepancy indication & annunciation.

- Protection Functions :
  a) Protection functions in line with Key protection SLD Doc. No. TB-3-383-510-007 shall be interfaced with SAS.
- System Control Functions :
  a) Branch P&Q Load flow monitoring & analysis.

b) Fault analysis.
c) State estimation from Real time measurements.
d) Real time Online study mode (PAS ,ie Power Application software) based on data originating from the network that will be utilized with results directly related to actual situation and Offline mode analysis.
e) Contingency analysis to identify overload & load shedding /overload monitoring.
f) Each branch Load management with demand side load control.
g) Grid , Generator Transformer & Station Transformer Load management using data from transformer monitoring equipment to assess short term overload capability of transformers during emergencies to allow evaluation of load balancing /allocation between transformers.
h) Islanding Scheme for 66kV GIS based on either or all of the following principles –
   (i) under frequency
   (ii) under voltage
   (iii) Voltage Vector shift and /or rate of change of frequency (df/dt)
i) BCU shall be provided for the 66kV GIS for control & monitoring of the Auxiliary requirement of the 66kV GIS ie, 415V ACDB , 220V/110VDCDB , Battery & battery Chargers.

III.2 **11kV System**

- 11kV Switchboard is fed from two incomers ie, two No. 66/11kV Station Transformer(STR-1&STR-2). SAS shall have provision to control ie, Tripping of 11kV Switchgear incomer /outgoing /bus-coupler under service conditions and closing of the 11kV Incomers , Buscouplers , all outgoing feeders except motor outgoing feeders.
- Control & Monitoring of existing 11kV Switchgear incomer & outgoing feeder shall be considered in SAS.
- SAS shall have provision to indicate the measured outputs of digital multi function meters provided in the existing & new 11kV feeders/bus.
- The tri-vector meter outputs of GRP shall be indicated in SAS .
- The proposed SAS shall have provision to interface with clients existing SCADA for monitoring of existing plant electrical system.

III.3 **415V System**

The functions envisaged in SAS are-

- 415V PMCC :
  a) Opening of all 415V PMCC breakers.
  b) Closing of all incomers and buscouplers in independent mode in service position.
  c) Closing of all outgoing breakers except motor outgoing breakers . (closing of motor outgoing breakers shall be from DCS in line with drive control philosophy).
  d) Status/alarm indications .
  e) Metering /Voltage /current indication.

- 415V MCC :
  a) MCC incomer & buscoupler control & monitoring is envisaged from SAS.
- 415V DG Set :
  a) When DG sets are selected for standby, AMF operation shall be scheduled from SAS.
  b) On failure of Plant normal supply an impulse shall be extended from SAS, Upon receipt of this impulse the genset shall be started automatically, brought to rated speed and generator voltage brought to rated value.
- Synchronization facility shall be provided for DG incomer, EPMCC incomers and bus couplers from SAS.

ALL DIMENSIONS ARE IN mm.

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ANNEXURE-6

ELECTRICAL CONTROL PHILOSOPHY

PROJECT : 1x51 MW COMBINED CYCLE COGENERATION CAPTIVE POWER PLANT

CLIENT : OIL AND NATURAL GAS CORPORATION LTD. AT HAZIRA PLANT, GUJARAT.

CONSULTANT : FICHTNER
Consulting Engineers (India) Private Limited
Chennai, Bangalore.

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	K.V.NAGENDRA		30.06.2015	N.A.
CHD.	G.SESHU KIRAN		30.06.2015	
APPD.	J.K PATTANAIK		30.06.2015	

RESTRICTED USE

DEPT.	UNTOL. DIMS. GR.		SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PE&SD	C/M/F		N.T.S	N.A.	N.A.	N.A.	N.A.
CODE 450							

TITLE: ELECTRICAL CONTROL PHILOSOPHY

CARD CODE: NA

DRAWING NO: 4-381-21-03670 REV. 00

SHT. No 01 NO. OF SHT. 20

A4 SIZE

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COMPUTER NO. | REF. DRG. NO. | SIGN. & DATE | INVENTORY NO.

Ref. Doc

INDEX

Legends:

CCCPP	:	Combined Cycle Captive Power Plant
GCP	:	Generator Control Panel
GIS	:	Gas Insulated Substation
GRP	:	Generator Relay Panel
GTG	:	Gas Turbine Generator
GTG#xx TR	:	Gas Turbine Generator Transformer
SAS	:	Substation Automation System
STG	:	Steam Turbine Generator
STG#xx TR	:	Steam Turbine Generator Transformer

1. OBJECTIVE

The document provides guidelines for Operation and Control philosophy of Plant electrical systems. It also covers annunciation, metering, control and indication of plant electrical systems.

2. REFERENCE DOCUMENTS

1. ONGC Contract specification Section 3.2, 3.3, 3.6.1 & 3.6.3.
2. BHEL Key Single Line Diagram (1-381-21-02259 rev 00)
3. ONGC contract 66kV system SLD (00-5111168-E-203 Rev-B)
4. BHEL 11kV Switchboard SLD (1-381-21-02884 rev 00)
5. BHEL PMCC & EPMCC Switchboard SLD (1-381-21-02885 rev 00)

3. GENERAL

The power plant electrical system is designed to meet the electrical power requirements of combined cycle power plant.

The power plant consists of 1 no. of New GTG (viz. GTG#4) having a capacity of 36.1MW, 1 no of STG (viz. STG-1) having a capacity of 22.1MW and 1 nos. of Existing GTG (viz. GTG#3) having a capacity of 25MW and provided with complete electrical system catering to the power requirements of the refinery.

Evacuation is done through 66kV GIS Switchboards. 66kV GIS Switchboard is fed from GTG#4 TR, STG#1 TR, GTG#3 TR (for existing GTG#3) through 11/69 kV Generator transformers.

The CCCPP 66KV GIS also hooked up with 66KV Ichhapore GEB substation through outdoor transmission lines and 11kV MRSS switchboard (existing) via Existing Grid transformers (69/11kV, 25/31MVA).

Synchronization facility for GTG#4, STG-1 are envisaged from respective GCP control panel and from SAS system. Further, synchronization for GTG#3 (existing), Grid Incomers (connected to Ichhapore substation), Tie line incomers (connected to MRSS substation) and Bus coupler is envisaged from SAS.

Further downstream distribution to CCCPP Auxiliaries is done through 11kV CCCPP Aux. switchgear, 415V PMCC & EPMCC. Power supply to 11kV CCCPP Aux. switchgear is fed from 66 kV GIS through Station transformers (STR-1 & 2) whereas power supply to 415V PMCC & EPMCC switchgear is fed from 11kV Aux. Switchboard through LV. Distribution transformers.

Emergency power for safe shutdown of CPP and power required for Black start of GTG is envisaged from 415V Black start cum Emergency DG set. 415V DG set connected to 415V EPMCC.

4. GENERATORS AND 66kV INDOOR GIS

The control and monitoring of Generators is envisaged from hard wired Generator Control Panel (GCP) as well as from SAS which will be located in CPP control room. The control and monitoring of complete 66kV GIS is envisaged from SAS.

66kV Indoor GIS is having following sources of supply:

(i) Incomer from existing GTG#3 through a GTG#3 TR of 11/69kV rating.
(ii) Incomer from GTG#4 through a GTG#4 TR of 11/69kV rating.
(iii) Incomer from STG#1 through a STG#1 TR of 11/69kV rating.
(iv) 2Nos direct Incomers from 66kV Ichhapore GEB sub station.
(v) 2Nos tile lines from Existing MRSS substation via transformer 11/69kV rating.

4.1. Control functions

- Auto/Manual Synchronization of GTG#3, GTG#4, STG#1, DG set, Tie-Line Incomers, Grid Incomers, Bus coupler etc.
- ON/OFF control of all incomers, outgoing feeders and bus couplers of 66 kV GIS.
- Tap changer control of GTG#3 Trafo., GTG#4 Trafo., STG#1 Trafo. & Station transformers
- Voltage and frequency control of all Generators.
- Automatic synchronizing device with inputs to governor and excitation control of selected generator(s) for automatic synchronization of the selected breakers.
- Auto/Manual Synchronization facility with complete with Double voltmeters, Double frequency meters, synchroscope, check synchronizing relay with guard relay, auto-synchronizer relay and necessary selector switches with synchro-permissive indication lamp etc. to complete the synchronizing scheme considered in generator control panel
- All other controls, as required for control/synchronization of generators, namely, field breaker control, etc.
- Independent close (for incomer1/incomer2/bus coupler) of 11kV Aux. switchboard of CCCPP.

4.2. Monitoring functions

- Voltage of 66 KV incomers and buses.
- Current of each phase of 66 KV incomers, Tie lines and bus couplers.
- Line and field voltage of each generator.
- Field current of each generator.
- Frequency of each generator.
- Power factor of each generator incomer.
- MW, MVAR & MVA of each generator incomer, outgoing feeders of 66KV GIS & incomers from switchyard.
- MWH, MVARH of each generator incomer, incomers from switchyard & Tie lines
- Voltage and frequency recorder of each bus.
- Null voltmeter of each generator.
- Tap position indicator for generator transformers & STRs.

Ref. Doc

4.3. Audio-Visual Annunciation Functions

- Operating and fault status of all protective relays and trip alarm of steam/gas turbine generators.
- Complete trip and non-trip alarm annunciation for all transformers including alarm of OLTC.
- Annunciation of all protective relays and trip alarms of all major electrical equipment's in CPP i.e. DC System
- Annunciations of GIS as per manufacturer's recommendation will be provided in SAS.

4.4. Control and Operation Philosophy

Each 66 kV GIS LCC (Local Control Cabinet) is provided with local/remote selector switch. (Local-GIS LCC, Remote-SAS). In case of Generator feeder remote operation facility is envisaged either from SAS or GCP.

i. When selector switch is selected in local mode, controls will be done from 66kV GIS LCC.
Following operations are possible from GIS when selector switch is in local mode.
- Close of all incomers and bus couplers breakers in feeder/bus earthing mode.
- Close of all outgoing breakers in feeder earthing mode.
- Open of all breakers.
- Close & Open of isolators & earth switches of all incomers, bus couplers and outgoing feeders.

ii. When selector switch is selected in remote mode, all the controls will be transferred to GCP for GTG#4 & STG-1 breakers. For GTG#3, Grid incomers, Tie-feeders and outgoing feeders, controls will be transferred to SAS.
Further, based on selector switch at GCP, control of GTG#4 & STG#1 will be possible either from GCP or from SAS or from Mark Vi(GTG-4).

a. **For GTG#4 & STG -1 feeders:**
When selector switch at GIS is selected in remote mode, controls will be transferred to GCP.

Hard wired GCP is provided with the following major selector switch for operation of Generators.

SW-1 4 position control selector switch (**OFF /GCP/Mark-VI/SAS**) for GTG#4 & 3-position selector switch (GCP/OFF/SAS) for STG-1.

SW-2 4 position synchronizing selector switch (**OFF/Dead bus/Manual Synchronizing/Auto synchronizing**) for STG#1 generator breaker & 3-position selector switch (**OFF/Dead bus/Manual Synchronizing**) for GTG#4 generator breaker.

When selector switch SW-1 in GCP is selected **in GCP mode,** following operations are envisaged from GCP (GTG#4 & STG-1):
- Close of Generator incomers breakers on dead bus condition in service mode. (Breakers dead bus closing to be checked on either side).
- Auto and Manual Synchronization for STG Generator breaker and manual synchronization for GTG#4 generator breaker in service mode.
- Open of Generator breakers.

When selector SW-1 in GCP is selected in **Mark-VI mode,** controls of 66kV GTG#4 breaker is transferred to MARK-VI (GTG#4). Following operations are possible from MARK-VI:-

- Auto Synchronization GTG#4 Generator breaker in service mode.
- Open of Generator breaker.

When selector switch SW-1 in GTG#4 & STG#1 GCP is selected in SAS mode, controls of 66kV Generator breakers are transferred to Substation Automation System (SAS).

Following operations are possible from SAS:

- Close of Generator incomers on dead bus condition in service mode (breakers dead bus closing to be checked on either side).
- Auto Synchronization of Generator incomer breakers in service mode.
- Open of Generator breakers.
- Close & Open of isolators associated with generator incomers.

As part of SAS, Auto/OFF/Dead bus selector switch shall be provided for carrying out auto synchronization & dead bus closing.

In addition to the control functions as specified above for GTG-4 & STG-1, following operations are also envisaged from SAS:-

- Remote manual changeover of generating operating mode along with their remote status indication as per below:
  - Generator excitation / AVR control in either of the Voltage Control or Power Factor or MVAR control mode.
  - Generator Speed control in either of the droop or isochronous or isochronous load sharing or isochronous base load operation.
- Remote Generator voltage and frequency control
  - Generator power reference setting/Speed raise and lower control
  - Generator voltage raise and lower control
  - Generator load acceptance and reduction rate change
- Remote automatic and/or manual equal or unequal load allocation/sharing between sets as required
- Remote transfer of generator capability diagram and generator operating point on the capability curve for mimicking of generation capability and operating point at the HMI of the remote automation system.

b. **For other 66kV grid incomers, Tie-line incomers, Bus couplers and outgoing feeders.**

When selector switch in GIS is selected in remote mode, controls are transferred to Substation Automation System (SAS):

Following selector switches are part of SAS

i. **Auto/Manual/OFF/Dead bus** synchronizing selector switch for Grid Incomers, Tie Line Incomers & Bus coupler.
ii. **OFF/GTG-4/STG-1/GTG-3/ALL** Generator selector switch for Grid Incomers Bus coupler and Tie Line Incomers.
iii. **Auto/OFF/Dead bus** synchronizing selector switch for GTG#3.

Following operations are possible from SAS:

- Close of Grid incomers, tie lines, GTG#3 incomer and bus coupler breakers on dead bus condition in service mode.
- Auto Synchronization of GTG#3 incomer in service mode.
- Manual synchronization of all Grid incomers, tie lines, bus coupler breakers in service mode.
- Close of all outgoing breakers in service mode.
- Open of all breakers.
- Close & Open of isolators.

5. 11kV Aux. SWITCH BOARD

11kV switchgear is connected with two incomers fed from 66kV GIS through two nos.66kV/11.5kV Station Transformers.

5.1. Control Scheme

All metering, control and indication will be provided on the switchgear panel. The control scheme is described in brief as follows.

Normal operating condition

i. 11kV switchgear shall be normally operated with two incomer breakers ON & the bus coupler OFF. Necessary auto changeover scheme and manual change over scheme is be provided with necessary control, indications and interlocks. Momentary paralleling facility with check synchronizing relay shall also be provided in the manual change over scheme.
ii. Auto/Independent (Dead bus closing)/Manual (Momentary paralleling) Selector Switch is provided on the switchboard & normally kept in Auto Position for Auto Changeover.
iii. The switchgear is provided with automatic in phase (microprocessor based fast bus transfer scheme, FBTS) and manual live changeover scheme for emergency and planned changeover of supply from one source to the other and vice versa.

5.1.1. 11KV Switchgear Auto Transfer:

The Auto Transfer have three modes and operate sequentially i.e Fast Transfer, In Phase Transfer, Slow Transfer.

Fast Transfer

The bus voltage and incoming source voltage should be monitored on a continuous basis for magnitude and phase angle to ensure that transfer

operation is carried out under conditions conducive to fast bus transfer as per high speed sync-check supervision and ANSI C50.41 (1982) criterion.

In Phase Transfer

The breaker power contacts shall close when the decaying and drifting bus voltage synchronizes with the incoming source voltage within acceptable voltage and frequency parameters. The Bus transfer system shall continuously process the bus voltage and the drifting phase angle dynamics to determine in real-time the exact moment of sending a command to the breaker-closing coil to achieve the above.

Slow Transfer

The breaker power contacts shall close when the falling bus voltage shall reach an acceptable safe value. The auxiliary drives are selectively tripped simultaneously to limit the transformer inrush current.

- When Incomer 1 or 2 fails, the respective unhealthy incomer is tripped through under voltage and a timer.
- Bus coupler will close automatically by sensing healthy voltage of healthy incomer.
- Auto changeover is blocked if any incomer trips due to fault or both the incomers simultaneously experience under-voltage.
  Necessary protection interlocks will also be realized in the switchboard

5.1.2. Independent operation

In independent mode either of incomer 1 or incomer2 or bus coupler can be closed in dead bus condition after ensuring relevant bus under voltage.

5.1.3. Manual operation (Momentary Paralleling Transfer)

This is a “Make before Break” transfer for a very short duration of the order of few cycles where, under supervision of the bus voltage and incoming source voltage for magnitude and phase angle, the new source breaker is closed before opening the old source breaker. Normally not recommended for unplanned transfers and auto/protective transfers from the system safety consideration

It is possible to take either of incomer1/incomer2/bus coupler for maintenance and bring it back to the normal operating condition by momentary paralleling.

In Manual mode either of incomer1 or incomer2 or bus coupler can be closed through contacts of check sync relay.

PT selection switch & Trip selector switch shall be provided on the switchboard.

5.2. Controls

11 kV Switchgear has one **local/remote** control selector switch.

(i) When selector switch is selected in **local** mode, controls will be done from 11 KV Switchgear.

Following operations are possible from Switchgear:

- Close of all incomers, bus coupler and outgoing breakers in test position.
- Close of all incomer in independent and manual mode in service position.
- Close of bus coupler breaker on auto, independent and manual mode in service and test position.
- Close of all outgoing breakers in test position.
- Open of all breakers.

(ii) When selector switch is selected in **remote** mode, controls are transferred to SAS.

Following operations are possible from SAS:

- Close of all incomers and bus couplers on independent mode only in service position.
- Close of all outgoing breakers except motor outgoing breakers in service position.
- Open of incomers, bus coupler and outgoing breakers.

5.3. Annunciation/Indications

The following contacts for remote indication of breaker are provided on SAS.

Indications:

- Close
- Open
- Service
- Ready to close (L/R in Remote, Breaker in service, Breaker Spring charged ready, Trip circuit healthy, control supply healthy, 86 not operated)

Annunciations

- 86 operated
- Under voltage trip
- Trip circuit unhealthy
- DC control supply-1 or 2 fail (common for switchgear)
- Transformer trouble (only for Transformer outgoing feeder).
- Incomer Line PT & Bus PT MCB OFF
- Numerical relay faulty

5.4. Metering

The following metering is provided on the switchboard and same shall be monitored in SAS through Soft link.

(i) Incomer/ Transformer feeder/ Plant feeder/Motor feeder
- Voltage, Current, Frequency, Power factor, Power, Energy through MFM

(ii) Bus coupler
- Ammeter
- Bus voltage

6. TAP CHANGER CONTROL PHILOSOPHY FOR OLTC TRANSFORMERS.

Tap changer control (Raise/Lower) of Generator transformers (GTG#3, GTG#4 & STG#1) Station Transformers (STs) will be done from Transformer Local or from RTCC panel located in control room or from SAS.

Local/Remote selection is located on OLTC (Transformer local), when the selection is made in Local, tap changer control of Transformers is possible from OLTC. When the selection is made in Remote, controls are transferred to RTCC panel. Further, based on selection made at RTCC (i.e. RTCC/SAS selector switch as part of RTCC), the tap changer controls are possible either from RTCC or SAS.

7. 415V PMCC

415V PMCC is connected with two incomers fed from 11kV switchboard through two nos.11/0.433kV Station Transformers.

All metering, control and indication will be provided on the switchgear panel. The control scheme is described in brief as follows.

7.1. Control scheme

Normal operating condition

i) 415V switchgear shall be normally operated with two incomer breakers ON & the bus coupler OFF. Necessary auto changeover scheme and manual change over scheme is be provided with necessary control, indications and interlocks. Momentary paralleling facility with check synchronizing relay shall also be provided in the manual change over scheme.

ii) Auto/Independent (Dead bus closing)/Manual (Momentary paralleling) Selector Switch is provided on the switchboard & normally kept in Auto Position for Auto Changeover.

7.1.1. Auto changeover

- When Incomer 1 or 2 fails, the respective unhealthy incomer is tripped through under voltage and a timer.
- Bus coupler will close automatically by sensing healthy voltage of healthy incomer.
- Auto changeover is blocked if any incomer trips due to fault or both the incomers simultaneously experience under-voltage.
- Necessary protection interlocks will also be realized in the switchboard.

7.1.2. Independent operation

In independent mode either of incomer 1 or incomer2 or bus coupler can be closed in dead bus condition after ensuring relevant bus under voltage.

7.1.3. Manual operation

It is possible to take either of incomer1/incomer2/bus coupler for maintenance and bring it back to the normal operating condition by momentary paralleling.

In Manual mode either of incomer1 or incomer2 or bus coupler can be closed through contacts of check sync relay.

Trip selector switch shall be provided on the switchboard.

7.2. Controls

415V PMCC Switchgear breaker feeders shall have one local/remote control selector switch.

(i) When selector switch is selected in **LOCAL** mode, controls will be done from 415V PMCC Switchgear.

Following operations are possible from Switchgear:

- Close of all incomers, bus coupler and outgoing breakers in test position.
- Close of all incomers on independent and manual mode in service position
- Close of bus coupler breaker on auto, independent and manual mode in service & test position.
- Close of all outgoing breakers in test and service position.
- Open of all breakers.

(ii) When selector switch is selected in **REMOTE** mode, controls are transferred to SAS.

Following operations are possible from SAS:

- **Close of all incomers and bus couplers on independent mode only in service position.**
- Close of all outgoing breakers except motor outgoing breakers in service position. (L/R Switch is part of Switch board)
- Open of all breakers.

Control of all outgoing motor feeder shall be provide from DCS inline with drive control philosophy.

For Operation EPMCC switchgear refer Cl.10 as part of DG control philosophy.

7.3. Annunciation/Indications

The following contacts for remote indication are provided in SAS.
Indications:

- Close
- Open

- Service
- Ready to close (L/R in Remote, Breaker in service, Breaker Spring charged ready, Trip circuit healthy, control supply healthy, 86 not operated)

Annunciations

- 86 operated
- Under voltage trip
- Trip circuit unhealthy
- DC control supply-1 or 2 fail (common for switchgear)
- Transformer trouble (only for Transformer outgoing feeder).
- Incomer Line PT & Bus PT MCB OFF
- Numerical relay faulty (NR healthy signal-invert signal)

7.4. Metering

The following metering is provided on the switchboard and same shall be monitored in SAS through Soft link Incomer

- Voltage, Current, Frequency, Power factor, Power, Energy through MFM

(i) Bus coupler

- Ammeter
- Bus voltage

(ii) Plant feeder

- KWH meter*
- Ammeter*

*For ACB feeders, KWH and Current measurement is part of Numerical relays.

8. 415V MCC AND DBs

MCC:

- MCC incomer & buscoupler control & monitoring shall be provided in SAS.
- Control of all outgoing motor feeder shall be provide from DCS as per drive control philosophy. For Non-motor feeders all applicable control and monitoring are provided on the switchgear only

DB:

All applicable control and monitoring are provided on the switchgear only.

9. OPERATING PHILOSOPHY IN VARIOUS CONDITIONS

9.1. Normal Operation

During normal operation all the generators (STG & GTG's) shall operate in parallel among themselves and also with grid. In case of outage of any GTG or STG, power drawn from grid shall increase to meet the generation short fall.

9.2. Black Start Condition

The plant will be started manually with power supply from 415V DG set.

During Black start, DG is sized to cater following loads.

- Black start of GTG#4.
- All critical loads of CPP like DC, UPS, emergency lighting etc.

9.3. Emergency Condition (Blackout Condition)

When there is a blackout of CPP due to outage of all generators & grid, 415V DG sets shall start automatically by sensing the simultaneous under voltage on 415V buses.

In emergency condition, 415V will start automatically to fed below loads

- Emergency shutdown loads of GTG's, STG.
- Emergency CPP loads like DC, UPS, AC emergency lighting.

10. DG OPERATING PHILOSOPHY

- DG AMF breaker is in always NC mode.

Location of DG selector switches as follows

- DG "**AUTO/MANUAL**" selector switch shall be located in SAS. (Default position of selector switch is in **AUTO** mode)
- DG **"LOCAL / REMOTE"** selector switch shall be located in DG AMF panel.
- **Dead Bus/Manual synch/Auto Sych**. Selector switch part of AMF panel.
- **Dead Bus/Auto Synch** Selector switch part of SAS panel.
- **MAINS INCOMER-1/INCOMER-2/OFF** selector switch in SAS.

10.1. BLACK START OPERATION:

In this condition auxiliary power supply is not available in complete CPP of Refinery complex. Thus, auxiliary power supply for starting of GTG#4 will be arranged from Black Start cum Emergency DG set which will be connected 415V EPMCC. 415V DG start / stop operation shall be performed either from AMF panel (local) or from SAS.

- Engine can be started/stopped either from DG AMF panel or from SAS as per following philosophy:

A. Control from DG AMF Panel:

- **"AUTO /MANUAL"** selector switch on SAS panel is in **MANUAL** position.
- **"LOCAL / REMOTE"** selector switch is selected in "**LOCAL"** position, Engine can be started from DG AMF panel by pressing the engine start push button.

Operation of DG incomer breaker:

- **Local/Remote** selector at 415V EPMCC Incomer breaker shall be selected for **Remote**.
- **Dead Bus/Manual synch/Auto Sych.** (part of AMF panel) Shall be selected for **Dead bus**.

- Once the voltage and speed of DG is built up (Voltage >80% and Engine speed reached to rated speed), close command will be issued to 415V EPMCC panel DG incomer breaker from AMF panel via TNC switch.

B. Control from SAS:

- **"AUTO /MANUAL"** selector switch on SAS panel is in **MANUAL** Position.
- **"LOCAL / REMOTE"** selector switch is selected in "**REMOTE"** position, Engine can be started from SAS for remote operation.

Operation of DG incomer breaker:

- Breaker **Local/Remote** selector at 415V EPMCC Incomer breaker shall be selected for **Remote**.
- **Dead Bus/Auto Syn.** (part of SAS) Selector switch shall be selected for **Dead bus**.
- Once the voltage and speed of DG is built up (Voltage >80% and Engine speed reached to rated speed), manual close command from SAS will be issued to 415V EPMCC panel DG incomer breaker.

During Black start, DG is sized to cater following loads.

- Black start of GTG#4.
- All critical loads of CPP like DC, UPS, emergency lighting etc.

10.2. EMERGENCY BLACK OUT OPERATION:

When there is a blackout of CPP due to outage of all generators & grid, 415V DG sets shall start automatically by sensing the simultaneous under voltage on 415V buses.

In emergency condition, 415V DG will start automatically to fed below loads

- Emergency shutdown loads of GTG's, STG.
- Emergency CPP loads like DC, UPS, AC emergency lighting.

During Blackout condition, DG will be started automatically subject following conditions are met:

- **"AUTO /MANUAL"** selector switch on SAS shall be selected on **AUTO** mode.
- Under voltage on both the buses of 415V EPMCC has been sensed. One potential free contact confirming the blackout condition will be wired to AMF panel from 415 EPMCC.
- Once above conditions are met, 415V DG will start automatically irrespective of **Local/Remote** selector switch position in AMF panel. Once the voltage and speed of DG is built up (Voltage >80% and Engine speed reached to rated speed), 415V EPMCC DG incomer breaker shall be closed automatically on dead bus, provided there is no bus fault and AMF condition persists in EPMCC
- If 415V EPMCC Incomer is fails to close on **AUTO**, provision shall be made to close the same manually from DG AMF panel or from SAS.

10.3. Restoration of normal supply to Normal cum Emergency switchgear

DG **Local/Remote** mode selector switch is selected in **Remote** mode (SAS).

- **Local/Remote** selector switch at 415V Incomer breaker shall be selected for **Remote**
- Synchronizing mode selector switch **Dead Bus/Auto Syn.** (located in SAS) is selected **for Auto Syn.** Synchronization selector switch selection on for **Mains Incomer-1/Incomer-2/OFF** (located in SAS) depending on the breaker to be synchronized.
- Based on above selection either Incomer-1 or Incomer-2 will be closed from SAS after getting permissive signal from synchronizing relay. Here the voltage and frequency of the DG will be adjusted from SAS.
- 415V DG Breaker at 415V EPMCC will be opened manually from SAS after unloading the DG set.
- Annunciation will be provided in SAS panel when DG is in parallel with grid beyond a preset time delay. (10 Minutes)

10.4. Testing and Loading of DG

Testing of DG envisaged from DG AMF panel

- **"AUTO /MANUAL"** selector switch on SAS shall be selected for **Manual** mode.
- DG **Local/Remote** selector switch is selected in **Local** mode. DG will be started manually from DG AMF panel.

Operation DG incomer breaker from DG AMF panel.

- **Local/Remote** selector switch at 415V Incomer breaker shall be selected for **Remote**
- **Off/Dead Bus/Manual synch/Auto Sych.** (part of AMF panel) Shall be selected for either **Auto** or **Manual** synchronisation.
- After voltage build up DG incomer breaker will be closed from AMF panel through TNC switch during Manual mode or command will be issued automatically in Auto mode.
- A pre-set value of Power shall be delivered to the EMCC Bus by the DG.
- After testing, the DG may be unloaded and DG Breaker shell be tripped from AMF Panel and DG shall be stopped.

11. ANNEXURE –I

Control and monitoring facilities provided for each electrical system on various panels viz. SAS, GCP, Switchgear in tabular form (in line with this document) is indicated in this annexure.

S.No.	EQUIPMENT	BREAKER	SAS						GCP for GTG/STGs, GCP/AMF PANEL (DG)						SWITCHBOARD					
			Location : GIS Control room						Location :GTG/STG GCP in CCCPP control room, DG GCP/AMF in DG Control room						Location : CPP Substation Switchgear Room					
			Synchronisation	Control	Metering	Annunciation	Indication	Remarks	Synchronisation	Control	Metering	Annunciation	Indication	Remarks	Sync	BKR	Metering	Protections	Indication	Remarks
1	GTG#4, STG#1	NA	Auto Synch facilities are provided on SAS. Sync is done at respective Incomer CB of 66kV GIS.	Voltage control	V, A,F,PF, MW,MVA, MVAR , MWH	Fault status of trips & alarms of GTG	PF/MVAR ON/OFF		"*"Auto & Manual Synch facilities are provided on GCP. Sync is done at respective Incomer CB of 66kV GIS.	Voltage control	V, A,F,PF, MW,MVA, MVAR	Fault status of trips & alarms of GTG	PF/MVAR ON/OFF	"*" For STG both Auto & Manual synchronisation facilities are provided in GCP.For GTG Auto synchronisation facility will be provided as part of Marks Vi and Manual synchronisation facility will be provided as part of GCP.	NA	NA	NA	NA	NA	
				Speed control		Group Alarm for Generator temperatures	AVR Ch-1/2 in service			Speed control	Exciter V,A	Group Alarm for Generator temperatures	AVR Ch-1/2 in service							
				PF, MVAR Regulation			AVR in local, reset			Exciter Field breaker control	Null voltmeter		AVR in local, reset							
				AVR Auto/Manual SS			Exciter CB ON,OFF			PF, MVAR Regulation	Trivector meter		Temperature Scanner							
				ISO/droop Mode			ISO/droop Mode			AVR Auto/Manual SS			Exciter CB ON,OFF							
2	GTG#3	NA	Auto Synch facilities are provided on SAS. Sync is done at respective Incomer CB of 66kV GIS.	Voltage control	V, A,F,PF, MW,MVA, MVAR , MWH	Fault status of trips & alarms of GTG	PF/MVAR ON/OFF		NA						NA	NA	NA	NA	NA	
				Speed control		Group Alarm for Generator temperatures	AVR Ch-1/2 in service													
				PF, MVAR Regulation			AVR in local, reset													
				AVR Auto/Manual SS			Exciter CB ON,OFF													
				ISO/droop Mode			ISO/droop Mode													
2	415V BLACK START CUM EMERGENCY DG	NA	Auto synch facilities are provided on SAS(During power restoration). Synch is done at EPMCC Incomer of 415V EPMCC swbd.	DG Start	V,A,F,PF,MW, MAR,MVAR	DG Tripped on fault	DG ON		Auto & Manual synch facilities are provided on DG AMF panel during routine trail run/test operation of DG. Synch is done at DG incomer CB for routine trial run operation.	DG Start	V, A,F,PF, MW,MVA, MVAR	Alarm/ Trip fault status of DG	DG ON		NA	NA	NA	NA	NA	
				DG Stop		DG failed to start	DG OFF			DG Stop		DG Tripped on fault	DG OFF							
				Voltage Rise		DG Parallel with grid	AMF BKR ON			Voltage Rise		DG failed to start	AUTO/ MANUALISS in AUTO mode							
				Voltage Lower		DG AMF BKR OPEN	AMF BKR OFF			Voltage Lower			AUTO/ MANUAL SS in MANUAL mode							
				Speed Rise			DG Local/Remote SS in Local mode			Speed Rise										
				Speed Lower			DG Local/Remote SS in Remote mode			Speed Lower										
				DG AUTO/ MANUAL SS						L/R switch										
3	GENERATOR TRANSFORMER (GTG#1TR &STG#1TR)	NA	On load Tap changer control (OLTC)	Tap Raise	NA	TAP Changer Incomplete	TAP control SS in SAS mode		NA			Windg. Temp. High Alarm & trip	Tap change In progress		NA	NA	NA	Transformer incipient faults (66kV GIS-For GTG#3 transformer)	Windg. Temp. High Alarm & trip	For GTG#3 transformer only.
				Tap Lower		TAP Changer out of STEP	TAP Changer in progress					Oil Temp. High Alarm & trip							Oil Temp. High Alarm & trip	
						Windg. Temp. High Alarm & trip	TPI (4-20mA Analog)					Bucholz Alarm & trip							Bucholz Alarm & trip	
						Oil Temp. High Alarm & trip						PRV trip,Oil Surge Trip, MOG alarm							PRV trip,Oil Surge Trip, MOG alarm	
						Bucholz Alarm & trip						Tap changer out of step Trip							Tap changer out of step Trip	
						PRV trip, MOG alarm						Tap change incomplete Alarm							Tap change incomplete Alarm	
																			Tap change In progress	
4	STATION AUXILIARY TRANSFORMER (STR#1 & STR#2)	NA	On load Tap changer control (OLTC)	Tap Raise	NA	TAP Changer Incomplete	TAP control SS in SAS mode		NA	NA	NA	NA	NA		NA	NA	NA	Transformer incipient faults (66kV GIS)	Windg. Temp. High Alarm & trip	
				Tap Lower		TAP Changer out of STEP	TAP Changer in progress												Oil Temp. High Alarm & trip	
						Windg. Temp. High Alarm & trip	TPI (4-20mA Analog)												Bucholz Alarm & trip	
						Oil Temp. High Alarm & trip													PRV trip,Oil Surge Trip, MOG alarm	
						Bucholz Alarm & trip													Tap changer out of step Trip	
						PRV trip, MOG alarm													Tap change incomplete Alarm	
																			Tap change In progress	

S.No.	EQUIPMENT	BREAKER	SAS						GCP for GTG/STGs, GCP/AMF PANEL (DG)						SWITCHBOARD					
			Location : GIS Control room						Location :GTG/STG GCP in CCCPP control room, DG GCP/AMF in DG Control room						Location : CPP Substation Switchgear Room					
			Synchronisation	Control	Metering	Annunciation	Indication	Remarks	Synchronisation	Control	Metering	Annunciation	Indication	Remarks	Sync	BKR	Metering	Protections	Indication	Remarks
5	66kV GENERATION SWBD	GTG#4 I/C	Auto Synch facilities are provided on SAS.	1) Auto Synch/ Dead bus CB Close in service position. 2) Isolator-1, 2 close	V, A, MW	CB Tripped on fault	CB, ISO-1 & 2 CLOSE	"OFF/Ind/Auto sync" Selector switch shall be located in SAS.	Auto & Manual Synch facilities are provided on GCP.	1) Auto Synch/ Ind/ Man Synch CB Close in service position. 2) Isolator-1, 2 close	V, A,F,PF,MW,MV A,MVAR, MWH	CB Tripped on fault	CB, ISO-1 & 2 OPEN	"OFF/Ind/Auto sync/ Manual Sync" Selector switch is mounted on GCP. Synchro. Check selector switch (OFF/GCP/SAS/MARK VI) is part of GCP.	NA	CB Close for feeder earthing	As per respective switchboard SLD			
						Line PT Sec MCB off	CB, ISO-1&2 OPEN					Line PTs Sec MCB off	CB, ISO-1&2 CLOSE							
						Trip circuit unhealthy	ESW OPEN, CLOSE					Trip circuit unhealthy	ESW OPEN, CLOSE							
				1) CB Open 2) Isolator-1, 2 Open			CB RTC, GIS LCC in REMOTE			1) CB Open 2) Isolator-1, 2 Open			CB RTC, GIS LCC in REMOTE			CB Open				
							GCP Syn.Selector switch in SAS Mode													
		STG I/C	Auto Synch facilities are provided on SAS.	1) Auto Synch/ Dead bus CB Close in service position. 2) Isolator-1, 2 close	V, A, MW	CB Tripped on fault	CB, ISO-1 & 2 CLOSE	"OFF/Ind/Auto sync" Selector switch shall be located in SAS.	Auto & Manual Synch facilities are provided on GCP.	1) Auto Synch/ Ind/ Man Synch CB Close in service position. 2) Isolator-1, 2 close	V, A,F,PF,MW,MV A,MVAR, MWH	CB Tripped on fault	CB, ISO-1 & 2 OPEN	"OFF/Ind/Auto sync/ Manual Sync" Selector switch is mounted on GCP. Synchro. Check selector switch (OFF/GCP/SAS) is part of GCP.	NA	CB Close for feeder earthing	As per respective switchboard SLD			
						Line PT Sec MCB off	CB, ISO-1&2 OPEN					Line PTs Sec MCB off	CB, ISO-1&2 CLOSE							
						Trip circuit unhealthy	ESW OPEN, CLOSE					Trip circuit unhealthy	ESW OPEN, CLOSE							
				1) CB Open 2) Isolator-1, 2 Open			CB RTC, GIS LCC in REMOTE			1) CB Open 2) Isolator-1, 2 Open			CB RTC, GIS LCC in REMOTE			CB Open				
							GCP Syn.Selector switch in SAS Mode													
		GTG#3 I/C	Auto Synch facilities are provided on SAS.	1) Auto Synch/ Dead bus CB Close in service position. 2) Isolator-1, 2 close	V,A, MW	CB Tripped on fault	CB, ISO-1 & 2 CLOSE	"OFF/Ind/Auto sync" Selector switch is in SAS.	NA	NA	NA	NA	NA	NA	NA	CB Close for feeder earthing	As per respective switchboard SLD			
						Line PT Sec MCB off	CB, ISO-1&2 OPEN													
						Trip circuit unhealthy	ESW OPEN, CLOSE													
				1) CB Open 2) Isolator-1, 2 Open			CB RTC, GIS LCC in REMOTE									CB Open				
		GRID I/C & Tie Line	Auto/Manual Synch facilities are provided on SAS.	1) Manual Synch/ Dead bus CB Close in service position. 2) Isolator-1, 2 close	V, A,F,PF,MW	CB Tripped on fault	CB, ISO-1 & 2 CLOSE	OFF/GTG-4/STG-1/GTG-3/ALL (GTG-3+GTG-4 & STG-1) Generator selector switch located in SAS for Grid Incomers. OFF/GTG-1/GTG-2/ALL (GTG-1 + GTG-2) Generator	NA	NA	NA	NA	NA	NA	NA	NA	CB Close for feeder earthing	As per respective switchboard SLD			
						Line PT Sec MCB off	CB, ISO-1&2 OPEN													
						Trip circuit unhealthy	ESW OPEN, CLOSE													
				1) CB Open 2) Isolator-1, 2 Open			CB RTC, GIS LCC in REMOTE									CB Open				
		BUS Couplers	Auto/Manual Synch facilities are provided on SAS.	1) Manual Synch/ Dead bus CB Close in service position. 2) Isolator-1, 2 close	V, A,F,PF,MW	CB Tripped on fault	CB, ISO-1 & 2 CLOSE	OFF/GTG-4/STG-1/GTG-3/ALL Generator selector switch located in SAS	NA	NA	NA	NA	NA	NA	NA	CB Close for bus earthing	As per respective switchboard SLD			
							CB, ISO-1&2 OPEN													
						Trip circuit unhealthy	ESW OPEN, CLOSE													
				1) CB Open 2) Isolator-1, 2 Open			CB RTC, GIS LCC in REMOTE									CB Open				
		BUS PT	NA	NA	Bus Voltage	Bus PT Sec MCB off	NA		NA	NA	NA	NA	NA	NA	NA	NA	As per respective switchboard SLD			
					Frequency	Bus Under voltage														
						DC Supply-1/2 FAIL														
		O/G	NA	1) CB Close in service position. 2) Isolator-1, 2 close	A,MW, MVA	CB Tripped on fault	CB, ISO-1 & 2 ON		NA	NA	NA	NA	NA	NA	NA	CB close in feeder earthing & service position	As per respective switchboard SLD			
						Trip circuit unhealthy	CB, ISO-1&2 OFF													
							ESW ON, OFF													
				1) CB Open 2) Isolator-1, 2 Open			CB RTC, GIS LCC in REMOTE									CB Open				

S.No.	EQUIPMENT	BREAKER	SAS						GCP for GTG/STGs, GCP/AMF PANEL (DG)						SWITCHBOARD					
			Location : GIS Control room						Location :GTG/STG GCP in CCCPP control room, DG GCP/AMF in DG Control room						Location : CPP Substation Switchgear Room					
			Synchronisation	Control	Metering	Annunciation	Indication	Remarks	Synchronisation	Control	Metering	Annunciation	Indication	Remarks	Sync	BKR	Metering	Protections	Indication	Remarks
6	11KV HT SWGR	I/C	NA	CB Close on Independent mode in service position	V, A,F,PF,MW,MVA,MWH	CB Tripped on fault	CB ON, OFF	Auto/ Independent (Dead bus closing)/ Manual (Momentary paralleling) SS provided in Switchboard	NA	NA	NA	NA	NA	NA	NA	1) CB Close on Ind & Manual mode in service position 2) CB Close in test position	V, A,F,PF,MW,MVA, MVAR,MWH through MFM	As per respective switchboard SLD	Open, Close, Trip	Auto/Ind/Manual SS Provided at B/C (Common SS for SWBD)
						Line PT Sec MCB off	CB SERVICE												Trip Circuit healthy,	
						Trip circuit unhealthy	CB RTC												DC SUPPLY FAIL	
						Under voltage trip	Auto/Independent/ Manual selected in INDEPENDENT mode												Spring charged	
				CB Open		NR Unhealthy	Auto/Independent/ Manual selected in AUTO mode									CB Open			BKR SERVICE/TEST	
																			Upstream Breaker ON/OFF	
		B/C	NA	CB Close on Independent mode in service position	A	CB Tripped on fault	CB ON, OFF	Auto/ Independent (Dead bus closing)/ Manual (Momentary paralleling) SS provided in Switchboard	NA	NA	NA	NA	NA		NA	1) CB Close on Auto, Ind & Manual mode in service position 2) CB Close in test position	A	As per respective switchboard SLD	Open, Close, Trip	Auto/Ind/Manual SS Provided at B/C (Common SS for SWBD)
						Trip circuit unhealthy	CB SERVICE												Trip Circuit healthy,	
						DC Supply-1 fail	CB RTC												DC SUPPLY FAIL	
						DC Supply-2 fail	Auto/Independent/ Manual selected in INDEPENDENT mode												Spring charged	
				CB Open			Auto/Independent/ Manual selected in AUTO mode									CB Open			BKR SERVICE/TEST	
		O/G	NA	CB Close in service position	V, A,PF,MW,MVA, MWH	CB Tripped on fault	CB ON, OFF		NA	NA	NA	NA	NA		NA	CB Close in test position	V, A,PF,MW,MVA,MWH through MFM	As per respective switchboard SLD	Open, Close, Trip	NA
						Trip circuit unhealthy	CB SERVICE												Trip Circuit healthy,	
						Under voltage trip	CB RTC												DC SUPPLY FAIL	
				CB Open		NR Unhealthy													Spring charged	
																CB Open			BKR SERVICE/TEST	
		BUS PT	NA	NA	V	Bus PT MCB off	PT TEST position		NA	NA	NA	NA	NA		NA	NA	V	As per respective switchboard SLD	PT SERVICE/TEST	
																			R, Y, B Healthy	
7	0.415KV PMCC (Refer Note 2)	NORMAL I/C	NA	CB Close on Independent mode in service position	V, A,F,PF,MW,MVA,MWH	CB Tripped on fault	CB ON, OFF	Auto/ Independent (Dead bus closing)/ Manual (Momentary paralleling) SS provided in Switchboard	NA	NA	NA	NA	NA		NA	1) CB Close on Ind & Manual mode in service position 2) CB Close in test position	V, A,F,PF,MW,MVA, MVAR,MWH through MFM	As per respective switchboard SLD	Open, Close, Trip	Auto/Ind/Manual SS Provided at B/C (Common SS for SWBD)
						Line PT Sec MCB off	CB SERVICE												Trip Circuit healthy,	
						Trip circuit unhealthy	CB RTC												Spring charged	
						Under voltage trip													BKR SERVICE/TEST	
				CB Open		NR Unhealthy										CB Open			R, Y, B Healthy	
		B/C	NA	CB Close on Independent mode in service position	A	CB Tripped on fault	CB ON, OFF	Auto/ Independent (Dead bus closing)/ Manual (Momentary paralleling) SS provided in Switchboard	NA	NA	NA	NA	NA		NA	1) CB Close on Auto, Ind & Manual mode in service position 2) CB Close in test position	A	As per respective switchboard SLD	Open, Close, Trip	Auto/Ind/Manual SS Provided at B/C (Common SS for SWBD)
						Trip circuit unhealthy	CB SERVICE												Trip Circuit healthy,	
						DC Supply-1 fail	CB RTC												DC SUPPLY-1 & 2 FAIL	
						DC Supply-2 fail	Auto/Independent/ Manual selected in INDEPENDENT mode												Spring charged	
				CB Open			Auto/Independent/ Manual selected in AUTO mode									CB Open			BKR SERVICE/TEST	

S.No.	EQUIPMENT	BREAKER	SAS						GCP for GTG/STGs, GCP/AMF PANEL (DG)						SWITCHBOARD					
			Location : GIS Control room						Location :GTG/STG GCP in CCCPP control room, DG GCP/AMF in DG Control room						Location : CPP Substation Switchgear Room					
			Synchronisation	Control	Metering	Annunciation	Indication	Remarks	Synchronisation	Control	Metering	Annunciation	Indication	Remarks	Sync	BKR	Metering	Protections	Indication	Remarks
8	0.415KV EPMCC (Refer Note 2)	NORMAL I/C	Auto Synch facilities are provided on SAS.	CB Close on Auto Syn./ Independent mode in service position	V, A,F,PF,MW,MVA,MWH	CB Tripped on fault	CB ON, OFF	Auto/ Independent (Dead bus closing) SS provided in SAS.	NA	NA	NA	NA	NA		NA	1) CB Close on Ind & Manual mode in service position 2) CB Close in test position	V, A,F,PF,MW,MVA, MVAR,MWH	As per respective switchboard SLD	Open, Close, Trip	Auto/Ind/Manual SS Provided at switchboard and will be located in switchboard
						Line PT Sec MCB off	CB SERVICE												Trip Circuit healthy,	
						Trip circuit unhealthy	CB RTC												Spring charged	
						Under voltage trip													BKR SERVICE/TEST	
				CB Open		NR Unhealthy										CB Open			R, Y, B Healthy	
		DG I/C	Auto Synch facilities are provided on SAS.	CB Close on Independent mode in service position	V, A,F,PF,MW,MVA,MWH	CB Tripped on fault	CB ON, OFF	Auto.Syn / Independent (Dead bus closing) SS provided in SAS	Auto & Manual Synch facilities are provided on AMF Panel.	Auto Synch/Manual/ Ind CLOSE in service position.	NA	CB Tripped on fault	CB OPEN	LOCAL(AMF)/REMOTE(SAS) Switch shall provide in AMF panel	NA	1) CB Close on Ind mode in service position 2) CB Close in test position	V, A,F,PF,MW,MVA, MVAR,MWH	As per respective switchboard SLD	Open, Close, Trip	Dead bus contact and AMF signal shall be provided to AMF panel from PMCC
						Line PT Sec MCB off	CB SERVICE					Line PTs Sec MCB off	CB CLOSE						Trip Circuit healthy,	
						Trip circuit unhealthy	CB RTC			CB OPEN		Trip circuit unhealthy	CB RTC						Spring charged	
						Under voltage trip													BKR SERVICE/TEST	
				CB Open		NR Unhealthy										CB Open			R, Y, B Healthy	
		B/C	NA	CB Close on Independent mode in service position	A	CB Tripped on fault	CB ON, OFF	--	NA	NA	NA	NA	NA		NA	1) CB Close on Auto, Ind & Manual mode in service position 2) CB Close in test position	A	As per respective switchboard SLD	Open, Close, Trip	Auto/Ind/Manual SS Provided at B/C (Common SS for SWBD)
						Trip circuit unhealthy	CB SERVICE												Trip Circuit healthy,	
						DC Supply-1 fail	CB RTC												DC SUPPLY-1 & 2 FAIL	
						DC Supply-2 fail	Auto/Independent/ Manual selected in INDEPENDENT mode												Spring charged	
				CB Open			Auto/Independent/ Manual selected in AUTO mode									CB Open			BKR SERVICE/TEST	
9	0.415kV PMCC & EPMCC SWBD (Refer Note 2)	O/G BKR	NA	CB Close in service position	V, A,KW,KVA, KWH	CB Tripped on fault	CB ON, OFF		NA	NA	NA	NA	NA		NA	CB Close in test position	V, A,PF,KW,KWH	As per respective switchboard SLD	Open, Close, Trip	NA
						Trip circuit unhealthy	CB SERVICE												Trip Circuit healthy,	
						NR Unhealthy	CB RTC												Spring charged	
				CB Open															BKR SERVICE/TEST	
																CB Open				
		BUS & BUS PT	NA	NA	V	Bus PT MCB off	NA		NA	NA	NA	NA	NA		NA	NA	V	As per respective switchboard SLD		

S.No.	EQUIPMENT	BREAKER	SAS						GCP for GTG/STGs, GCP/AMF PANEL (DG)						SWITCHBOARD					
			Location : GIS Control room						Location :GTG/STG GCP in CCCPP control room, DG GCP/AMF in DG Control room						Location : CPP Substation Switchgear Room					
			Synchronisation	Control	Metering	Annunciation	Indication	Remarks	Synchronisation	Control	Metering	Annunciation	Indication	Remarks	Sync	BKR	Metering	Protections	Indication	Remarks
10	0.415KV MCC (Refer Note 2)	NORMAL I/C	NA	CB Close on Independent mode in service position	V, A,F,PF,MW,MVA,MWH	CB Tripped on fault	CB ON, OFF	Auto/ Independent (Dead bus closing)/ Manual (Momentary paralleling) SS provided in Switchboard	NA	NA	NA	NA	NA		NA	1) CB Close on Ind & Manual mode in service position 2) CB Close in test position	V, A,F,PF,MW,MVA, MVAR,MWH through MFM	As per respective switchboard SLD	Open, Close, Trip	Auto/Ind/Manual SS Provided at B/C (Common SS for SWBD)
						Line PT Sec MCB off	CB SERVICE												Trip Circuit healthy,	
						Trip circuit unhealthy	CB RTC												Spring charged	
						Under voltage trip													BKR SERVICE/TEST	
				CB Open		NR Unhealthy										CB Open			R, Y, B Healthy	
		B/C	NA	CB Close on Independent mode in service position	A	CB Tripped on fault	CB ON, OFF	Auto/ Independent (Dead bus closing)/ Manual (Momentary paralleling) SS provided in Switchboard	NA	NA	NA	NA	NA		NA	1) CB Close on Auto, Ind & Manual mode in service position 2) CB Close in test position	A	As per respective switchboard SLD	Open, Close, Trip	Auto/Ind/Manual SS Provided at B/C (Common SS for SWBD)
						Trip circuit unhealthy	CB SERVICE												Trip Circuit healthy,	
						DC Supply-1 fail	CB RTC												Spring charged	
						DC Supply-2 fail	Auto/Independent/ Manual selected in INDEPENDENT mode												BKR SERVICE/TEST	
				CB Open			Auto/Independent/ Manual selected in AUTO mode									CB Open				
		O/G	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA		As per respective switchboard SLD					
		BUS & BUS PT	NA	NA	V	Bus PT MCB off	NA		NA	NA	NA	NA	NA		NA	NA	V	As per respective switchboard SLD	R, Y, B Healthy	

NOTES

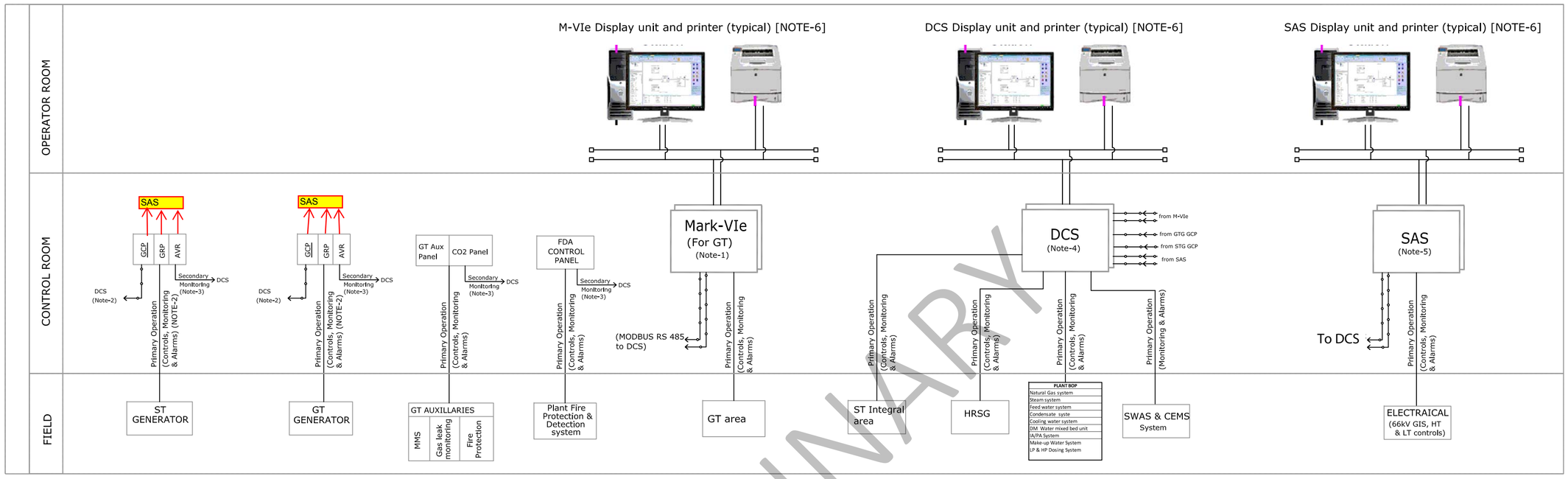
1 Open, Close, Trip, Trip Circuit healthy, DC Fail(buscoupler), Spring charged LED type indicating lamps provided on switchboard.

2 Only Breaker feeders are covered.

LEGEND:

A - AMMETER	64R - RESTRICTED EARTH FAULT RELAY	I/C - INCOMER
V - VOLTMETER	51G - STANDBY EARTHFAULT RELAY	B/C - BUSCOUPLER
MW - MEGAWATT METER	87GT - OVERALL DIFFERENTIAL RELAY	B/S - BUS SECTIONISER
MWH - ENERGY METER	80 - CONTROL SUPPLY SUPERVISION RELAY	SWBD - SWITCHBOARD
MVA - MEGAVOLTAMP METER	81 - U/F RELAY WITH DF/DT	CB - CIRCUIT BREAKER
MVAR - MEGAVAR METER	86 - LOCK RELAY	SS - SELECTOR SWITCH
F - FREQUENCY METER	87B - BUS DIFFERENTIAL RELAY	ACO - AUTOCHANGEOVER
PF - POWER FACTOR METER	87F - FEEDER DIFFERENTIAL RELAY	IND/DB - DEAD BUS
TPI - TAP POSITION INDICATOR	87T - TRAFO DIFFERENTIAL RELAY	MAN/MP - MOMENTARY PARALLING
2- TIMER	95 - TRIP CKT SUPERVISION RELAY	PTSS - PT SELECTOR SWITCH
25 - CHECK SYNC RELAY	95B - BUS DIFFERENTIAL SUPERVISION RELAY	TSS - TRIP SELECTOR SWITCH
27 - UNDER VOLTAGE RELAY	97 - FUSE FAILURE RELAY	BKR - BREAKER
50 - INSTANTANEOUS OVER CURRENT RELAY	98 - DEAD BUS RELAY	ISO- ISOLATOR
50N - INSTANTANEOUS EARTH FAULT RELAY	OFF/IND/ AUTO SYCH/ MAN SYNCH SS - OFF/ INDEPENDENT/ AUTO SYNCHRONIZATION/ MANUAL SYNCHRONIZAT	DIST - DISTRIBUTION
51 - IDMT OVRERCURRENT RELAY	ESW - EARTH SWITCH	O/G - OUTGOING
51N - IDMT EARTH FAULT RELAY		SYNC - SYNCHRONISATION
67 - DIRECTIONAL PHASE O/C RELAY		CR - CONTROL ROOM
67N - DIRECTIONAL EARTHFAULT RELAY		NA - NOT APPLICABLE/ NOT ENVISAGED

ANNEXURE-7



NOTEs:

(1) Mark-VIe is envisaged for control of Gas turbine & its on-base system.

(2) Generator temperatures shall be provided in DCS through MODBUS link from Temperature scanners.

(3) Critical parameters shall be hardwired to DCS for monitoring.

(4) DCS is envisaged for control of ST INTEGRAL, HRSG & PLANT BOP.

(5) SAS is envisaged for control of ELECTRICALs & its on-base system.

(6) Refer respective System Configuration drawings for exact qunatity of HMIs and printers.

(7) Control system redudancy shall be as per contract specifications.

(8) All control systems shall be powered from Plant UPS and are located in CPP Sub-station building.

Plant Instrumentation Design:

(1) For classified area, Ex-proof philosophy shall be followed for all input/ output in hazardous area except for MCC input/ outputs.

(2) All commands fron control system to MCC and SOVs shall be routed through Interposing Relays (IPRs) and IPRs shall be housed in respective control system.

(3) SOV oparting voltage is 24V DC and shall be powered from respective control system (plant DCS, any local panel as per application).

(4) Limit switches shall be conventional type.

(5) Local instrument racks are not applicable for this project.

(6) For all instruments hookups, pipe & pipe fittings shall be followed. Material shall be as per piping specificatons execpt CS & MS lines. For CS & MS lines, SS pipe & fitting shall be provided.

(7) All tube fittings shall be of SWAGELOK & PARKER make only.

(8) Pressure gauge : Bourdon tube type (upto 60K/scm2(g)) & : Bourdon tube with solid front (for above 60Kg/cm2(g))

(9) Temperature Gauge : Bi-metallic type

(10) 3-wire, pt-100 duplex type RTDs shall be used for a temperature upto 200 Deg C

(11) k-type Thermocouples shall be used for a temperature above 200 Deg C

(12) Thermowell process connection shall be M33*2 with stainless steel MOC.

(13) Temperature transmitters shall be provided only for closed loops

(14) Hotwell LTs are Guided wave Radar type, Cooling water sump LTs are Non contact type radar level transmitter and all others are Diaphragm seal DP type.

(15) Signal cables shall be with 1.5mm2 tinned Cu conductor, Non-IS, PVC/FRLS PVC with Individual & Overall shielding.

(16) Control cables shall be with 1.5mm2 bare Cu conductor, Non-IS, PVC/FRLS PVC without shielding.

LEGENDs:

- HARDWIRED CONNECTION
- MASTER CLOCK SIGNAL
- NETWORK CABLE
- SERIAL COMMUNICATION CABLE

ABBREVATIONs:

M-VIe	:	Mark-VIe
OS	:	Operating Station
ES	:	Engg. Station
GCP	:	Generator Control Panel
GRP	:	Generator Relay Panel
BOP	:	Balance Of Plant
MMS	:	Machine Monitoring System
AVR	:	Automatic Volatge Regulator
FDA	:	Fire Detection & Annunciation Panel

REV.	DATE	ALTERED	CHD/APPD	ZONE
REV.	DATE	ALTERED	CHD/APPD	ZONE
REV.	DATE	ALTERED	CHD/APPD	ZONE
REV.	DATE	ALTERED	CHD/APPD	ZONE
REV.	DATE	ALTERED	CHD/APPD	ZONE

PROJECT:
1x51 MW COMBINED CYCLE COGENERATION CATIVE POWER PLANT

CLIENT:
OIL AND NATURAL GAS CORPORATION LTD.
AT HAZIRA PLANT, GUJARAT.

CONSULTANT:
FICHTNER Consulting Engineers (India) Private Limited
Chennai, Bangalore.

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE
DRN.	VINEET		20.08.15
CHD.	SUJATHA		22.08.15
APPD.	SEKHAR		24.08.15

NO.OF VAR. —NA—

DEPT. CODE	UNTOL. DIMS. GR. ¢/M/f	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
		NTS	—NA—	—NA—	—NA—	—NA—

TITLE
PLANT CONTROL OVERVIEW

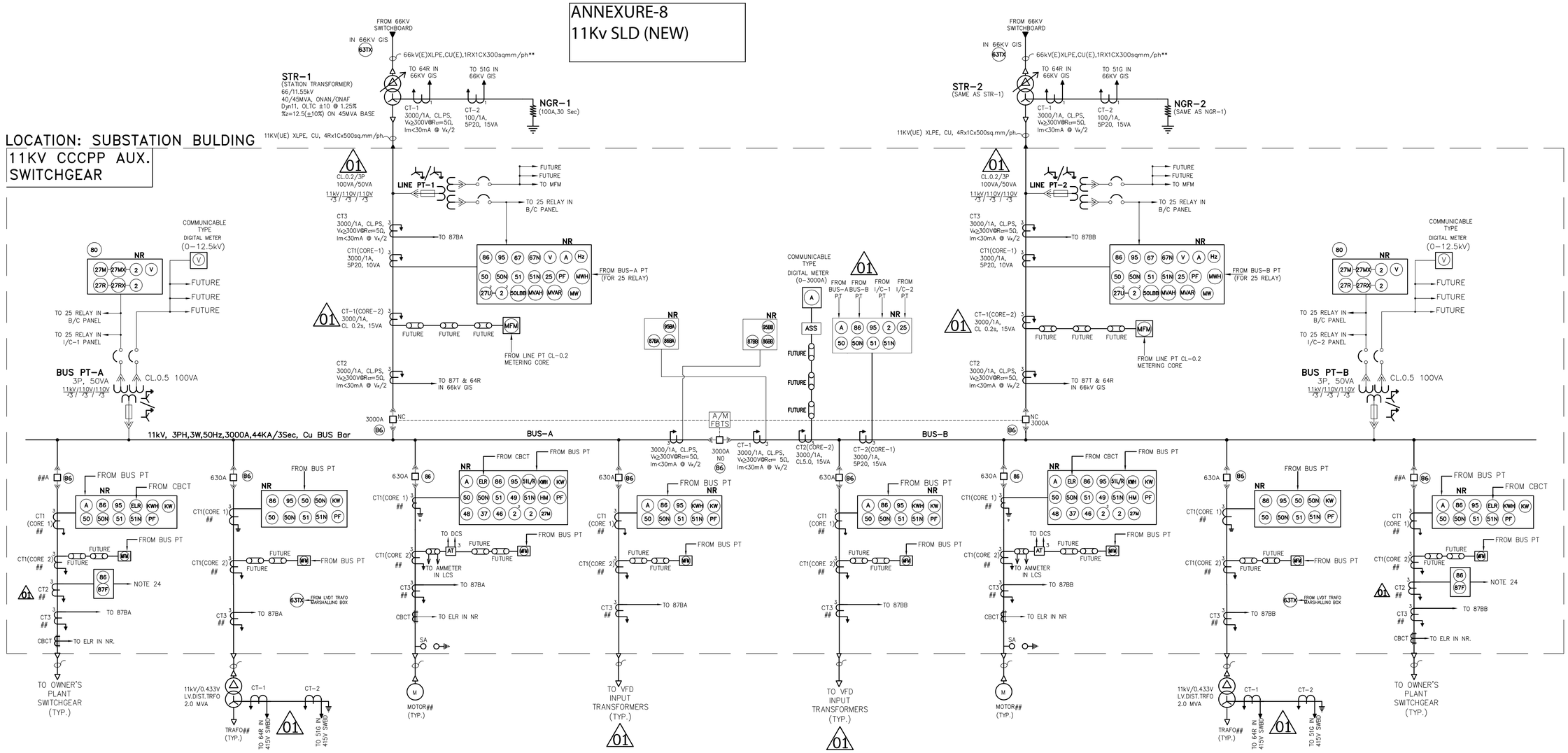
CARD CODE NA

DRAWING NO. 2-381-21-01015 REV. 00p

SHT. No 01 NO. OF SHT. 01

ANNEXURE-8
11Kv SLD (NEW)

LOCATION: SUBSTATION BULDING
11KV CCCPP AUX. SWITCHGEAR



REFERENCES:

1. KEY SINGLE LINE DIAGRAM : 0-381-21-02259

NOTES:

01. ## FOR CT DETAILS & OUTGOING FEEDER DETAILS OF 6.6KV SWITCHBOARD-1 REFER TABLE-1 IN SHEET-04.
02 ALL BREAKERS ARE FULLY DRAWOUT TYPE.
03 CABLE ENTRY FROM BOTTOM.
04 PAINT SHADE OF THE PANEL -RAL7032
05 CONTROL SUPPLY SHALL BE 110V DC.
06 NUMERICAL RELAYS SHALL BE HOOKED UP TO DATA CONCENTRATOR AND MMI SYSTEM. COMMUNICATION PROTOCOL FOR NUMERICAL RELAYS AND MFM SHALL BE IEC-61850 VIA SOFT LINK.
07 SPRING CHARGING MOTOR SHALL BE SUITABLE FOR 110V DC .
08 REAR AND FRONT SIDE OF THE PANEL SHALL HAVE FEEDER DESCRIPTION AND PANEL No. ON METALLIC NAMEPLATE.
01 09 DELETED.
10 HARDWARE INCLUDING INDICATING LAMPS(LED TYPE) SHALL BE PROVIDED AS PER CONTRACT SPECIFICATION.
11 REMOTE METERING AT STATION HMI IS PROVIDED THROUGH SOFT LINK FROM DATA CONCENTRATOR.
12 PROTECTION RELAYS ARE NUMERICAL TYPE. WHEREVER NUMERICAL RELAYS ARE NOT AVAILABLE SAME FUNCTION SHALL BE ACHIEVED THROUGH ELECTROMECHANICAL/STATIC TYPE RELAYS
13 STABILISING RESISTOR, METROSILS AS REQUIRED SHALL BE PROVIDED FOR PROTECTION RELAYS.
14 87M RELAY SHALL BE PROVIDED FOR FEEDERS WITH MOTOR DIFFERENTIAL CT (FOR MOTOR RATING > 1000 KW)
15 POWER CABLE SIZE SHALL BE AS PER HT POWER CABLE SIZING CALCULATIONS,WHICH WILL BE SUBMITTED SEPARATELY.
16 SUPPLY OF CABLES & TERMINATIONS FOR OWNER'S FEEDERS IS IN ONGC SCOPE EXCEPT FOR 10NO OWNER FEEDERS SHIFTING FROM MRSS SUBSTATION.
17 NUMERICAL RELAY CONTROL SUPPLY SHALL BE 110V DC.
18 FOR PROCESS TRIPS ADDITIONAL SELF RESET TYPE LOCKOUT RELAY AND ITS INDICATION SHALL BE PROVIDED IN NR FOR MOTOR FEEDERS.
19 SIGNAL TRANSDUCERS FOR HARDWIRED ANALOGUE INPUTS SHALL HAVE ACCURACY CLASS 0.2 FOR THE RANGE (0-120%). ALL TRANSDUCERS SHALL BE EXTERNALLY POWERED TYPES. EXTERNAL POWER SUPPLY SHALL BE 110VDC
20 ONE NO. DC SUPPLY SUPERVISION RELAY(80) SHALL BE PROVIDED FOR EACH INCOMING DC SUPPLY TO THE SWITCHBOARD
21. KNEE POINT VOLTAGE FOR CTs WILL BE AS PER OEM's RECOMENDATION BASED ON FINALISATION OF RELAY MODEL.
22. FOR OWNER FEEDERS CT DETAILS, CT KNEE POINT VOLTAGE, FEEDER DIFFERENTIAL PROTECTION SCHEME & CABLE TERMINATION DETAILS INDICATED AS PER THE INPUTS FURNISHED BY ONGC DURING MOM DT 20/05/2015. HOWEVER TO BE CONFIRMED BY ONGC/FICHTNER.
23. ** EQUIPMENT RATING/PARAMETERS/QUANTITY ARE SUBJECT TO APPROVAL OF RESPECTIVE EQUIPMENT SIZING CALCULATIONS WHICH WILL BE SUBMITTED SEPARATELY BASED ON LOAD ANALYSIS.
01 24. FOR MARKED 11KV SPARE OUTGOING PLANT FEEDERS FOR OWNER'S USE, FEEDER DIFFERENTIAL (87F) PROTECTION SHALL BE PROVIDED BY BHEL. THE SENDING END RELAY SHALL BE MOUNTED IN 11AUX. SWITCH BOARD AND RECEIVING END RELAYS SHALL BE SUPPLIED LOOSE BY BHEL. RECEIVNG END CTS, CABLE FOR RELAYS (BOTH ENDS) & MOUNTING OF RELAYS IN RECEIVING END WILL BE IN ONGC SCOPE. M/s ONGC FICHTNER SHALL PROVIDE CABLE DISTANCE FOR FINALIZING DIFFERENTIAL SCHEME.
25. FAST BUS TRANSFER SCHEME(FBTS) SHALL BE PROVIDED BETWEEN INCOMERS, BUS COUPLER AS PER SPECIFICATION.
26. DEAD BUS CLOSING SHALL BE PROVIDED FROM SAS SYSTEM. MOMENTARY PARALLELING SHALL BE PROVIDED BETWEEN INCOMERS, BUS COUPLER SWITCHBOARD ITSELF.
27. ALL MEASURING METERS SHALL BE DIGITAL AND COMMUNICABLE TYPE. METERS SHALL BE DAISY CHAINED FOR REMOTE HOOKUP AS PER CONTRACT.

LEGEND:

	CURRENT TRANSFORMER	A	AMMETER	27U	U/V RELAY (SETTING RANGE 40-80%)	86	LOCKOUT RELAY
	HV CIRCUIT BREAKER (DRAWOUT TYPE)	V	VOLTMETER	37	UNDER CURRENT RELAY	87T	TRANSFORMER DIFFERENTIAL RELAY
	FUSE	MW	MEGAWATT METER	46	NEGATIVE PHASE SEQ RELAY	87F	CABLE DIFFERENTIAL RELAY
	DRAWOUT CONTACTS	KWH	KILOWATT HOUR METER	49	THERMAL OVERLOAD RELAY	87BB	BUS DIFFERENTIAL RELAY
	CABLE	PF	POWER FACTOR METER	50	INSTANTANEOUS OVER CURRENT RELAY	87BA 87BB	BUS DIFFERENTIAL TRIP RELAY
	POTENTIAL TRANSFORMER	Hz	FREQUENCY METER	50N	INSTANTANEOUS EARTH FAULT RELAY	95BA 95BB	BUS DIFFERENTIAL SUPERVISION RELAY
	MCB (4 POLE)	HM	HOUR RUN METER (5 DIGITS)	51	IDMTL O/C RELAY	95	TRIP CIRCUIT SUPERVISION RELAY
	BUS DUCT	MVA	MVA METER	51N	IDMTL E/F RELAY	VSS	VOLTMETER SELECTION SWITCH
SA	SURGE ABSORBER	MVAH	MVAH METER	51R	LOCKED ROTOR RELAY	ASS	AMMETER SELECTION SWITCH
NR	NUMERICAL RELAY	2	TIMER	51G	STANDBY E/F RELAY	KWHT	ENERGY TRANSDUCER
Ics	LOCAL CONTROL STATION	25	CHECK SYNC RELAY	59	OVER VOLTAGE RELAY (DEFINITE TIME)	VT	VOLTAGE TRANSDUCER
TTB	TEST TERMINAL BLOCK	27	UNDER VOLTAGE RELAY	60	NEUTRAL DISPLACEMENT RELAY	AT	CURRENT TRANSDUCER
RVT	RESIDUAL VOLTAGE TRANSFORMER	27R	RESIDUAL U/V RELAY (SETTING 40%)	63TX	TRANSFORMER AUX. RELAY	FT	FREQUENCY TRANSDUCER
SAT	STATION AUXILIARY TRANSFORMER	27M	U/V RELAY FOR TRIPPING MOTOR FDRS	64R	REF RELAY	KWT	KW TRANSDUCER
MFM	MULTIFUNCTIONAL METER			80	DC SUPPLY SUPERVISION RELAY		
MFM	SUB-STATION AUTOMATION SYSTEM						
FBTS	FAST BUS TRANSFER SCHEME						

REV.	DATE	DESCRIPTION	DRN.	STR.	MECH.	ELEC.	INST.
				APPROVED BY			
01	30-06-15	REVISED INLINE WITH FICTNER COMMENTS VIDE TR.NO.5111168-2000-EL-VDT-005	GSK	XXX	XXX	JKP/ATM	XXX

PROJECT:
1x51 MW COMBINED CYCLE COGENERATION CATIVE POWER PLANT

FICHTNER
Consulting Engineers (India) Private Limited
Chennai, Bangalore.

CLIENT:
OIL AND NATURAL GAS CORPORATION LTD.
AT HAZIRA PLANT, GUJARAT.

EPC CONTRACTOR:
BHARAT HEAVY ELECTRICALS LTD
HYDERABAD

	SIGNATURE	DATE
DRAWN	G.SESHU KIRAN	20-12-14
DESIGNED	G.SESHU KIRAN	20-12-14
CHECKED	SURESH.P	20-12-14
DEPT.HEAD	J.K. PATTANAIK	20-12-14
PROJ.MGR	XXX	XXX

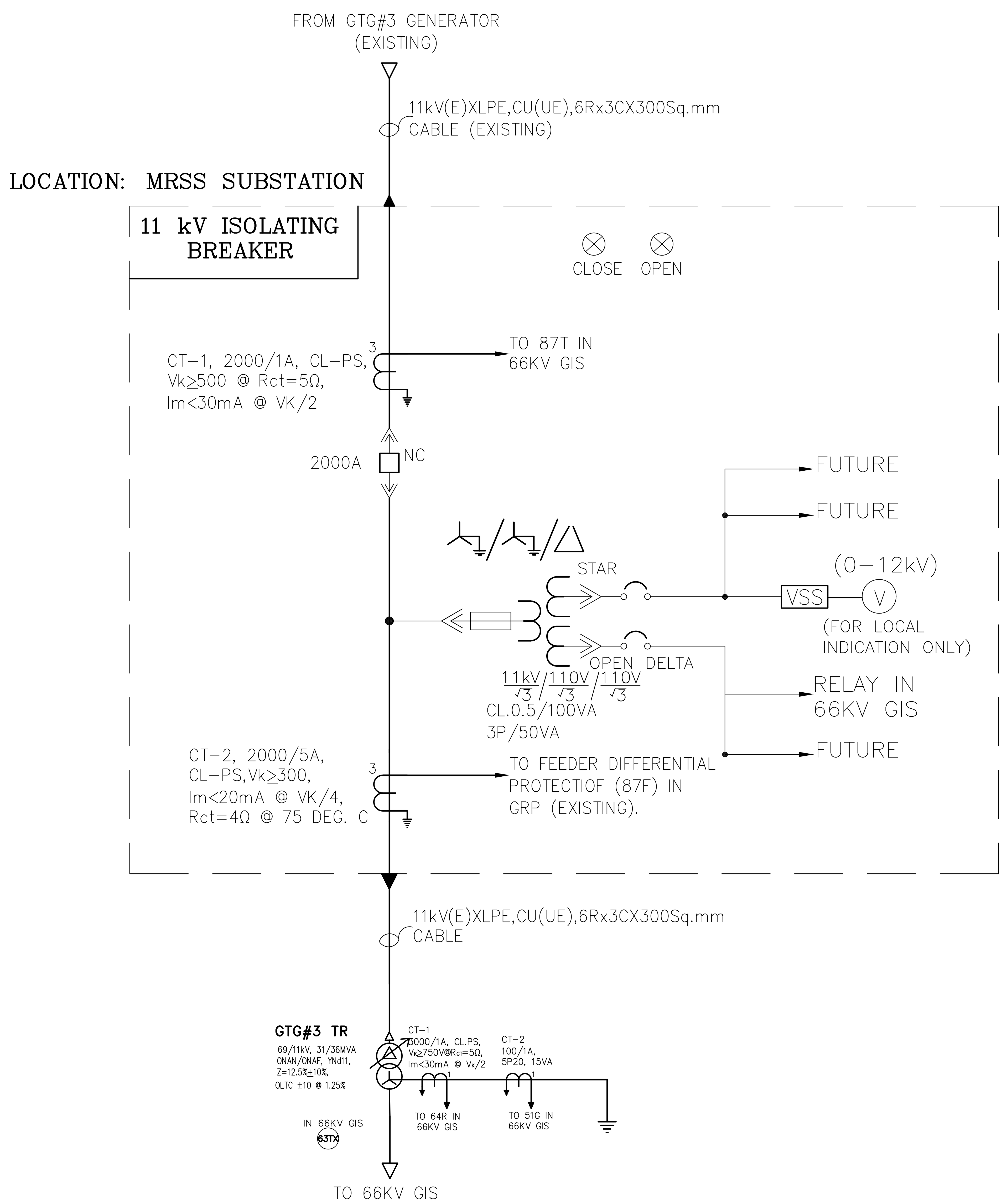
RELEASED FOR: PRELIMINARY, TENDER, ENGINEERING ✓, CONSTRUCTION

TITLE:
11KV CCCPP AUX. SWITCHGEAR SLD
.

DEPT PE&SD(450) | JOB NO. XXX | SCALE NA | SHEET 01 OF 02 | REV.

DWG.NO. 1-381-21-02884 | 01

RESTRICTED



##TABLE-1: 11KV CCCPP AUX. SWITCHGEAR OUTGOING FEEDER DETAILS.

REV.	SL NO.	FEEDER DESCRIPTION	RATING	TYPE	BREAKER RATING	TOTAL	BUS-A	BUS-B	CT1		CT3	CT2	TERMINATION
									CORE-1	CORE-2			
	1	LV DIST. TRAFO-1 (LV DTR-1)	2.0MVA	TRAFO	630A	1	1	–	125/1A, 5P20, 10VA	125/1A, CL0.5, 15VA		NA	11kV(UE) XLPE CU 1RX3CX150sqmm
	2	LV DIST. TRAFO-2 (LV DTR-2)	2.0MVA	TRAFO	630A	1	–	1	125/1A, 5P20, 10VA	125/1A, CL0.5, 15VA		NA	11kV(UE) XLPE CU 1RX3CX150sqmm
	3	LV DIST. TRAFO-3 (LV DTR-)	2.0MVA	TRAFO	630A	1	1	–	125/1A, 5P20, 10VA	125/1A, CL0.5, 15VA		NA	11kV(UE) XLPE CU 1RX3CX150sqmm
	4	LV DIST. TRAFO-4 (LV DTR-)	2.0MVA	TRAFO	630A	1	–	1	125/1A, 5P20, 10VA	125/1A, CL0.5, 15VA		NA	11kV(UE) XLPE CU 1RX3CX150sqmm
	5	COOLING WATER PUMP MOTORS FOR CONDENSER	215KW	MOTOR	630A	3 (2W+1S/B)	2 (1W+1S/B)	1 (1W)	25/1A, 5P20, 10VA	25/1A, CL0.5, 15VA			11kV(UE) XLPE CU 1RX3CX150sqmm
	6	VFD FOR BFP-HRSG MOTOR	240KW	VFD FEEDER	630A	4 (2W+2S/B)	2 (1W+1S/B)	2 (1W+1S/B)	30/1A, 5P20, 10VA	30/1A, CL0.5, 15VA		NA	11kV(UE) XLPE CU 1RX3CX150sqmm
	7	SPARE TRANSFORMER FEEDER	–	TRAFO	630A	1	1	–	125/1A, 5P20, 10VA	125/1A, CL0.5, 15VA		NA	–
	8	SPARE MOTOR FEEDER	–	MOTOR	630A	1	–	1	25/1A, 5P20, 10VA	25/1A, CL0.5, 15VA		NA	–
	9	SPARE VFD	–	TRAFO	630A	1	1	–	30/1A, 5P20, 10VA	30/1A, CL0.5, 15VA		NA	–
01	10	11KV FEEDER TO S/S-14 TO SWGR-212 (OWNER'S USE)	–	PLANT	1250A	2	1	1	1250/1A 5P20, 10VA	1250/1A, CL0.5, 15VA		1250/1A, CL.PS, Vk≥440V, Rct=5Ω Im<30mA @ Vk/2	11kV(UE) XLPE CU 4RX3CX300sqmm
01	11	11KV TRANSFORMER FEEDER TO TR-111 S/S-2 (OWNER'S USE)	12.5MVA	PLANT	1250A	1	1	–	750/1A 5P20, 10VA	750/1A, CL0.5, 15VA		NA	11kV(UE) XLPE CU 4RX3CX300sqmm
01	12	11KV TRANSFORMER FEEDER TO TR-112 S/S-2 (OWNER'S USE)	12.5MVA	PLANT	1250A	1	–	1	750/1A 5P20, 10VA	750/1A, CL0.5, 15VA		NA	11kV(UE) XLPE CU 4RX3CX300sqmm
01	13	11KV TRANSFORMER FEEDER TO TR-131 S/S-2 (OWNER'S USE)	1.6MVA	PLANT	630A	1	1	–	100/1A 5P20, 10VA	100/1A, CL0.5, 15VA		NA	11kV(UE) XLPE CU 1RX3CX185sqmm
01	14	11KV TRANSFORMER FEEDER TO TR-132 S/S-2 (OWNER'S USE)	1.6MVA	PLANT	630A	1	–	1	100/1A 5P20, 10VA	100/1A, CL0.5, 15VA	3000/1A, CL.PS, VK≥300V, Rct=5Ω, Im<30mA @ VK/2	NA	11kV(UE) XLPE CU 1RX3CX185sqmm
01	15	11KV TRANSFORMER FEEDER TO TR-133 S/S-2 (OWNER'S USE)	1.6MVA	PLANT	630A	1	1	–	100/1A 5P20, 10VA	100/1A, CL0.5, 15VA		NA	11kV(UE) XLPE CU 1RX3CX185sqmm
01	16	11KV TRANSFORMER FEEDER TO TR-134 S/S-2 (OWNER'S USE)	1.6MVA	PLANT	630A	1	–	1	100/1A 5P20, 10VA	100/1A, CL0.5, 15VA		NA	11kV(UE) XLPE CU 1RX3CX185sqmm
01	17	11KV TRANSFORMER FEEDER TO TR-135 S/S-2 (OWNER'S USE)	1.6MVA	PLANT	630A	1	1	–	100/1A 5P20, 10VA	100/1A, CL0.5, 15VA		NA	11kV(UE) XLPE CU 1RX3CX185sqmm
01	18	11KV TRANSFORMER FEEDER TO TR-136 S/S-2 (OWNER'S USE)	1.6MVA	PLANT	630A	1	–	1	100/1A 5P20, 10VA	100/1A, CL0.5, 15VA		NA	11kV(UE) XLPE CU 1RX3CX185sqmm
01	19	SPARE-11KV FEEDERS (OWNER'S USE)	–	PLANT	1250A	4	2	2	1250/1A 5P20, 10VA	1250/1A, CL0.5, 15VA		1250/1A, CL.PS, Vk≥500V@Rct=5Ω, Im<30mA @ Vk/2	NOT IN BHEL SCOPE (HOWEVER TERMINATION SUITABLE FOR 11kV(UE) XLPE CU 4RX3CX300sqmm)
01	20	SPARE-11KV TRANSFORMER FEEDER FOR 12.5 MVA TRAFO (OWNER'S USE)	12.5MVA	PLANT	1250A	4	2	2	750/1A 5P20, 10VA	750/1A, CL0.5, 15VA		750/1A, CL.PS, Vk≥500V@Rct=5Ω, Im<30mA @ Vk/2	NOT IN BHEL SCOPE (HOWEVER TERMINATION SUITABLE FOR 11kV(UE) XLPE CU 4RX3CX300sqmm)
01	21	SPARE-11KV TRANSFORMER FEEDER FOR 6.25 MVA TRAFO (OWNER'S USE)	6.25MVA	PLANT	1250A	4	2	2	400/1A 5P20, 10VA	400/1A, CL0.5, 15VA		400/1A, CL.PS, Vk≥500V@Rct=5Ω, Im<30mA @ Vk/2	NOT IN BHEL SCOPE (HOWEVER TERMINATION SUITABLE FOR 11kV(UE) XLPE CU 4RX3CX300sqmm)
01	22	SPARE-11KV TRANSFORMER FEEDER FOR 2.0 MVA TRAFO (OWNER'S USE)	2.0 MVA	PLANT	630A	6	3	3	125/1A 5P20, 10VA	125/1A, CL0.5, 15VA		NA	NOT IN BHEL SCOPE (HOWEVER TERMINATION SUITABLE FOR 11kV(UE) XLPE CU 1RX3CX185sqmm)
01	23	SPARE-11KV TRANSFORMER FEEDER FOR 1.0 MVA TRAFO (OWNER'S USE)	1.0 MVA	PLANT	630A	6	3	3	60/1A 5P20, 10VA	60/1A, CL0.5, 15VA		NA	NOT IN BHEL SCOPE (HOWEVER TERMINATION SUITABLE FOR 11kV(UE) XLPE CU 1RX3CX185sqmm)
01	24	SPARE-11KV TRANSFORMER FEEDER FOR 0.5 MVA TRAFO (OWNER'S USE)	0.5 MVA	PLANT	630A	6	3	3	50/1A 5P20, 10VA	50/1A, CL0.5, 15VA		NA	NOT IN BHEL SCOPE (HOWEVER TERMINATION SUITABLE FOR 11kV(UE) XLPE CU 1RX3CX185sqmm)

(*REFER NOTE-22)

NOTES:

01. FOR NOTES, REFER TO SH.01 OF 02.

REV.	DATE	DESCRIPTION	DRN.	STR.	MECH.	ELEC	INST.
01	25-06-15	REVISED INLINE WITH FICTNER COMMENTS VIDE TR.NO.5111168-2000-EL-VDT-005	GSK	XXX	XXX	JKP	XXX

APPROVED BY

PROJECT:
1x51 MW COMBINED CYCLE COGENERATION CATIVE POWER PLANT

FICHTNER
Consulting Engineers
(India) Private Limited
Chennai, Bangalore.

	SIGNATURE	DATE
DRAWN	G.SESHU KIRAN	20-12-14
DESIGNED	G.SESHU KIRAN	20-12-14
CHECKED	SURESH.P	20-12-14
DEPT.HEAD	J.K PATTANAIK	20-12-14
PROJ.MGR	XXX	XXX

CLIENT:
OIL AND NATURAL GAS CORPORATION LTD.
AT HAZIRA PLANT, GUJARAT.

EPC CONTRACTOR:
BHARAT HEAVY ELECTRICALS LTD
HYDERABAD

TITLE:
11KV CCCPP AUX. SWITCHGEAR SLD

DEPT PE&SD(450) | JOB NO. XXX | SCALE NA | SHEET 02 OF 02 | REV.

RELEASED FOR: PRELIMINARY / TENDER / ENGINEERING / CONSTRUCTION

DWG.NO. 1-381-21-02884 | 01

ANNEXURE-9
11Kv SLD(Existing)

Electrical Single Line Diagram of Cogen

GEB I/C 1

LINE-1 MOCB

66 kV SWITCHYARD

66 kV BUS-TIE, 800A

66 KV BUS

2500 MVA, 50 HZ

GEB I/C 2

LINE-2 MOCB

7.9 Ω, 10 Sec 800A NGR

NGR BRKR

GT-1

19.2 MW, 11 kV

MASTER BRKR, GT#1

66KV,TR-101 BRKR

ISOLATOR

TR 101
66/11 kV,
25/31 MVA

SOLID EARTHING

7.94 Ω, 10 Sec 800A NGR

7.94 Ω, 10 Sec 800A NGR

NGR BRKR

GT-3

19.2 MW, 11 kV

MASTER BRKR GT#3

ISOLATOR

66KV,TR-102 BRKR

TR 102
66/11 kV,
25/31 MVA

7.9 Ω, 10 Sec 800A NGR

NGR BRKR

GT-2

19.2 MW, 11 kV

MASTER BRKR, GT#2

SOLID EARTHING

7.94 Ω, 10 Sec 800A NGR

REACTOR

11 KV, 1500 A
0.55 Ω

PNL-33
BUS COUPLER

SLAVE BRKR, GT#1

11KV INCOMER-1 BRKR

SLAVE BRKR-A,GT#3

SLAVE BRKR-B GT#3

11KV INCOMER-2 BRKR

SLAVE BRKR, GT#2

A BUS 11 kV 50 Hz,3000A,750 MVA 3Ø BUS – 1A

11 kV,50 Hz,3000A 750 MVA, 3Ø BUS-1B B BUS

TR-179(E),Cogen Ph#3
11 kV Cogen A
TR-176,Gas Terml.
TR-145, S/S-7
TR-149, S/S-4
TR-151, S/S-4
TR-159, S/S-9
TR-131, S/S-2
TR-133, S/S-2
TR-155, S/S-10
TR-135, S/S-2
TR-137, S/S-3
TR-157, S/S-11
TR-147, S/S-7
TR-139, S/S-8
TR-174, Const S/S-8
TR-141, S/S-5
SPARE FDR,10/12.5 MVA
TR-111, S/S-2
TR-113, S/S-3
SWGR 212, S/S-14A
TR-143, S/S-6
TR-153, S/S-8
TR-115, S/S-4
TR-117, S/S-4
SPARE FDR,1.6 MVA
TR-144, S/S-6
TR-142, S/S-5
TR-118, S/S-4
TR-116, S/S-4
SWGR 212, S/S-14B
TR-114, S/S-3
SPARE FDR,1MVA
TR-112, S/S-2
SPARE FDR,10/12.5 MVA
TR-140, S/S-8
TR-148, S/S-7
TR-158, S/S-11
TR-180(F),Cogen Ph#3
TR-138, S/S-3
TR-136, S/S-2
TR-156, S/S-10
TR-134, S/S-2
TR-132, S/S-2
TR-160, S/S-9
TR-152, S/S-4
TR-150, S/S-4
TR-146, S/S-7
11KV COLONY FDR
TR-172/173,Const S/S-7
TR-154, S/S-8
TR-171, Gas Termnl.
11 kV Cogen B

TYPICAL (S/S-2)
TR 111 & TR 112
11 /6.6 kV, 10/12.5 MVA
6.6 kV, 1250 A BUS
250 MVA, SEC A
250 MVA SEC B
6.6 kV, HT LOADS

TYPICAL
(FROM SWGR 212 AT S/S-14)
TR 163 & TR 164
11 kV/440 V
415 V BUS
SEC A
SEC B
S/S-14
415 V, LT LOADS

TYPICAL
(FROM SWGR 212 AT S/S-14)
TR 123 & TR 124
11 kV/6.6 kV
S/S-16
TR-169
TR-170
S/S-16, 415 V,
PCC 324

- two (2) single ropes each with 2 eyes at the ends, each rope 4 m long
- two (2) endless ropes, extended length 4 m each
- eight (8) shackles.
- 2 Sets of soft/synthetic slings of suitable capacity for handling generator rotor of GTG and STG.

The load-bearing capacity of the ropes and shackles must be suitable for the relevant hoist.

The maximum tension in the rope must not exceed 1/8 of the calculated breaking capacity of the rope. The ropes must be of the stranded type, and galvanized wires must be used.

The eyes of the single ropes must be secured with compression fittings. The length of the eyes must be at least 15 times the nominal diameter of the rope.

In special cases, where safe lifting of the relevant component is not certain, specially-made devices must be provided. At least two (2) of these must be provided in each individual case.

For each installation a list must be submitted, showing the number, type, nominal load-carrying capacity and strength characteristics of the materials used. In addition, factory and acceptance certificates must be submitted for all ropes and materials.

The safe lifting capacity of lifts is to be clearly marked stating both the maximum load in kg and the number of persons the lift was designed for. For this purpose the weight of a standard person shall be taken to be 75 kg.

For Design data for lifting devices for MPP supplied equipment shall be as per MPP standard, refer the detailed technical specification.

7.13.9 **Elevator**

One (1) no. elevator with a carrying capacity of ten (10) passengers shall be provided for the Switchgear / control building.

7.14.0 General Electrical Requirements

All equipment supplied and all work done including system design and detailed engineering shall also comply with the statutory requirements of the State/Central government and with the Indian Electricity Rules.

Unless otherwise specified, at least 10 % margin shall be considered in equipment sizing over and above the calculated load current/fault current/power requirments.

If not specified otherwise the electrical operational equipment must be designed to meet protection classes stated below.

• HT Switchgear (Indoor)	-	IP 4X
• LT Switchgear (Indoor)	-	IP 52
• Control panels (Indoor)	-	IP 42
• Relay panel	-	IP 42
• Motors (indoor)	-	IP 54
• Motors and other equipment located outdoor	-	IP 55
• Emergency DG (Indoor)	-	IP 23

Each individual enclosure accommodating electrical equipment which is liable to suffer from internal condensation due to atmospheric or load variations shall be fitted with heating

devices suitable for electrical operation at AC single phase. Heaters in switchgear / control cubicles, panels, desks shall be controlled automatically by thermostats.

Motors rated 0.2 kW and below, except otherwise required for reversible service, shall be rated for use on a 240 V, single phase, 50 Hz, solidly grounded system. Motors rated above 0.2 kW and up to 160 kW shall be rated for use on 415V, 3 phase, 50 Hz, solidly grounded system. Motors above 160 kW shall be rated for use on a 11 kV, 3 phase, 50 Hz resistance grounded system. All Motors shall be designed for direct on line starting at full voltage.

Electrical motor operated actuators shall have non- integral starters.

Guards shall be provided for protection of personnel from all exposed moving and/or rotating machine elements. Necessary supports and accessories shall be furnished with each guard to prevent vibration. Guards for outdoor installation shall be galvanized steel. Grease fittings shall be extended through the safety guards.

For all other requirements of electrical system, the respective electrical sectionals shall be referred.

7.15.0 General Control and Instrumentation (C&I) Requirements

The Instrumentation and control systems shall be provided for safe, reliable and efficient operation of the combined cycle power plant. In general a consistent control and instrumentation philosophy is to be applied throughout the power plant. Standardization concepts shall be applied wherever possible to rationalize operation, maintenance and reduce spare parts. Adequate redundancy are to be ensured, so that no single point failure of the I&C systems/ equipments in the power plant results in the overall reduction of the plant output.

For the turbine control package standard control/protection system shall provide no single failure of field sensor cause Unit to trip. Redundant sensors shall be provided for control / protection functions with the exception of functions used only during start-up and where redundancy cannot be provided due to limitation in installation space. Also final control elements (trip solenoids and fuel valves) themselves and related accessories shall not meet this requirement.

In general all I&C systems/ equipments should be of modern and compact design, incorporating proven technology and modern industrial practice.

7.16.0 General Civil Requirements

The design specification covered in Section 5 of Vol-III establish the minimum basic requirements for all Civil structural and Architectural works. However all structures shall be designed for the satisfactory performance of the function for which the same are to be constructed.

With regard to soil and other hydrographic data furnished, it shall be clearly understood that the same are given to the Contractor in good faith and as such no claim for extra payment shall be entertained by the Owner/Owner's representative, if the actual condition met with during execution are at variance with the data given in Contract. The Contractor shall fully satisfy himself about the site conditions,nature of soil,ground water,contour levels etc,prior to the submission of the bid.The contractor shall conduct his own investigations to ascertain the correctness of the data furnished and based on the actual data the Contractor shall finalise the most suitable civil and structural design basis, which will be submitted to Owner/Owner's representative for review & approval.

7.17.0 List of Approved Sub-vendors

~~Refer Volume IV/Annexure-1/ Section 8.~~

With full information substantiating the technical acceptability of the proposed change. The Owner/Owner's representative's decision shall be final. Concessions granted shall not absolve the Contractor from any of his responsibilities under the Contract.

8.0.0 QUALITY ASSURANCE, SHOP INSPECTION AND TESTING

8.1.0 General

This section contains general requirements for inspection of material, parts, equipment and workmanship of the plant during manufacture, assembling to demonstrate compliance with specification, codes and standards to ensure overall reliability of plant operation and performance.

The Owner/Owner's representative and/or authorised Representatives shall, at any time, be allowed free and ready access to the Contractor's premises and those of his suppliers as well as to the site installation and the Contractor has to make the plant items available for the purpose of inspecting the specified equipment components and obtaining information as to the progress of the work. Failure on the part of the Owner/Owner's representative, at this or any other time, to discover or reject materials or work which do not meet specified requirements shall not be deemed an acceptance thereof nor a waiver of defects therein.

The approval of the Owner/Owner's representative shall not prejudice the right to reject equipment if it does not give complete satisfaction in service.

8.2.0 Scope

All materials, components and equipments covered under this specification shall be tested at all stages of procurement, manufacturing, erection, commissioning as per a comprehensive quality assurance programme. The requirements of minimum quality plans to be followed by the Bidder in respect of various equipment are specified in detailed technical specification. The Bidder shall draw his own quality plans in line with these requirements and his standard practices and implement such programme after approval by the Owner/Owner's representative.The Owner/Owner's representative shall appoint a Third party inspection (TPI) agency for bought out items/outside inspection.The Owner/Owner's representative will carry out on-site supervision and inspection.

Manufacturing quality plan shall detail out, for all the components and equipments, various tests/inspection to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by contractor's quality control organization, the relevant reference document and standards, acceptance norms and inspection documents raised. during all stages of material procurement, manufacture, assembly and final testing/performance testing.

The Contractor has primary responsibility for ensuring the quality of items of equipment supplied under the contract and remains accountable when manufacture or erection is subcontracted. It is therefore a requirement of the specification that work is only subcontracted to companies with effective quality control organization and that the Contractor monitors the performance of these by the attendance at tests of experienced inspectors employed by the Contractor. The Contractor shall, at the appropriate time, prove that his

material and / or equipment comply with all the requirements of this Section, such proof being the successful completion of tests and inspections. Routine test and type test certificates shall be submitted for each item of equipment, wherever applicable.

All materials, components and equipment supplied under the contract shall be subject to inspection by the Owner/Owner's representative, his representative, Inspectors of Boilers (India) or his authorized Agency or any other Inspector of the Government, should they so require during manufacture, erection and after completion. The necessary inspection charges of the authorized agency of Inspection of Boilers (India) shall be borne by the contractor. The inspection and tests shall include but shall not be limited to the requirements of this section of the specification. Further requirements to be applied are specified in the detailed specification.

The Bidder along with quality plan, shall also furnish copies of the reference documents/plant standards/acceptance norms/test and inspection procedure referred by him in quality plans. These quality plans and reference documents/standards will be subject to Owner/ Owner's representative's approval and will form a part of the contract. In these approved quality plans, Owner/Owner's representative shall identify customer hold points (CHP), indicating tests/checks which shall be carried out in presence of the Owner/Owner's representative's or authorized representative and beyond which work will not proceed without consent of Owner/Owner's representative's in writing.

No materials/equipment shall be dispatched from the manufacturer's works before the same is either accepted subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspections by Owner/Owner's representative or such pre-dispatch final inspection is waived by the Owner/Owner's representative and dispatch is authorized after review of test reports.

All materials used or supplied shall be accompanied by valid and approved material certificates and test and inspection reports duly approved by the Owner/Owner's representative. These certificates and reports shall indicate the acceptable identification number of the material they proposed to certify. The material certified shall also have the identification details stamped on it.

All material used for equipment construction including castings and forgings shall be of tested quality as per relevant codes/standards. Details of results of the test conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedures recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or as specified in detailed specification.

All welding shall be carried out as per welding procedure drawn and qualified in accordance with requirements of ASME Section IX. Welding procedures shall be submitted to the Owner/Owner's representative for approval prior to carrying out qualification test in the presence of I/Owner/Owner's representative

All welders/welding operators employed on any part of the contract either in the Supplier's works or at site or elsewhere shall be qualified as per ASME Section-IX.

Test results of qualification tests and specimen testing shall be furnished to the Owner /Owner's representative for approval. However, wherever required by the Owner/ Owner's representative, tests shall be conducted in presence of Owner/Owner's representative

All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

All the sub-vendors proposed by the Bidder for procurement of major bought out items including castings, forgings, pumps, heat exchangers, semi finished and finished components/equipment-(list of which shall be drawn up by the Bidder along with his offer and finalized with the Owner/Owner's representative) shall be subject to Owner/ Owner's representative's approval.

The type and extent of inspection of items shall be in accordance with the relevant International/Indian Standards/Indian Boiler Regulations and other standards approved by the Owner/Owner's representative, supplemented or amended by the requirements of this section of the specification or as specified elsewhere in the Specification.

8.3.0 Inspection Program and Test Notifications

Before manufacturing commences and not later than 45 days after award of contract, the Contractor shall submit an outline of his proposed inspection program, which shall include all major stages during manufacturing. The inspection and test program shall include for the various items the designation No., name of equipment, part of equipment, the kind of test, test standard, company which carries out the test, place, date and witnesses by the Contractor, third party or Owner/Owner's representative's .

The Owner/Owner's representative will return a copy of the Contractor's proposed inspection program indicating those inspection stages for which notification is required. Notification shall be by Fax or email in a format to be agreed and shall be sent at least 20 days prior to the intended test in accordance with 'Conditions of Contract'. If the Owner/Owner's representative intends to be represented at the test he will provide at least 24 hours' notice and if his representative does not attend on the notified date, the test may proceed unless an altemative date has been requested by the Owner/Owner's representative.

8.4.0 Test Certificate Documentation

The results of all tests shall be certified by the manufacturer, Contractor or independent agency as appropriate.

Document files containing material certificates, welding procedures, test report shall be compiled for each item of plant and shall be suitably identified (including equipment classification reference) and bound.

Three copies of each document file containing inspection reports and certificates of site erection testing activities of a particular item of plant or system shall be supplied to the Owner/Owner's representative prior to commissioning.

Copies of the performance and acceptance test reports shall be prepared and distributed as specified in Clause 'Performance and acceptance test data and reports' of this Section. All documentation as required by IBR shall also be prepared and submitted.

8.5.0 Certification of Equipment by Owner/Owner's representative's

The Personal and travelling costs in connection with the Owner/Owner's representative's inspection and witnessing of tests of equipment, components and material manufactured in India and abroad will be borne by the Owner/Owner's representative.

8.6.0 Codes and Standards

8.6.1 General

The type and extent of inspection shall generally be in accordance with that specified in the standard used for design and construction of the item of equipment supplemented or amended by the requirements of this section of the specification. The Contractor should provide the relevant codes and standard to the Owner/Owner's representative.

8.6.2 Reference to Codes and Standards

Reference to special codes and standards, where designated either directly or as "relevant", is intended to provide a measure of performance, safety, in-shop and on-site testing, and methods of construction and/or installation which must be equalled or exceeded in order to be considered acceptable for use under this specification. If more than a single degree of quality or accuracy is permitted within the scope of particular code or standard, the highest quality shall be applicable and the degree of accuracy commensurate with the intended function shall be selected, but with the understanding that the final decision will be made by the Owner/Owner's representative.

In all instances, the finally accepted applicable code or standard shall be the version last published.

8.6.3 Alternative Standards

Where no appropriate standard is available, tests shall be conducted in accordance with the manufacturer's standard practice, subject to the approval of the Owner/Owner's representative.

In such cases the Contractor shall submit to the Owner/Owner's representative, complete data and a suggested procedure for the testing to be performed. Commencement of manufacture before receipt of the Owner/Owner's representative's approval shall be at the Contractor's risk.

If the proposed procedures are accepted, the Contractor shall provide the Owner/Owner's representative with four additional copies in English before any test is performed.

8.6.4 Derating Standards

The Contractor's attention is drawn to the climatic conditions in the site area. Derating factors shall apply in accordance with the relevant and approved standards if not specified in the contract documents.

8.7.0 Services prior to and During Inspection and Testing

In accordance with and in addition to specified standards the Contractor shall submit procedures for material testing, manufacture, quality control and performance testing as they apply from the procurement phase of raw materials to the finished product. Manufacture commenced before receipt of the Owner/Owner's representative's approval of material specifications and testing procedures shall be at the Contractor's risk.

No inspection shall be valid unless the Contractor and manufacturer are in possession of relevant approved drawings and procedures for the item to be tested. The Contractor on

request shall supply the Owner/Owner's representative's with a copy of drawings and procedures at the time of the test.

All instruments and apparatus required for the inspection or used for the performance of tests shall be subject to the approval of the Owner/Owner's representative at his discretion and shall be calibrated to an agreed standard in approved laboratories. The cost of making such calibrations shall be borne by the Contractor in all cases.

If the Contractor wishes to apply for a concession in respect of a departure from an approved procedure or standard, this shall be made in writing with full information substantiating the technical acceptability of the proposed change. The Owner/Owner's representative's decision shall be final. Concessions granted shall not absolve the Contractor from any of his responsibilities under the Contract.

8.8.0 Testing During Manufacturing

The minimum testing requirements for mechanical, electrical and C&I equipment testing to be conducted at manufacturer's works are specified in the detailed specifications.

9.0.0 EQUIPMENT ERECTION, SITE TESTING, COMMISSIONING AND PERFORMANCE TEST

This Specification generally covers the standards, scope of works, documentation, scope of installation, testing and commissioning of various mechanical, electrical, control and instrumentation equipment & system and various requirements to be adhered to during the execution of the works.

Works shall be performed in accordance with this technical specification and various other drawings and schedules submitted and approved by the Owner/Owner's representative during the execution and the instructions from Engineer-in-charge or his authorized representatives during the progress of the work. Consumables required for the job shall be ensured by the Contractor. All necessary equipments and instruments required to carry out the works, recalibration of the instruments required during loop checking and commissioning shall be done by the contractor.

Field quality plans shall be submitted and shall detail out for all the equipments, the quality practices and procedure to be followed by the Contractor's site quality control organization during various stages of site activities including receipt of materials/equipments at site, preservation and storage, pre-assembly, erection, pre-commissioning and commissioning. The Contractor shall provide all necessary means for execution of inspection and testing, according to the requirements.

9.1.0 Erection

9.1.1 General

Erection work shall be carried out in the manner and sequence as may be directed by Contractors supervisory Engineers and the Owner/Owner's representative.

All existing structures, piping, conduits, equipment and facilities shall be protected by the Contractor against damage/degrade during erection. Any damage/degradation caused by Contractor shall be rectified at his cost to the satisfaction of the Owner/Owner's representative within short timelines.

As erection proceeds each assembled part before being boxed up with a view to erecting it finally, shall be inspected and approved by the concerned supervisor. Should any defect be found out during such inspection, the Contractor shall make it good as per directives from Owner/Owner's representative.

All materials such as electrodes, gaskets, bolts, nuts shall be of reputed make and conforming to relevant Indian Standards. Prior approval of Owner/Owner's representative will have to be obtained before commencement of work. Manufacturer's test certificate shall have to be provided when called for.

Contractor shall furnish all instruments, isotopes, films for conducting radiography and equip himself fully. Necessary operators of all testing equipment shall be provided by the Contractor. Dark room facilities with air conditioners for storing and processing radiography films and equipment, as necessary, shall have to be arranged by the Contractor. The radiography shall be done on any weld (including welds for repair) only after final heat treatment.

The equipment shall be placed on respective support, levelled and aligned with precision measuring instruments, checked for proper clearance between moving and stationary parts wherever applicable.

The installation of motors shall be carried out along with driven equipment in accordance with manufacturer's instructions and/or as directed by the Owner/Owner's representative.

Wherever the scope includes control panels, all connections in control panels shall be completed, checked and adjusted to ensure safety and satisfactory operation of the equipment.

Particular attention shall be given towards removal of buckles and other forms of distortion.

Holes in plate work to assist in erection should be avoided.

Misalignment in vertical joints shall not exceed 10% of plate thickness or 1.0 mm, whichever is larger.

Misalignment in horizontal joints shall not exceed 15% of upper plate thickness with a maximum of 2 mm for plate thickness above 8 mm and a maximum of 1.0 mm for plate thickness less than 8 mm.

Welding sequence shall be adopted in such a way so as to minimise distortion due to weld shrinkage and shall be got approved from the Owner/Owner's representative prior to commencement of work.

Welding shall not be carried out on wet surfaces and shall be protected from high winds.

9.1.2 Erection Program and notification

The Contractor shall furnish a detailed erection programme taking into consideration the constraints likely to be encountered during various phases of work including interfacing with the existing plant. This erection programme shall be strictly adhered. The Contractor shall take appropriate steps as directed by the Owner/Owner's representative to make up for any slippage from this erection programme and no additional compensation shall be allowed on this account.

Before erection commences and not later than three months before start of erection, the Contractor shall submit the proposed erection test program and the commissioning test program with all proposed erection and commissioning tests and checks. Together with the test programs the proposed test procedures have to be submitted.

The test programs should consider:

- that the sequence and duration of the proposed activities are logical, realistic and in accordance with safety and permit regulations in force
- that the commissioning of any item of plant would not interrupt the normal operation of the existing plant.
- that allowance for training the Owner/Owner's representative's operation personnel during this period has been made.

The Contractor has to take care that the test programs are maintained by the erection organization during erection and commissioning.

The Contractor has to mark all stages, which are subject to the Owner/Owner's representative's acceptance and has to notify at least two week's in advance when such inspection for acceptance becomes due.

9.1.3 Supervision during Erection

The Contractor shall provide at proper time the necessary supervisory Engineers, Supervisors and other supervisory personnel duly qualified and in sufficient number for transportation, handling, unloading, storage, erection, pre-commissioning and post commissioning, startup, testing and test operation of plants and equipment.

The Contractor shall keep a competent representative who will be resident Engineer-in-charge and shall remain as In-charge of Contractor's work site and also remain answerable to the Owner/Owner's representative for all activities of the Contractor at site. Before his placement at site, the Contractor shall submit his bio-data to the Owner/Owner's representative for his approval.

The Resident Engineer-in-charge shall supervise the work of all men of the Contractor working at site. He shall work in complete harmony and co-operation with Owner/Owner's representative. All statutory rules and labour laws prevailing in the area must be observed by the Contractor. All safety measures against occurrence of accidents must be taken effectively. Resident Engineer-in-charge shall not be withdrawn without written permission of the Owner/Owner's representative. If any of the Contractor's personnel was found unsuitable for the job, the Contractor shall remove him forthwith and a suitable replacement shall be posted to site within a reasonable time. No compensation for withdrawing of unsuitable or unqualified person(s) from site or for posting suitable person(s) to site at any stage of the project shall be allowed by the Owner/Owner's representative.

9.1.4 Sequence of Erection Work

All packing cases and packages shall be opened in presence of the Owner/Owner's representative or his authorised representative.

Nails and packing strips should be pulled out with suitable appliances and kept separately in container and not thrown away at random. All timber of packing cases shall have to be sorted out and stored properly at a suitable place as directed by the Owner/Owner's representative.

From time to time packing materials, timber, nails and strips shall be delivered back to the Owner/Owner's representative or otherwise disposed of as directed by the Owner/Owner's representative. All timber and packing materials shall remain the property of the Owner/Owner's representative.

Each material after stripping from boxes or received loose, shall be carefully inspected, checked with shipping list and identified with erection drawing if necessary. Any short supply and/or damaged part shall be reported forthwith to the Owner/Owner's representative in writing. The Contractor shall be completely responsible to make all necessary arrangements, application and follow procedure to process claim on underwriters, obtain replacement repair/rectify and modify as required on all such damaged/defective/lost equipment and material at no extra cost to the Owner/Owner's representative in order to execute the work to satisfaction of the Owner/Owner's representative within the stipulated contract time. Once the materials are inspected, the same shall be preserved properly and adequately protected from theft and deterioration or damage by rain, storm, dust, water, tampering by casual visitors or workers. The Contractor shall prepare and maintain stores, ledgers and bin cards for all materials in his custody.

Carrying out all repairs to damages/degradation that might have occurred during transit and in subsequent storage. Also modifications and rectification work as necessary and replacement of all lost parts, are under the Contractor's scope.

9.1.5 Safety Regulations

Contractor should follow all the safety regulations / norms as imposed by the Law/Authority/factory inspectorate /Owner/Owner's representative. When going to or from place of work in the plant only the prescribed walkways, paths or cross-overs shall be used and required protections, barricades shall be established for the plant area.

Crawling on, over or under movable equipment shall generally be prohibited.

For overhead work, proper signs shall be placed below and, when conditions justify, a watchman shall be stationed to warn employees in the vicinity.

Work on or about crane runways shall not be undertaken without the Owner/Owner's representative's permission. Whenever it is necessary to do any work on or above the crane runways, the Contractor shall furnish a flag man stationed on the floor.

Only scaffolds which meet the requirements of governing laws shall be used in the project.

Work in area of electric wires and cables shall generally be avoided.

All burning and welding equipment shall confirm to, and be used in accordance with, regulations governing such equipment. No burning or welding shall be done at any place on the site until location where such work is to be done is approved.

Adequate fire protection shall be available before work preceding the work.

All warning signs shall be observed.

Contractor shall require his employees to wear hard hats at all times when they are inside the plant area.

Goggles shall be worn whenever there is a possibility of flying particles or splashing of corrosive fluid.

While working at site all workmen shall wear necessary safety protective equipment.

When ladders are the means of access to a platform, they shall be firmly secured top and bottom and the ladder rails shall extend at least one meter above the top landing. When a ladder cannot be secured, a man shall be stationed at the base.

Safety belts shall be used by men working in high places when no hand rails or other guards are in place.

All accidents resulting in injury shall be reported to the Owner/Owner's representative promptly. Owner/Owner's representative's safety rules, regulations and directives shall be followed and reports thereon shall be submitted as and when required.

9.1.6 Proper Treatment of Injured

Contractor shall ensure that proper treatment of injuries is immediately available either as such or in the form of constantly available transportation to a source of such treatment.

Contractor shall ensure that stretchers are available near all areas in which their men are working and that the location of stretchers are well marked.

Contractor shall be solely responsible for the dissemination of all safety regulations including those written here, those promulgated by Owner/Owner's representative and those dictated by good practice, and shall ensure that all his employees and those of his Sub-Contractors are conversant with same

9.2.0 Inspection

After completion of erection and/or installations and before start-up the equipment and all its appurtenances shall be thoroughly cleaned and then, inspected in the presence of the Owner/Owner's representative for correctness, soundness and completeness of installation and acceptability for start-up.

All works to be carried out by the Contractor shall be subject to inspection by the / Owner/Owner's representative as applicable. The work shall be carried out as per applicable specifications, codes of practice, drawings and instructions of Owner/Owner's representative . The Contractor shall provide necessary facilities, instruments and personnel for carrying out the inspection as above and shall comply with the instructions given.

A check list in triplicate will be furnished for the approval of Owner/Owner's representative wherein all items to be checked and necessary instructions will be listed. Inspection and checking shall strictly follow this check list. On completion of the joint inspection and checking two (2) copies of the check list will have to be handed over to the Owner/Owner's representative. The check lists after checking will have to be jointly signed by the Contractor's supervisor and the Owner/Owner's representative to ensure that all inspection and checking have been properly carried out. However, such endorsement shall not relieve the Contractor from the responsibility in ensuring proper erection and cleaning.

During inspection all clearance, alignment and important measurements and adjustments as may be directed shall be noted by the Contractor for future reference and guidance. Two (2) copies of such notes shall be delivered to the Owner/Owner's representative.

All reports of radiographic examination in a format approved by the Owner/Owner's representative shall be submitted to the Owner/Owner's representative for his approval and records.

9.2.1 Cleaning

The Contractor shall observe strict cleanliness during execution of the work and shall be in possession of vacuum cleaner for cleaning the internals of machinery under installation. They shall check that all the finished surfaces are greased and covered.

Before boxing up, the Contractor shall examine carefully to ensure that no foreign material, such as welding rod ends, welding beads, metal chips, rope, working tools has been left inside any equipment.

In the case of motors, the following procedure shall be observed

a. Checking and cleaning of bearings and charging / filling of lubricants, wherever necessary.

b. Cleaning of core and winding, drying out and cornicing the winding and measurement of air gap for motor assembled at site.

Wherever the scope includes control panels, all withdrawable components shall be taken out and internals shall be cleaned with vacuum cleaner, if required.

9.3.0 Testing and Commissioning

9.3.1 Erection Test

Following the satisfactory completion of inspection, checking and cleaning of a unit, the plant will be placed in test run. During this period, all adjustments and repairs as required shall be made by the Contractor. Protocol shall be made and signature has to be obtained from Owner/Owner's representative. On completion of satisfactory test run, the plant will be placed under trial operation.

Prior to trial operation of any equipment the following shall be checked:

During erection all required erection tests as well as final erection checks of the mechanical completion of the systems and part thereof have to be performed.

After successful mechanical completion Mechanical Completion Certificates will be issued.

The activities necessary for mechanical completion shall include but not be limited to following testing:

- Visual inspection after unloading at site
- Checking of completion of relevant systems
- Proper installation of the drive and equipment on the foundation
- Proper alignment of drive and the driven equipment
- Proper connection of supports, hangers, piping, valves, instruments and other fittings.
- Freeness of the rotors of drive and equipment
- Healthiness of lube oil system, changing and filling as necessary.
- Safety audit
- Testing of site welds (non-destructive examinations)

- Pressure/leak/tightness test
- Pipe line and equipment flushing and cleaning
- Chemical protection of piping systems
- Checking of coating
- Testing of cranes and hoists
- Safety signs and warning signs
- Completion of buildings and civil works
- Test of ventilating and air-conditioning units

Electrical/instrumentation equipment tests

The following checks and tests measurements shall be made:

- Screwed connections for correct assembly
- Terminals and terminal connections for correct assembly
- Checking of earthing connections and testing of earthing resistances
- Measurement of insulation values
- Verification of neutralization conditions
- Fire-proof partitioning
- Marking, inscription, provision of designation plates
- Voltage checks
- Polarity checks in the case of DC voltages
- Fuses, over current trips, short-circuit trips, time settings, relay settings
- Transformer oil levels
- Setting indicators, revertive (check-back) signals to the central control room.
- Checks on wiring and cabling for conformity with the constructional circuit-drawings and plans
- checking and functionality testing of electrical systems according to IEC standards
- checking and testing of instruments

9.3.2 Pre-Commissioning Testing

After alignment of all equipment, alignment tests shall be carried out by the Contractor to check levelling, clearance, eccentricity.Measurements will be witnessed and acceptance will be certified by the Owner/Owner's representative.

Hydro-test / eddy current test, as applicable will be carried out on equipment as identified in the QAP to be finalized during detailed engineering. . All necessary blanking arrangements for hydro testing shall be furnished by the Contractor. All necessary test pump/temporary piping shall be supplied by the Contractor.

Preconditions for the commissioning are the issue of the Mechanical Completion Certificate and the availability of the accepted commissioning program and the Contractor's commissioning procedures. The Pre-commissioning Checks cover the functional tests of the individual items and their alarm and tripping systems. Following tests shall be included:

Mechanical equipment

- Individual pre-commissioning runs of all rotating equipment such as pumps, compressors, dosing equipment.
- functional tests of the mechanical equipment
- Testing and adjustment of safety devices.

Chemical Cleaning of Piping Systems and Equipment

Necessary procedure for chemical cleaning of piping and equipment shall be submitted to Owner/Owner's representative for their approval along with pre-commissioning document during detail engineering stage.

Before introducing chemicals, all the piping systems and equipment shall be water flushed. Water flushing will be followed by alkaline cleaning, acid cleaning and passivation or by EDTA (Ethylene Diamene Tetra Acid) and passivation.

However, the Contractor shall submit along with the offer his usual procedures and practices for chemical cleaning of the piping and equipment specified. The Contractor shall submit all schematics, write up, details of chemicals to be used. and detailed procedures he intends to follow. These schematics and procedures shall be subject to the approval of the Owner/Owner's representative.

Pre- cleaning procedure:

Prior to starting any phase of cleaning operation the following procedures shall be ensured:

Installation of all temporary piping, valves, pumps and equipments as required for the flushing and chemical cleaning operations. Temporary piping shall be routed at floor level as far as possible and secured in place to prevent movement/ vibration beyond acceptable limits.

Installation of the instruments as required to ensure satisfactory monitoring and control of the cleaning process. The Contractor shall also determine and arrange locations for sampling of the cleaning solution during cleaning.

By passing all regulation/control valves coming in the cleaning circuit or installation of temporary spool pieces.

Installation of special end covers and temporary suction strainers, for boiler feed pumps and condensate pumps. Pump internals shall not be installed.

Installation of plastic seal in the condenser neck to protect the turbine from alkaline fumes.

Blocking and securing of all spring hangers in the steam lines which may be flooded during the cleaning operation.

Hand cleaning of the interiors of all vessels which are included in the cleaning operation.

General cleaning procedures:

a) Seal water lines to pump shall be flushed by the permanent arrangement provided for the same.

b) Where pipeline terminate in spray headers, these headers shall be inspected after each phase of the cleaning operation and cleaned if necessary.

c) All strainers shall be observed closely during the cleaning operation by reading differential pressure gauges, and shall be cleaned when the differential pressure exceeds a predetermined value.

d) All high points, vents shall be opened periodically to ensure full system flow.

e) Upon completion of each stage of cleaning, the waste products shall be drained and transferred to the waste treatment basins. The Contractor shall then supply and add the necessary chemicals to the basin to neutralise all waste solutions and rinses generated by the cleaning process, and arrange for its disposal to an area to be indicated by the Owner/Owner's representative.

f) Strict safety precautions shall be exercised at all times during the chemical cleaning and during storage and handling of the chemicals. The Contractor shall ensure provision of all protective clothing, apparatus and equipment along with necessary first aid kits as required for handling the chemical and for carrying out the cleaning operation.

g) All Hazardous waste material generated during construction, erection and commissioning shall be disposed by Contractor using authorised waste disposal agency.

Steam Blowing of Piping Systems

i) Steam blowing shall include engineering, supply and installation of all temporary piping, valves, fittings including quick actuating valves (for puffing purposes), supports, blanking plates, spools, target plates, instruments, controls and all other accessories and services required to complete the cleaning process as specified herein

ii) The detailed schemes and procedure for steam blowing operations shall be prepared and furnished by the contractor and discussed and finalized during the detailed engineering stage.

iii) Steam blowing shall also include reinstatement of cleaned piping systems; and dismantling/removal of all temporary piping, equipment and materials from site. All temporary piping, valves, equipment and materials shall be taken back by the contractor upon satisfactory completion of cleaning, and shall be removed from the Owner/Owner's representative's premises.

iv) Engineering involved regarding temporary piping shall include the following:

a. Selection of temporary piping including disturbance factor calculation.
b. Preparation of layout of temporary piping and performing stress analysis as per ANSI B 31.1.
c. Selection of temporary hangers and supports as required.

v) The following piping systems shall be cleaned through steam blowing operation.

a) Main steam, , LP, HP and LP bypass and process steam piping system.
b) Auxiliary steam piping system.

vi) Steam blowing shall be carried out for removal of particles (rust, scales, weld splatter) from various piping systems to avoid damage to turbine bladings. Cleanliness of system shall be checked by means of test plates made of steel, which will be installed in the centre line of the piping system.

vii) Cleaning shall be achieved by steam purging i.e. by blowing of steam through the piping such that the momentum of flow is greater than that of steam flow during normal operation of unit (at TMCR). The disturbance factor during steam blowing (ratio of momentum of flow during purge to that during TMCR) shall be more than 1.4.

viii) The blow off shall be done with steam, which is exhausted through adequately sized, open-ended temporary piping. Temporary piping and motor operated valves shall be installed for steam blowing operation. Pressure shall be built up in the boiler and the

piping warmed before release of steam by quick opening of motor operated valve located on temporary piping. The cycle shall be repeated until steam from the blow out pipe is determined to be clean.

ix) If the flow nozzles and control valves have already been erected these shall be removed and replaced by spool pieces before steam blowing. The removed flow nozzle and control valves shall be put back after steam blowing.

x) The motor operated valves used for steam blowing shall have special characteristics like minimum loss of pressure, resistance to wear during severe working conditions (high velocity and carryover of water and solid particles), quick opening time, minimum effort on electric actuator.

xi) The steam blowing termination criteria shall be as under:

a) Acceptable target plate condition
b) Measured disturbance factor (DF) more than 1.4 ((to be reviewed and decided during detailed engineering stage depending upon type of cleaning adopted by Contractor Acid/alkali boil-out).

The required values to calculate actual DF will be measured at site. The criteria for acceptable target plate condition shall be finalised during detailed engineering.

Electrical equipment

As far as not already covered by the erection tests the pre-commissioning tests shall cover:

- High voltage tests
- trip tests
- Equipment Functional Test

Tests on Motors as per IS

- Insulation test of winding by megger, drying out and, if necessary, high potential test.
- Winding resistance measurement on all 3 phases for motors of bigger size.
- Testing the motor for proper direction of rotation and reconnection, if necessary.
- No load test run of the motor for a minimum of eight (8) hours to check out bearing or other associated parts.
- During test run, hourly record of currents on all the three phases shall be maintained and careful watch shall be maintained on the equipment for any abnormal sound, temperature of bearing, vibrations.
- After no load test run of the motor each rotary equipment shall be coupled and shall be subjected to a test run. The duration of this test run shall be mutually agreed.
- The objective of the test run shall be to ascertain that the following are within the permissible limits and the operation is satisfactory.
  - Vibration and noise level
  - Bearing vibration and temperature
  - Performance of the lube oil systems

- Motor winding temperature
- Performance of various control, interlocks and protective elements, wherever applicable.
- Performance of annunciation system and indication, wherever applicable.

Tests on transformers

During installation : Checking of complete delivery, checking of core earthing and insulation of active part from tank, H.V. sample tests of transformer Oil in accordance with IEC or equivalent Standards.

During commissioning : Checking of satisfactory operation.

Tests on earthing and lightning protection system

Acceptance tests and measurements of the earthing installations in accordance with IEC or IS standards.

Tests on lighting system

Proof of the minimum new value of lighting densities, checking of correct operation both electrically and mechanically.

Contractor shall provide the list of site tests to be performed on electrical equipment as part of pre-commissioning activities for Owner/Owner's representative's review.

Control Equipment

- Calibration tests of all analog measuring loops including all remote indications and recorders and the input signals used for closed loop control.
- Testing of all plant mounted transmitters.
- Wiring test of all control cabling in the field, control rooms combined with the function tests.
- Testing of all control modules in the control room

Functional testing of remote control of drives, circuit breakers, solenoid valves, actuators etc.

- Testing of open loop devices especially all sequence logic equipment using simulated inputs.

Testing of all interlocks to ensure safe operation.

- Testing of the alarm annunciation and event recorder system in connection with all field and control room devices using simulated inputs.
- Testing of all closed loop controls.
- Testing of insulation between cable screen and ground.

9.3.3 Commissioning

Preconditions of the commissioning are the successful completion of the pre-commissioning checks of all items of the whole system.

Commissioning tests shall be performed in accordance with the procedure contained in the commissioning program approved by the Owner/Owner's representative for individual equipment/system and as a plant. Commissioning test shall also include Redundancy and automatic fall back by simulation of fault conditions

On completion of each commissioning activity to the satisfaction of the Owner/Owner's representative,the commissioning schedule shall be signed and dated by the Contractor and countersigned by the Owner/Owner's representative.

Commissioning test shall prove that the plant is prepared and adjusted to ensure the correct functioning of the individual components and of the complete plant.

After successful completion of the commissioning tests "Authorization to Performance Test " shall be signed.

The Commissioning test shall cover at least following tests:

- Protection tests
- operation of protection devices including the following as a minimum
  - fire protection
  - HRSG protection
  - Gas turbine protection
  - steam turbine protection
  - generator protection
  - transformer protection
  - 66kV GIS protection
  - Balance of plant protection
- Method of alarm/trip condition reset for subsequent starting Isolation procedures method of isolation of plant equipment for safe shut-down and maintenance procedures including as a minimum
  - HV station and unit supplies
  - LV supplies
- Protection systems/settings, in accordance with agreed design and the requirements of the transmission system
- Start-up tests
  - Normal automatic start to preset load
  - Staged automatic including start to synchronous speed, manual synchronizing (including synchro-check), automatic synchronizing, manual and automatic loading
  - Starting with stand-by auxiliaries
  - Operation of all auxiliaries
  - Verification of start-up times and loading rates of power units and steam generators at various conditions
  - Power unit(s), test partial and full load rejection to demonstrate.

- Full load rejection tests to measure transient maximum speed and steady state speed at normal governor droop setting
- Method of resynchronism to be demonstrated.

- Turbine bypass operation capability
- Demonstaration of start up of the plant utilising start up power only from black start DG and demonstration of safe shut down utilising DG for emergency purposes.
- Operating stability when operated in the full range of load conditions with load variations by increasing or decreasing the electric load/steam delivery.
- Demonstration of the capabilities of the Power Units to operate at rated voltage and frequency, at power factors and reactive conditions between 0.85 (lag) and 0.95 (lead)
- Start-up tests of the Plant equipment, facilities and
- Verification of vibration and noise emission
- Environmental monitoring equipment, water quality monitoring equipment, functioning tests and verification of guarantees
- Verification of active power response and voltage control response according to the requirements specified in the network connection conditions
- Demonstration of proper controlling, monitoring and recording according to the requirements of the grid code shall be as per MPP recommendations.
- Verification of completeness of scope of supply. This shall be carried out along with the punch list.
- Verification of 24 hours uninterrupted MCR operation
- Establish the capability to deliver the specified process steam even at minimum Gas turbine load, without any fresh air for atleast 8 hours on a continous basis.

9.4.0 Trial Operations

After successful completion of commissioning test and after relevant test protocols have been accepted by the Owner /Owner's representative, the Contractor shall be allowed to prepare the Plant Units for trial operation. The plant will be started up and loaded. During this loading operation all the controls and protections shall be finally set.

After the plant is loaded to the maximum capability rating and the contractor is fully satisfied with its performance he shall offer the unit for Trial Operation by communicating the same to the Owner/Owner's representative in writing. After receipt of such communication the plant will be on trial operation. The trial operation will be for a minimum period of fifteen (15) days continuously at rated full load/part load as made available by the Owner/Owner's representative or as mutually agreed between the contractor & / Owner/Owner's representative to demonstrate the following :-

- Sustained capability of the plant
- Reliability of the equipment and auxiliaries
- Adequacy of the various auxiliaries, ancillaries & systems and controls.
- Capability of each equipment of the plant to correctly perform the functions for which it is specified.
- Safety requirements

This trial operation shall be undertaken jointly with the Owner/Owner's representative. As a part of the trial operation reliability run and guarantee tests of the plant shall be conducted.

9.5.0 Reliability Run

Reliability run shall be undertaken jointly with the Owner/Owner's representative as a part of the trial operation and within the trial operation period. Reliability run shall be conducted for seven (7) days uninterrupted at a load as available at prevailing ambient conditions.

In the event of interruptions to the reliability test run, for which the Contractor is responsible, the length of the reliability test run can be extended by a period equal to the total duration of the interruptions. If such an interruption lasts more than 24 hours, the reliability test run shall be restarted, after repairing the defect. The reliability test run may be interrupted on a maximum of three occasions, provided that no interruption exceeds 8 hours and that the Owner/Owner's representative is notified of the interruption in good time.

After the successful completion of reliability run test the Contractor shall offer the Owner/Owner's representative to conduct the gurantee test on prior intimation to the Owner/Owner's representative. The Contractor shall conduct gurantee test as per approved procedures for such test to the satisfaction of the Owner/Owner's representative. Perfromace and gurante tests shall be a part of the trial operation and shall be conducted to the requirements of testing stated under the clause Guarantee test.

Essentially the perfromace tests shall consist of a simultaneous test to establish the capability of the plant when delivering the base load. The gross heat rate of the unit shall be also tested while demonstrating to the Owner/Owner's representative the Gross Power Output and Auxilliary Power Consumption.in order to demonstrate that the plant is able to perform within the parameter limits specified in clause 20 below.

A joint log would be maintained to note various performance data, the malfunctions, output deficiency and short comings and would be compiled and furnished at the end of the trail operation along with the perfromace test results.

9.6.0 Guarantee Test

This consists of performance and guarantee tests as a part of the trial operation and within the trial operation period.

9.6.1 Objective of the test

The parameters which have an impact on commercial viability of the station are Gross Power Output &Gross Heat rate of the plant and the Auxiliary Power Consumption for the entire plant.

Performance Guarantee shall be provided for operation at contract specific site reference conditions as specified and the guaranteed performance parameters of the plant shall be proved by the Contractor during the test. Should the results of these tests show any deficiency from the guaranteed value, the Contractor shall modify the equipment as required at no extra cost to enable it to meet the guaranteed parameters.

All heat rates shall be based on Lower Heating value for the fuel.

9.6.2 Test Documents

The procedure for carrying out the above tests shall be submitted to the Owner/Owner's representative for approval six (6) months in advance. The procedure shall highlight the anticipated date for the test, arrangement and form of the tests.

The procedure shall include the following for each test or group of tests:

1. The sequence of the tests to be conducted.
2. The time duration of each test
3. The number of test runs
4. A list of instruments that will be used for each test. The list shall define which instruments are (a) special test instruments, (b) certified, (c) to be calibrated before and after each test, (d) check instruments, (e) station supply instruments (f) Schematic diagram showing all test points and cross referenced to the instrument list and (g) method of data logging. Data logging thro' satellite communication is not permitted.
5. All formulae, calculations, conversion factors, curves, correction curves etc., to be used in the conducting of the tests and the calculations of the test results. All such items shall be to a accuracy level of four decimals.
6. Sample test reports to data sheets and all specific result sheet forms that will be used for the test.
7. Written procedure and description of conducting the test.

9.6.3 Testing Method

The testing shall be carried out as per PTC – 46. The test boundary shall include the entire unit with heat sink.

9.6.3.1 Measurements

The following measurement has to be taken during performance and guarantee test

Output

- Gross power out put of the GTG and STG
  - Auxiliary Power Consumption
- Noise level

All the plant, equipment and systems covered under this specification shall perform continuously without exceeding the noise level over the entire range of output and operating frequency.

Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrated sound level meter meeting the requirement of IEC 651 or BS 5969 or IS 9779.

Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/machine and at a height of 1.5 m above the floor level in elevation.

A minimum of 6 points around each equipment shall be covered for measurement. Additional measurement points shall be considered based on the applicable standards and the size of the equipment. The measurement shall be done with slow response on

the A-weighing scale. The average of A-weighted sound pressure level measurements expressed in decibels to a reference of 0.0002 micro bar shall not exceed 85 dBA.

- Corrections for background noise shall be considered in line with the applicable standards. All the necessary data for determining these corrections in line with the applicable standards shall be collected during the tests.

- Emission level

Input

- Natural Gas consumption

Specific Site Conditions

- Ambient pressure
- Ambient temperature
- Relative humidity
- Grid frequency
- Power factor
- Fuel analysis (Natural Gas)
- Cycle blow down

Correction curves shall be applied only on the above measured specific site conditions to arrive at the Plant Performance Parameters at the contract specified specific site reference conditions.

9.6.3.2 **Contract Specific Site Reference Conditions**

- Ambient pressure - 1013 mbar
- Ambient temperature- 35°C
- Relative humidity - 70 %
- Grid frequency - 50 Hz
- Power factor – 0.80
- Design NOX – As per GPCB norms
- Design fuel analysis - LHV of the Natural gas fuel as per contract
- Cycle blow down equal to 0 %
- Deterioration due to aging - factors that are to be applied for Gross power output as agreed and stated in the contract.
- Tolerances that are to be applied on corrected Gross Heat Rate and Gross power output parameters as specifically stated in the contract.

9.6.3.3 **Specific Conditions of Testing Method**

The correction method stated under cl.5.5.2 in PTC 46 shall be applied to correct the performance parameters measured and corrected as per the above stated method Tolerances are applied over these corrected performance parameters in such case.

9.6.3.4 **Test Uncertainties**

The test uncertainty (not tolerence) shall be calculated based on the accuracy and number of test instruments utilized. The same shall be done as per PTC 46 and the maximum expected uncertainty shall not exceed 3 % for corrected gross heat rate and 1.2% for corrected Gross

power output to validate the test. Accordingly the Tenderer shall state in the proposal the permitted deviations/fluctuations of design parameters that are permitted during the test for each operating mode testing.

9.6.3.5 **Correction Curves & Tolerance**

The correction curves shall be provided as mathematical equations in addition to the curves to an accuracy of four decimals. The equations supplied shall be utilized to perform the test result calculations.

9.6.4 Measuring Equipment

All test instrumentation and test equipment shall be provided by the Contractor. All the instruments shall be calibrated by a certified body before and after the tests. The calibration certificates shall be submitted to the Owner/Owner's representative prior to the tests. The calibration certificates shall be considered valid for a period of not more than six (6) months from the date of its calibration.

The anticipated points of measurement together with necessary isolation during the tests shall be indicated by the Contractor.

10.0.0 CLEANING, PROTECTIVE COATING AND PAINTING

Refer Vol III /Section 2/ Sub Section 2.15 Surface Preparation and Painting.

11.0.0 SPARE PARTS

The contractor shall also provide a list of recommended spares for two (2) years of normal operation of the plant over and above the mandatory spares.

11.1.0 List of Mandatory Spares – As per Section-I BOQ

~~Refer Vol IV /Section 8/ Annexure 2.~~

NOTE: All mandatory spares as per OEM declared critical items shall be included in the list.

12.0.0 SPECIAL TOOLS, TACKLES AND EQUIPMENT

One set of special tools and tackles required unit for the operation, maintenance, inspection and repair of the individual main equipment and auxiliary equipment shall be supplied by the Contractors in sufficient quantity to equip the shift personnel, maintenance personnel and workshop craftsman for commissioning, testing, calibration, modification and maintenance of the unit, List of such special tools, tackles and equipment shall be submitted in the EPC bid. Special tools and tackles excludes conventional ones and those locally available normally (not those requiring a drawing and considered as those made to order).

The special tools and equipment for maintenance and repair shall be delivered by the Contractor in lockable steel boxes and they shall be marked in an approved manner for identification purposes and a corresponding tool chart shall be supplied with the steel boxes.

The following tools and appliances shall be supplied under this Contract for use by the Owner/Owner's representative:

- two sets of special tools and gauges required for the maintenance of the Plant
- one set of special lifting and handling tackles / appliances required for the maintenance of the Plant.

The tools, tackles and appliances supplied in general, shall not be used for erection purposes by the Contractor and shall be handed over in brand new condition. Damaged tools, tackles, and appliances shall be replaced before handing over.

The exception to this is the special lifting gear which may be used provided that when it is handed over to the Owner/Owner's representative it has not been subjected to more than normal wear and is still fully suitable for its intended use.

Each set of tools, gauges and appliances under category (a) above shall be suitably arranged in fitted boxes of mild steel construction, the number of boxes being determined in relation to the layout of the plant and equipment in question.

If the weight of any box and its contents should be such that it cannot conveniently be carried, it shall be supported on steerable rubber-tyred wheels.

Each cabinet and box shall be painted, fitted with a lock and clearly marked in white letters with the name of the item of equipment for which the tools and appliances contained are intended.

Suitable storage racks shall be provided for all portable lifting tackle supplied under this contract.

Suitable lifting lugs, ears or ring bolts, or tapped holes for lifting rings shall be provided on all equipment items where the weight exceeds 15 kg.

All lifting tackle shall be stamped with a unique identification number and safe working load. A test certificate from an approved Authority shall be supplied for each item of lifting tackle.

The Contractor shall provide a schedule of all lifting tackle and tools and appliances being supplied, for the approval of the Owner/Owner's representative.

The Contractor shall provide all runway beams, trolleys, lifting blocks, special slings necessary for the safe and efficient handling and maintenance of the works. Particular attention shall be paid to handling of equipment located at higher elevations safety valves

The tools and appliances with the appropriate storage racks, cabinets and boxes shall be handed over to the Owner/Owner's representative at the time of Taking Over of the complete Plant.

Since the Contract includes site erection, any special tools or appliances required solely for erection shall be provided by the Contractor for his own use and shall remain the property of the Contractor.

Control and Instrumentation: Software with associated hardware required to access instruments or control systems to be provided.

13.0.0 CONSUMABLES

13.1.0 Lubricants and greases

All lubricants proposed for the Plant operation shall be suitable for all operating and environmental conditions that will be met on site.

All oils and greases shall where possible be readily available in India.

The number of oils and greases shall be kept to a minimum to the extent feasible. For each type and grade of lubricant recommended the contractor shall list at least three equivalent lubricants manufactured by altemative companies. This will be in line with that suggested by OEM and outcome will be informed to the Owner/Owner's representative.

In case of imported oils, lubricants and other consumables, the contractor shall indicate the indigenous equivalents to enable the Owner/Owner's representative to arrange subsequent fills. Preference should be given to indigenous oils and lubricants during first filling itself. Short shelf life items if any may be supplied in a phased manner keeping in view of their actual use.

The Contractor shall supply the first fill lubricants and greases, and also shall provide at the Completion Certificate sufficient lubricants and greases necessary for the efficient operation and maintenance of the Plant at full load 24 hours per day for a period as mentioned in the relevant portion of Commercial Specification.

13.2.0 Chemicals and other consumables

Contract includes the supply (by the Contractor) of all chemicals, reagents, resins, and other consumables required for testing, commissioning and setting to work of each section of the Works.

The Contractor shall provide all chemicals and other consumables required for the efficient operation and maintenance of the plant at full load 24 hours per day for a period as mentioned in the relevant portion of Commercial Specification.

The Contractor shall prepare a list of these consumables giving quantities necessary for each section of the works and the recommended suppliers.

The Contractor shall deliver to site sufficient quantities of consumables in his supply to allow for 6 months running of the Works prior to the issue of the Completion Certificate. The delivery of the remainder of the consumables shall be programmed to suit the operational requirements and space availability within the various stores.

14.0.0 DOCUMENTATION

14.1.0 Format of Documentation

All engineering documents and drawings shall be of international "A" series sizes, that is, A0, A1, A2, A3 and A4.

One set of CD containing all the drawings in Auto CAD (for final as built drawings) shall also be supplied in addition to hard copies.

Soft copy of all other documents shall be supplied in a CD in PDF or editable format. For review purpose pdf or editable version shall be considered.

Grouped documents shall be provided by size A4, with the inclusion of bigger size drawings which, however, have to be folded as Size A4.

For MPP package documentation shall be as per MPP standard.

14.2.0 Numbering and Identification of Documents

All the drawings shall be identified through a common way of numbering in accordance with the requirement of contracting. The numbering system of drawings and documents proposed by the Contractor shall be in compliance with the plant identification system and to be agreed

with the Owner/Owner's representative. Apart from this, some drawings may also be numbered in the way which the contractor or subcontractors are used to do. But, there shall be a common title Block on all published drawings which include the following contents:

- Owner
- Owner's Engineer
- Project
- Contractor
- System
- Drawing No.
- Sheet No
- Revision No.

The measuring units and dimensions marked on the project engineering drawings shall be of SI system conforming to ISO 1000.

English words shall be used as descriptions on drawings.

In case dimensions are not marked in conformity with the scale of drawings and any dimension on the drawing does not conform to those dimensions and sizes measured through certain scale, the actual marked dimensions shall be applicable.

For revision of drawings, the revised part shall be clearly and definitely shown on the drawing. For revision of documents which have been grouped together, a brief description shall be a perpendicular line with the margin of the revised copy closely following it.

14.3.0 Provision for Documents

Generally, copies of drawings or documents containing trade secret and drawings with patented nature need not be provided.

However, to know whether the Contractor has performed its obligations, the Owner/Owner's representative has the right to examine those drawings within the Contractor's working scope.

The Contractor shall meet the Owner/Owner's representative's reasonable demands to files and do the following to satisfy the Owner/Owner's representative:

- Contractor will work according to the requirements specified in the contract.
- Contractor's working has been arranged properly and developed according to the plan.
- The quality control system is reliable.
- After receiving all documents necessary for power plant operation and maintenance, Contractor shall supply equipment and systems.
- Having received all necessary documents for Contractor to perform its legal obligations or other relevant responsibilities.

14.4.0 Owner/Owner's representative's Responsibilities

The Owner/Owner's representative agrees that the Contract will be concluded in accordance with the EPC method of building the power plant. It is the Contractor's duty to ensure that design standards and conditions meet the requirements and that the power plant shall operate safely and reliably and with high efficiency, having the same performance as

stipulated and guaranteed. This is applicable until the plant performance is established in the last PG test. The plant performance beyond such last PG test will not be the same because of degradation as per equipment characteristics.

The Owner/Owner's representative will examine and check the drawings and documents with the aim of ensuring all these drawings and documents meet the demands and duties written in the documents. The Contractor shall have an active and cooperation working relationship with the Owner/Owner's representative.

If drawings and documents have been supplied to the Owner/Owner's representative, Contractor will await clearance / approval from Owner/Owner's representative at a pre-agreed time frame, before proceeding on design. In case, Owner/Owner's representative has comments / opinion, the same can be informed to the Contractor on priority basis so that corrections, if feasible could be incorporated in the drawings.

15.0.0 PLANT AND EQUIPMENT IDENTIFICATION, LABELLING

15.1.0 Plant and Equipment Identification

The contractor shall follow identification system for the whole plant equipment, instruments, facilities and systems as per the Annexure-4 Guide for Coding Equipment, Documents & Drawings

MPP generated drawings, identification system shall be based on MPP standard.

15.2.0 Labelling

Name plates which are to be firmly fixed on all the equipment, instruments, buildings and structures shall be provided. For equipment of small size, these are to be fixed on the piping or structure adjacent to the equipment. The contents of nameplate are to include the designation and principal parameters of the equipment.

The nameplate within the field shall be made of a high temperature - resistant metallic sheets, with designation permanently engraved on them. Indoor installed equipments (e.g., panels, cabinets, switchgear) shall also be labelled by appropriate name plate.

The form, size, base colour and colour of contents of the name plates and prompting plates will be agreed between the Contractor and the Owner/Owner's representative. It shall be possible for these to be readily seen by the operator. The designation of warning tags shall be different from that of other tags. All buried pipes and cables routes shall be identified with permanent marker.

16.0.0 CONTRACT DRAWINGS, DOCUMENTS FOR APPROVAL, LIAISON MEETINGS

16.1.0 General

The Owner/Owner's representative reserves the right to ask the Contractor to submit copies of drawings and other documents for approval to his Head Office or to the Office of his Representatives. If the Owner/Owner's representative or his Representatives are satisfied with the drawing, one copy will be returned to the Contractor marked with an 'Approved' stamp Within a pre-agreed time frame, If the Owner/Owner's representative or his Representatives are not satisfied with the drawing, one copy stamped 'Examined and Returned with Comments' will be returned to the Contractor with comments marked thereon and the drawing shall be revised and re-submitted for approval.

The purpose of having drawings checked and approved by the Owner/Owner's representative is to assist the Contractor in interpreting the Technical Specification so as to eliminate mistakes in the equipment or material actually shipped to the site of the work. The formal approval given to the Contractor is to be considered as in conformity with this purpose and in no manner shall be construed so as to release the Contractor from any liability or responsibility for proper design, fabrication or compliance with the Contract Documents.

Equipment drawings shall clearly indicate the general arrangement of the equipment to be furnished, give principal dimensions, and show sufficient details required for a complete power station.

While submitting drawings for approval, including any prepared by a Sub-Contractor, the Contractor shall certify that he has fully examined such drawings and that they comply with the requirements of the Contract.

If any item, equipment or work shown in the drawings does not completely comply with the requirements of the Specification or any other requirement of the Contract Document, the Contractor is obliged to clearly inform the Owner/Owner's representative and his Representatives of the differences giving full explanations and reasons for such changes.

For the purpose of this Clause, the term "drawing" shall include design calculations, equipment specifications, diagrams, schedules, performance curves.

Approval of a drawing by the Owner/Owner's representative will imply that:

a) Arrangement and layout drawings and key diagrams have been examined and appear to be in accordance with the basic design concept of the project and meet the requirements of the Specification.

b) Other drawings of components and equipment have only been examined in relation to compatibility of the items and equipment with the Specification and in respect of interconnection with other items and equipment.

c) Any approval given by the Owner/Owner's representative shall in no way relieve the Contractor of his responsibility under the Contract.

The Owner/Owner's representative will not normally require to receive copies of detailed manufacturing drawings but the Contractor shall make these available if requested to do so.

The Contractor shall ensure that drawings are submitted in due time to permit amendments to be made and the drawings re-submitted for approval without delaying the scheduled deliveries or the guaranteed competition dates according to the Contract. Execution of work shall be taken up after the drawings are cleared by the Owner/Owner's representative.

If, during the Contract period, the Contractor is required to modify the size of any buildings, foundation from that shown in Technical Specification drawings to accommodate the finally approved arrangement of the Work (with due allowance for access, laydown, maintenance), then such modification shall be deemed to be included in the scope of the EPC Contract.

Requirements about the format of drawings and documents, the provision for documents and the Owner/Owner's representative's responsibilities with regard to documentation are specified in relevant section of this volume.

The Contractor shall be responsible for any discrepancies, errors or omissions in the drawings and other particulars supplied by him, whether such drawings and particulars have been approved by the Owner/Owner's representative or not.

16.2.0 Documentation by Contractor

The drawings to be submitted by the Contractor for approval shall cover the complete Scope of Contract work as defined by the Contract Specification and shall generally include, but not be limited to, the following:

16.2.1 Drawings and Documents to be submitted along with the proposal

(A) General (applicable for all discipline)

- Heat and Mass balance diagram as specified in Vol IV /Section 7 (Technical Data sheets and Schedules to be filled in by the Bidder).
- Completely filled in technical schedules for all equipments as enclosed with the Tender specification.
- P&ID (Process and Instrumentation drawings) indicating Instruments and the destination / functionality of the signals.
- Plot Plan.
- List of spares
- List of Special tools and Tackles

(B) Mechanical

Start up curve for cold, warm and hot condition

Performance and correction curve for Gas Turbine, Steam Turbine and HRSG

(C) Electrical

- Key Single line diagram
- Metering and protection Single line diagram for Generators
- Metering & protection Single line diagram for 66kV GIS
- Single line diagram for Auxiliary power distribution
- Description of all Electrical equipment
- Generator capability curve, Voltage vs frequency curve, Overload capability curve , Open and short circuit characteristic and Excitation curves

(D) Control and Instrumentation

- Control system configuration / architecture drawing for Plant DCS, GT & Generator, ST, local PLC's.
- Control philosophy / operation philosophy / design philosophy / redundancy philosophy.
- Scope of supply and services for C&I.
- Brief process description / functional write – up for all open loop and closed loop controls.
- Details of C&I and PLC System offered for offsite plants.
- Brief write-up, scheme, technical details of Continuous Emission Monitoring (CEM), Steam and Water Analysis System (SWAS) .
- Codes and applicable standards followed for the project.
- List of vendors for instrument / equipment.

- Deviation schedule (if any)

16.2.2 Drawings and Documents to be submitted after Award of Contract

The documents required for design, construction, installation, operation and maintenance of the entire plant shall be submitted by the Contractor in good time so as to permit the plant as a whole to be constructed in compliance with the specified time table. The Contractor shall establish a online document and work flow management system to control the document flow and the approval process.

MPP supplied equipment will follow their standard documentation.

Only the most important documents are listed below. The list and approval category of the doc/drawings shall be agreed sufficiently in advance before award of relevant order, so that corrections and amendments desired by the Owner/Owner's representative as well as resubmission of the documents will not result in any delays with respect to the guaranteed time table. The Owner/Owner's representative reserves the right to request from the Contractor additional drawings, documents as may be required for proper understanding and definition of the design and engineering of the Plant.

(A) General

- Re-Submission of all the technical data furnished during pre award contract stage.
- Complete filled-in technical schedule.- For approval
- Plot plan - For approval
- General arrangement drawings /Equipment layout of all equipments along with sections indicating the unloading and maintenance area .- For approval
- Design basis for all the systems and major equipment sizing calculation - For approval
- P&ID (Process and Instrumentation drawings) indicating Instruments and the interlocks for all the systems - For approval
- Monthly progress report with photographs (Hard and soft copies)
- L2 network
- Quality plan for approval
- Equipment Testing procedure for approval
- Complete list of documents with proposed submission schedule
- Vendor Engineering document via Data sheets, General arrangement drawing , material of construction ,performance curves for approval for major items
- Painting and surface preparation procedure
- Technical specification
- General arrangement drawing with section for major building viz., GTG/STG hall, CW pump house, Deaerator & BFP area 66 KV switch yard,66 KV indoor GIS room and HRSG showing maintenance area
- Description of options and alternatives offered
- Safety Plan
- Training program and schedule for training of Owner/Owner's representative's personnel
- Space requirement for construction site and equipment
- Maintenance proposal (for GTG, STG and Fuel Gas system)
- Inspection intervals (major/minor)for six years along with the spares to be replaced during the above inspections .

- Bidder shall enter into a long term spare supply agreement with the OEM and agree to transfer the same faithfully to the Owner/Owner's representative upon COD. Bidder shall commit to facilitate further negotiations on the spares with the OEMs directly by the Owner/Owner's representative.

(B) Mechanical

- Major equipment sizing calculation viz Boiler Feed pump, Condensate extraction pump, Condenser cooling water pump, Aux cooling and closed cooling water pump, Air compressor, Bypass valve, Make-up pumps, for approval
- Start-up and shut down procedure along with the curve for approval
- Content (index) of the system description document for approval
- System description for all the systems for approval
- Pipe rack and composite piping layout for approval
- Thermal calculation for critical items for approval
- Fire protection system layout
- Heating and ventilation system layout
- Pipe sizing and determination of pressure and Temperature criteria. for approval
- Critical piping drg and calculation
- Acceptance and Performance test procedure and program
- Acid/Alkali/Boiling out procedures

(C) Electrical

- Key Single line diagram
- Single line diagram for Auxiliary power distribution for approval
- Single line diagram of Switchboards
- Single line diagram for switchgears
- Metering and protection Single Line diagram
- Logic diagram and schematic diagram
- Wiring diagrams of all equipment
- Performance / Characteristic curves of Generators, Motors, transformers.
- System Study such as Load flow, Short circuit, Motor starting calculations.(to be done in ETAP and ETAP file to be submitted for review)
- 66kV GIS metering & protection SLD, Schemes & General arrangement
- 66kV transmission conductor data sheet other details
- 66kV OHL sag tension calculation
- SAS architecture & system description
- SAS input & output list
- Electrical equipment layout.
- Lighting layout, earthing and lightning protection layout.
- Notes & details for lighting, cable tray, ligntning, earthing.
- Foundation details, fixing details and loading details of all equipments.
- Installation details
- Cable tray/routing layouts for the entire plant
- Cable block diagrams ,Cable schedule and interconnection schedule

- Relay setting calculations (to be done in ETAP and ETAP file to be submitted for review)
- CT and VT sizing calculations
- Electrical load list / equipment list
- Alarm schedule and list of Circuit breakers and control.
- GA drawing for all the major equipment such as Generators, transformers, Busducts, Description Excitation System and AVR.
- Type test certificates for Generator, Generator transformer.
- Catalogues of all electrical equipment.
- GA drawing for all the major equipment such as generators, gransformers, busducts, descriptin excitation system and AVR.
- Type test certifications for generator, generator transformer.

(D) Control and Instrumentation

- Detail dimensional drawings of various equipment, components / sub-assemblies.
- Control Room layouts
- Detailed DCS / PLC/ GT & Generator, ST control system architecture drawing (also indicating interconnection of different offsite C&I System) highlighting the applicable standards for control and information domain ; networking and security features; graphic capabilities data exchanger procedure, engineering tool, system capability such as graphic displays, trending, archiving, logs, reports.
- Outline general arrangement / Internal general arrangement drawing for all the I&C equipments drawing for all the I&C equipments.
- DCS / PLC / Local control system / Vibration monitoring system functional specification covering both the hardware and software details along with the data sheets and technical catalogues.
- DCS / PLC IO allocation details, System loading details, controller grouping details.
- Design philosophy of C&I systems.
- Process description / functional write – up for all open loop and closed loop controls
- Instrument loop schematics,
- Analog control schemes, Logic and protection diagrams for the entire I&C system along with the write-up/functional description.
- Performance calculations write up.
- Start-up and shutdown logics with procedures and write-ups
- Grouping philosophy of control loops in controllers.
- Marshalling / cabling philosophy
- Cable schedule, JB Scheudle ,Interconnection and wiring schematics for the I&C systems offered.
- Detail wiring diagrams of all panel desk, control consoles, system cabinets.
- Plant graphics, alarms, various displays, logs and reports with menu and format.
- Flow element sizing calculations and dimensional drawings.
- Control valve and Safety Relief Valve sizing calculations and dimensional drawings.
- Operation and maintenance manuals for all the I&C equipments and systems.
- Details of the PLC / C&I System in offsite plants.
- Interconnection Diagram of different PLCs and the DCS showing all hardware details.
- Analog and binary drive list for the entire system

- Complete Instrument Schedule, DCS I/O list, (Software and hardware) Annunciation list, SOE list, Hardware list for safe shut down, Flow element schedule, Control valve schedule, JB schedule, Rack schedule.
- Data sheets, Specifications, Technical manuals and catalogues for the offered make and model of field instruments, analyzers, lab instruments, SWAS system, SEMS, GPS, CCTV, erection hardware and associated accessories.
- Technical Particular Sheets of each hardware / instrument/control system/software offered with complete bill of materials and related detailed technical literature, coding procedure.
- Confirmation certificate for the latest version of software and hardware offered.
- Final BOQ for the I&C system with the bought item vendor list.
- Calibration test and quality assurance test procedure and test certificates.
- Pre-FAT, FAT(Factory Acceptance Test), SAT (Site Acceptance Test) reports
- Instrument installation and Hook-up diagrams showing all erection hardwares.
- Tapping point details.
- Instrumentation Layouts such as, CEM room layout, SWAS room layout, JB/ Rack/ Tray /Instrument location drawing.
- C&I power distribution scheme including UPS supply.
- Instrument air distribution scheme.
- Reference list with capacity of plant, year of commissioning and control system implemented along with minimum two users' certificate for the DCS system configuration offered.
- Evidence that the offered DCS system is upgradable and evolutionary in both hardware and software
- Letter confirming that any future compliance required for the system / applications software supplied and all up gradation would be implemented.
- Spare parts list, Laboratory Instrument list, test and calibration report, special tools and tackle list.
- Earthing schemes,
- All other lists and drawings as required
- DCS vendor drawings/documents.
- All the above drawings as applicable for the mechanical packages

(E) Civil

- General site plan of the entire site showing all buildings and installations, traffic routes and landscaping.
- Architectural arrangement drawings, design layouts and itemized drawings (plans, elevations and sections) to scale 1:100 of all buildings and plants
- Views of all sides of all buildings, scale 1:100
- Architectural drawings of each floor (plants, sections) including all necessary detail drawings, scale 1:50
- Arrangement drawings of the external plants of the site as a whole (existing, planned) with all supply and disposal facilities, roads and vehicle access and manoeuvring areas, sewers, channels and culverts.
- Detailed constructive description of the building with regard to the structural design (structural systems, foundations)

- Detailed specification of the buildings including information on interior decoration ,materials and qualities for execution
- Detailed construction drawings of all corresponding civil / structural / Architectural works including buildings, foundations, roads, trenches, cable ducts and services.
- Structural design calculations for all buildings and foundations including equipment foundation. For rotating and vibratory equipment, dynamic analysis calculations shall also be submitted. Relevant software files used for analysis and design shall also to be submitted.
- Sectional elevations and roof plan
- False floors/systems
- Underground services and ducts with equipment appertaining to the services
- Layout of roads
- Plant drains layout
- Design of Roads and Drains.
- Principal details and sections for traffic areas, especially for ramps and retaining walls
- Layouts for external works showing plants and fencing.
- Schematic details for plumbing
- Foundations and other underground concrete works for the transformer area.
- Finishing schedules for all the buildings.

(F) Others

- Testing report for approval.
- Declaration of conformance with statutory regulations.
- Operation and Maintenance manual.
- Training program.
- As-built-documentation including drawings of all equipment
- Complete bill of materials of the plant with expected life of major items along with break up price.
- Welding procedure (for workshop and site).
- Lubrication list and Schedule.
- Site Quality plan.
- Erection and Commissioning procedure.
- Overall project implementation with key dates and milestones for major plants design, construction, erection, test run, mechanical completion / pre-commissioning testing / commissioning, trial operation / Reliability run test / performance guarantee test run, and taking over of the complete power plant.
- Reference lists for delivery and installation of plants of similar type and size.
- Layout of temporary site facilities , buildings, structures , installations.

16.3.0 Liaison Meetings

The liaison meetings shall be organised by the contractor. Time period for the same shall be mutually discussed and agreed after contract finalization stage. Document distribution schedule shall be discussed and finalized after contract award stage.

Contractor shall supply all documents required in the appropriated number as requested by the Owner/Owner's representative.

16.4.0 Distribution of documents

The source, distribution, no. of copies shall be as per the following document distribution schedule.

16.4.1 Document Distribution Schedule - After Placement of Order

Sl. No.	Document	Total Copies	Distribution		
			Owner		Owner's representative
			HQ	SITE	
1.	PERT Network, work schedules, Bar charts, Layout drawings	10	-	5	5
2.	Data, drawings, documents, write-ups, calculation				
	- Preliminary	10	-	5	5
	- Revised	10	-	5	5
3.	Approved drawings and documents.	10	-	5	5
4.	Instruction manuals for erection and O&M	10	-	8	2
5.	As built drawings including O &M manual				
	- Hard Copy	10	-	8	2
	- Soft Copy	-	-	-	-

16.5.0 Manuals

General

Bidder

The ~~Contractor~~ shall provide the manuals in a timely manner to enable the Owner/Owner's representative to review and comments and request changes as necessary.

Payments will be withheld for non-compliance or for late delivery of the drawings, procedures and manuals. In particular the ~~Contractor~~ Bidder shall be held responsible for consequential damage to the plant where such damage is due to late delivery of the O&M manual resulting in non-familiarity of the operating technique.

Subcontractor / Bidder

The ~~Contractor~~ shall also note that while all documents, procedures and manuals shall be in the English language ~~including that of the Subcontractor of the Contractor~~, it is particularly important that the O&M manuals be in clear concise English.

All manuals shall be divided by systems or sections and cross-indexed as necessary.

Certification Manual

This manual shall contain the approved works certification documentation for all plant equipment and services as specified in the relevant codes and standards and in this specification and the Contractors Quality Manual. This manual shall also include all material tests certificates. Certificates and test procedures shall be specific to the plant supplied.

Design Manual

This manual shall contain all the design calculations (except for HRSG) and all equipment and system data sheets and design criteria required under the Contract. Contractor shall provide a design basis report and HRSG datasheet during detailed engineering stage after award of Contract

Construction Manual

This shall include a comprehensive record of as built site construction tests and records. Again the manual(s) shall be compiled in separate parts to reflect the plant and services supplied.

Commissioning Manual

This manual shall include all the records, certificates and test results arising from the agreed pre-commissioning and commissioning procedures carried out on site. The performance tests and guarantee test results shall also be included. There is a particular requirement that all commissioned plant/equipment values be recorded in this manual and subsequently incorporated into the O&M manuals.

Operating and Maintenance (O&M) Manuals

Bidder

The ~~Contractor~~ shall provide the O&M Manual properly bound, within the time specified, to enable the Owner/Owner's representative's staff to become fully acquainted with the operation, adjustment and maintenance of the entire plant. The manuals shall contain full and explicit instructions in respect of the operation of the plant under all operating conditions and the maintenance routines and requirements to be established to maintain the plant in optimum performance. These instructions shall be in the English language and be as comprehensive as possible and the form in which they are to be set out shall be agreed with the Owner/Owner's representative. The instructions may be divided as appropriate into in individual sections and sub-sections as necessary. All section and sub-sections shall be clearly indexed and cross-referenced as required for clarity.

The instructions shall be tailored to suit the specific requirements of the Operations and Maintenance functions and personnel, taking into account the staffing philosophy for the combined cycle power plants.

The instructions for the related parts shall be accurate and easy to understand and shall contain the necessary sequence of individual activities. The diagram and drawings associated with the instruction shall be clear and unambiguous.

It is an essential requirement that all information and plant data contained in the manual must be project specific and derived from the design, manufacturers / suppliers and commissioning data of the as-built plant. Where the ~~Contractor~~ Bidder includes standard brochures the installed item of plant or equipment shall be clearly identified. All sections shall contain an introductory description of the particular item/system including its function and operating criteria and any special features. On the basis of the commissioning and running experience of the Plant, the instructions shall be amended to a final form within three months of the end of commissioning and, for this purpose; the Contractor shall supply the required number of printed copies of all approved amendments for insertion in the bound set of instructions.

The entire O&M manuals including that of the Subcontractor shall all adopt the same format paper size. The Contractor shall prepare manuals integrating all equipments supplied by the Subcontractors.

Operating Instructions:

The instructions shall include at least the following specific procedures/practices /items:

- starting-up
- shutting down
- operation / procedures during fault conditions
- surveillance and monitoring of plant .check lists
- standard readings
- operational parameters (especially limiting values in critical areas)
- isolating procedures
- Earthing /switching
- trouble-shooting
- fault reporting
- normal operational reporting
- compliance with requirements for interfacing with grid.
- safety/security/fire fighting/ first aid
- general plant standards and guidelines .
- test procedures
- maintenance and operating management systems
- drawings, schematics, logics and wiring diagrams, function diagram, P&IDs.
- protection

Maintenance Instructions:

The instructions should provide for the three maintenance functional groups – 1) Mechanical, 2) Electrical, and 3) Control and Instrumentation - and shall include at least the following:

Maintenance Management System

- a complete and accurate description of the main plant items and systems of the Power Station specific to each function
- detailed maintenance procedures and intervals for all plant items.

- assembly and disassembly procedures.
- spare parts
- use of special tools and equipment
- lifting procedures
- drawings, detailing tolerances
- schematics, logics and wiring diagrams, function diagrams P&ID's.
- isolating procedures,
- Safety and Codes of Safe Practice.
- Fire fighting/first aid
- set-up and calibrating procedures .
- optimisation of Control Loops
- diagnostics and trouble shooting
- specialist maintenance/repair procedures including welding procedures.
- materials test procedures

Storage and Retrieval Facility

For easy documentation storage and retrieval all the required software and hardware supply and commissioning shall be included in the scope of EPC Contractor.

Owner/Owner's representative's Responsibilities

The Owner/Owner's representative agrees that the Contract will be concluded in accordance with the EPC method of building the power plant. It is the Contractor's duty to ensure that design standards and conditions meet the requirements and that the power plant shall operate safely, reliably and with high efficiency, having the same performance as stipulated and guaranteed.

The Owner/Owner's representative may examine and check the drawings and documents at his discretion with the aim of ascertaining that all these drawings and documents meet the requirements specified in the contract documents. The Contractor shall have an active and cooperative working relationship with the Owner/Owner's representative. If there is a disagreement over any issue, Owner/Owner's representative and Contractor shall work together to reach some conclusion through mutual consultations.

The drawings and documents of the Contractor shall be returned with observations if any within ten working days by the Owner/Owner's representative. The Contractor shall clarify the observations raised by the Owner/Owner's representative and shall attempt to correct the drawing or document subsequently only.

17.0.0 ENVIRONMENTAL PROTECTION

17.1.0 Applicable Standards

The project must conform to the national standards of the Republic of India. The following standards and /or regulations are to be applied:

17.1.1 Environmental Quality Standards

The discharge of pollution in water and air as well as noise levels shall meet with the stipulations of State Pollution Control Board as well as other Acts of the Government under the Ministry of Environment and Forestry. It is a pre-condition that irrespective of what is stated in statutory regulations or any other act or norms, the Specification stipulated environmental qualities standards are the minimum requirements and shall be fulfilled in all aspects.

17.2.0 Fundamental Requirements of Environmental Protection for Power Plants

17.2.1 General Principals

To protect the environment, Power Plant should comply with state regulations, carry out composition and review system for Environmental Impact Assessment (EIA) report and execute the "Three Simultaneousness" system, namely, simultaneous design as per Technical Specifications, construction and operation of both pollution prevention facilities and the main plant. The preparation of EIA is not a part of EPC Contractor's Scope.

Environmental protection design for the power plant shall be based on the requirements of CPCB/ SPCB and relevant stipulations, and state of the art, proven technology shall be adopted. Latest CPCB/ SPCB guidelines as applicable.

17.2.2 Atmosphere Pollution Prevention and Control

HRSG main stack height shall satisfy the State Pollution Control Board requirement. The height of the HRSG stack shall be finalised during detail engineering (DDE). The exit velocity of flue gas at stack shall not be less than 22 m/s.

17.2.3 Water Pollution Prevention and Control

The plant should be designed to economize on water use and to set up a water management system featuring equilibrium between water feed and water discharge.

- Waste water from the plant shall be treated in distributed mode and will reach the standards before it is discharged to the final discharge point, i.e measurement shall be carried out before the return water reaches the existing seal pit
- The acid and alkali waste water from the chemical treatment station will be discharged after being treated in the neutralization pit and reaching the standards.
- The sanitary sewage will be permitted to discharge after the sewage has internally been treated and met the required criteria.
- The cooling tower blowdown shall be routed to the nearest OWS drain pit before being finally treated in the existing OWS treatment system. Also provision shall be kept for routing the cooling tower blowdown to the storm water drain with an isolation valve.
- Boiler blowdown along with the oily waste water (intermittent) shall be routed to the nearest PWS drain pit before being finally treated in the existing PWS treatment system.

17.2.4 Noise Pollution Prevention and Control

The Contractor shall take all necessary measures for noise attenuation in order to meet the specified noise levels.

General requirements of noise control :

- The minimum requirement shall be met as whatever has been specified in each of the Detailed Technical Specifications. However the station shall be acoustically designed so that an admissible noise level of 70 dB (A) during night time and 75 dB(A) during day time shall not exceed at nearest Property boundary during normal operating mode.

For Central Control room, near to the duct noise level shall not exceed 60 dB(A) and at other places noise levels shall not exceed 50 dB(A)

The noise level in the offices and the control room shall be not more than 50 dB (A)

The Contractor shall take measures for noise attenuation, if the above mentioned noise levels are not met.

17.2.5 Flue Gas Emission Levels

In order to meet the environmental quality requirements, the Contractor has to guarantee that at all loads and operating conditions of the plant the following flue gas emission levels, measured in the Main stack.

- Natural Gas – As per GPCB norms or better.

The above indicated emission levels shall be guaranteed by the Contractor for the entire load operation. Bidder to indicate how the Low NOx emission shall be ensured in the bid.

The Contractor shall provide on-line In-situ automatic continuous Stack Emission Monitoring System (SEMS) for monitoring the levels of SOx, NOx, SPM, CO, O_2, flue gas temperature and exit velocity. The Contractor shall also provide portable kit for measuring SOx, NOx and SPM in stack. Monitoring of required signals to Pollution control board shall be through an operator station . Required software shall be provided by contractor.

18.0.0 TRAINING REQUIREMENTS

18.1.0 General

The Contractor shall be responsible for the instruction and training of the Owner/Owner's representative's operation and maintenance personnel in all aspects of plant design, construction, erection, commissioning. and in such a way that operation, maintenance and if necessary repairs of all the power plant equipment and facilities specified can be handled competently by the said personnel.

Such training of the Owner/Owner's representative's personnel shall be performed

- DCS training shall be provided at manufacturers place. All other training provided for balance of plant systems shall be class room training at site.
- In Contractor's and/or sub-suppliers'/manufacturers' home office and/or workshops;
- In similar plants and such plants which are in operation or on simulator;

- On the job training at site by the Contractor's and/or his sub-suppliers, supervisors and/or instructors deputed to the site for supervision of erection, commissioning, testing and trial operation and/or by specialized training instructors.

- On the job training at site by the Contractor's and/or his sub-suppliers, supervisors and/or instructors deputed to the site for supervision of erection, commissioning, testing and trial operation and/or by specialized training instructors.

- At the Power Plant by the supervisors deputed to the Plant during the Warranty Period; in compliance with the provisions of the EPC Contract and the requirements of this specification.

The personnel required for the safe and efficient plant commercial operation and maintenance of the various types of equipment installed will be provided by the Owner/Owner's representative in accordance with the recommendation to be made by the Contractor.

The training shall be performed in English. Translators/interpreters if required shall be provided by the Contractor.

The Contractor's instructors shall use modern training techniques, procedures and aids and make available to the trainees all required notes, manuals, drawings to supplement the Operation and Maintenance Instruction Manuals.

The Contractor shall furnish during detail engineering detailed description on the recommended training services, including

- Number, category, seniority, experience required. of the personnel to be trained.
- Preliminary training program, showing
- Training facilities, training aids places of training
- Training schedule
- Specialty and details of lectures and training
- Duration of training courses

For each type of training such as classroom, manufacturer's / supplier/ sub-supplier works on the job site, at the proposed Plant.

The recommended training program should be based on the organizational and staff structures of similar plants already in operation in India, and should take into consideration not only the training for operation and maintenance staff, such as operators, skilled workers, foremen and technicians, but also for senior staff and key personnel employed for the management and organizational duties of the various power plant disciplines, such as for operation, maintenance, instrumentation and control, chemistry, administration, security, spare parts handling, scheduling and engineering.etc.

The bidder shall furnish in his bid quoted prices (all inclusive, taking into account the provisions specified in the following clause) for the training of the Owner/Owner's representative's personnel in the Contractor's country, in similar plants, at the Contractor's works and works of Contractor's sub-suppliers, on the job site and at the Plant site shall be given by the Bidder, based on his recommended training program to be indicated in the bid.

18.2.0 Contractor's Obligations and Tasks

The Contractor shall make every effort to train the Owner/Owner's representative's personnel so that they can be qualified for the management, operation and maintenance of the Plant.

The Contractor shall nominate their key person who will be in charge for organization and co-ordination of activities for training.

The training program shall be carried out according to the requirements of each speciality. It shall include but not limited to the following:

a) Systematic explanation in a classroom on specific subjects, such as the equipment performance, construction, main systems, auxiliary systems.

b) Visit to similar plants.

c) Practical training in similar power plants, which are under erection and commissioning.

d) Practical training on simulators and control rooms of similar plants.

b) Supply of all necessary training documentation (such as books, manuals, and drawings), equipment, tools and instruments. The Contractor will make best effort to achieve above item (c) and (d) with utility authority.

The Contractor will make available free of charge to the Owner/Owner's representative's personnel tools and tackles, safety helmets, shoes, stationary item as needed by the training program.

The Contractor shall allow the Owner/Owner's representative's personnel to carry back to India, all the technical documents supplied during the training. Transportation of Customer's personnel (air fare, car rental, train fare, etc.) to place of training will be to Owner/Owner's representative's account. Lodging and boarding and any other incidental expenses related to Training shall be to Owner/Owner's representative's account. Visa charges will be borne by Owner/Owner's representative. Local transportation from the place of staying to place of training shall be to Owner/Owner's representative's account.

The Contractor shall assist the Owner/Owner's representative's personnel in arranging entry visas and all the formalities for staying in foreign countries for training. Visa charges will be borne by Owner/Owner's representative .The Contractor shall also take all the necessary measures to ensure the safety of the Owner/Owner's representative's personnel during their stay in the foreign country.

Training shall be designed to offer instruction and training to both personnel with a reasonable level of experience in power plant operations and maintenance, and shall be of such quality so as to provide operation, maintenance personnel with a working understanding of all operational and maintenance aspects of the Plant. The purpose of the training services is to give to the Owner/Owner's representative's personnel a necessary knowledge of equipment and systems delivered by the Contractor.

In addition to classroom training, an essential part of the training will be the participation of the operation and maintenance personnel in the commissioning of the Plant.

Training shall be designed to offer instruction and training to personnel with a reasonable level of experience in power plant operations and maintenance, and shall be of such quality so as to provide operation, maintenance personnel with a working understanding of all operational and maintenance aspects of the Plant.

18.3.0 Owner/Owner's representative's Responsibilities

The Owner/Owner's representative shall appoint a person as official representative of the Owner/Owner's representative's trainees.

The trainees shall understand the English language and shall follow the training courses with due diligence. During their stay abroad, the Owner/Owner's representative's personnel shall

observe the Laws of that country and the rules/regulations of the factories/plants where the training will be conducted. The official holidays or national holidays, and weekly holidays as per the plant/ project site shall be followed by the Owner/Owner's representative's personnel.

For the successful completion of the training program, unless mutually agreed by the parties, the program cannot be interrupted for vacation leave.

To and fro rail/road/airfare of trainees between the place of posting of the trainees and place of training shall be borne by the Owner/Owner's representative.

18.4.0 Training schedule and program

The program for the Owner/Owner's representative's personnel will be defined during the liaison meeting.

Two (2) months before the arrival of the first group of the Owner/Owner's representative's personnel in training site, the Owner/Owner's representative shall inform the Contractor of the date when the Owner/Owner's representative's personnel are expected to be sent to training site

Within 2 (two) weeks after receipt of the Owner/Owner's representative's information mentioned above, the Contractor shall confirm their agreement or indicate difficulties, if any, for the staying of the personnel. Thirty (30) days before the arrival of the Owner/Owner's representative's personnel in the training site, the Owner/Owner's representative shall inform the Contractor of the brief career profile of the personnel including names, date of birth, nationality, specialisation, experience, qualification, position and knowledge of foreign languages for their reference / information.

The Contractor shall not charge the Owner/Owner's representative the costs for the training activities in the respective training sites.

19.0.0 PROGRESS REPORTS

19.1.0 Reports during design and procurement

The Contractor will submit a progress report each month, within the first 7 days of each month, which indicates the following aspects as a minimum:

- Executive summary
- Work completed last month
- Status of design and its approval
- Status of procurement, manufacturing, works test, shippings
- Status of permission from authorities
- Time schedule, indicating progress achieved
- Preview, indicating major activities, design meetings.
- Areas of concern

19.2.0 Report during Site Erection, Start-up, Testing

The intervals for report submission shall be decided jointly between Owner/Owner's representative and Contractor in addition to the aspects mentioned above, the following information should be added:

- Site safety report
- Photos showing erection progress
- employed personnel / equipments / cranes

- Preview on tests to be performed, start-up requirements.

20.0.0 PLANT PERFORMANCE GUARANTEES

20.1.0 Reference Condition

The plant performance guarantees to be provided during Performance Test shall be based on the following at .Site refernce conndtions as per clause 9.6.3.2 above

a) The "Gross power output" of the plant shall be the measured output at the outgoing terminals of the Generator and shall exclude excitation power.

b) The heat rate shall be referred to the gross power output at site reference conditions.

c) The plant shall be capable of operating at any ambient conditions prevailing at site as per specification without imposing any limitation on the specification requirements. However, the maximum power the plant can generate may be limited by the capacity to which the gas turbine is normally designed but shall at least be equal to its unrestricted capability at ISO conditions.

20.2.0 Auxiliary Power Consumption of the plant

The Contractor shall guarantee the power consumption of all continuously operating auxiliaries, which are required for the operation of the power plant at base load and transformer losses. The Bidder shall list the auxiliary power consumption separately for each equipment/system. Bidder shall provide correction procedure for variation in auxiliary power consumption for variation in ambient conditions and other reference conditions indicated above, as applicable.

20.2.1 Equipment / system to be considered for guaranteed auxiliary power consumption

20.2.1.1 Definition of guaranteed auxiliary power consumption

Guaranteed auxiliary power consumption shall mean the total electrical power consumed by the plant during normal operation, the plant generating guaranteed gross power output in combined cycle mode.

Equipment / systems need not be considered for guaranteed auxiliary power consumption

Lighting loads in areas other than specified below.

The performance test shall be conducted during daytime. However, all lighting in the following areas shall be switched "ON" while carrying out the Performance Guarantee Tests but not limited to :-

- GTG/STG Building
- Switchgear room
- Cable spreader room
- GTG/STG Control room
- GIS building
- GIS control room
- SWAS Room
- Air compressor/Workshop

Following equipment / systems also to be considered for guaranteed auxiliary power consumption

- CCW pumps
- ACW pumps
- Side Stream Filter (SSF) pumps
- DM water transfer pump
- BFP pumps
- CEP pumps
- Lube oil Pumps & Jacking Oil pumps.
- Compressed air system (CAS)

20.2.1.2 **Measurement of auxiliary power consumption**

To arrive at the Gross Power output of the plant, the Gross Power output of each generator shall be measured. The power to be measured/recorded at following locations to arrive at the auxiliary power consumption of the power plant-

a. 11 KV CCCPP auxiliary switchgear incomer,

b. Outgoing auxiliary trasformer feeders

c. Outgoing motor feeders for the power Plant

d. Outgoing feeders to the complex

Auxiliary power consumption of CCCPP will be measured at individual 11 kV auxiliary feeers of 11 kV CCCPP auxiliary switchgear (11 kV CCCPP motor feeders and auxiliary transformer feeders). Individaul auxiliary consumption of 11 kV auxiliary feedes shall be summated and to be displayed at 11 kV switchgear as well as at Sub-station Automation System (SAS).

All equipment / systems including transformer losses, busduct losses, switchyard losses etc., in the power plant shall be considered for guaranteed auxiliary power consumption.

20.3.0 Heat Balance Data

The Bidder shall furnish the heat balance diagrams as specified in Vol-IV / Section 7 (Technical Data sheets and Schedules to be filled in by the Bidder).

21.0.0 PENALTY FOR SHORTFALL IN PERFORMANCE

The Contractor shall provide guaranteed performance for the complete works and the values guaranteed shall be binding on him. The Contractor shall conduct performance test as described in contract document and prove the guarantees.

The terms under Guarantee fall under two categories:

A. Items for which penalty will be leviable for shortfall in Performance.

B. Items for which shortfall in performance is not acceptable and which must be corrected at no extra cost to the Owner/Owner's representative.

21.1.0 Items for which penalty will be leviable for Shortfall In Performance

21.1.1 Simple Cycle Mode – Not applicable

Gross Power Output

If the measured gross power output of the generator terminals falls short of the guaranteed gross power output under simple cycle mode, the penalty levied shall be as below:

Per kW shortfall : Rs. -

Auxiliary Power Consumption

If the measured auxiliary power consumption is in excess of the guaranteed auxiliary power consumption under simple cycle mode, the penalty levied shall be as below:

Per kW increase in Auxiliary power Consumption : Rs. -

21.1.2 Combined Cycle Mode

Gross Power Output

If the measured gross power output of the generator falls short of the guaranteed gross power output, the penalty levied shall be as below:

Per kW shortfall in Combined Cycle : Rs. **56192**

21.1.3 Auxiliary Power Consumption

If the measured auxiliary power consumption is an excess of the guaranteed auxiliary power consumption, the penalty levied shall be as below:

Per kW increase in Auxiliary power consumption in Combined Cycle : Rs. **67010**

Penalties for not meeting performance guarantees during the Performance guarantee tests shall be assessed and recovered by the Owner/Owner's representative from the Contractor as detailed above. Such penalties which are in addition to any other damages provided for in these General Conditions of Contract shall be assessed at the rates and subject to the other conditions set forth in the General / Technical Specifications.

21.1.4 Gross Heat Rate

If the gross heat exceeds the guaranteed heat release rate during performance & guarantee tests , the penalty levied will be as follows

For every excess in kcal/kwhr Rs. **20,00,000**

If the total penalty for shortfall and/or in excess of guaranteed performance figures is upto 5 % of contract price, the plant / system will be accepted after levying the penalty as specified. If the total penalty exceeds 5 % of the contract price, contractor shall carry out necessary modification to make the system comply with guaranteed requirement. However, if the contractor is not able to demonstrate the guaranteed values even after the modification within 90 days of notification by the Owner/Owner's representative, the Owner/Owner's representative

may at his discretion reject the plant and recover the payment already made for the entire contract or accept the equipment after levying the penalty at actuals.

21.2.0 Items with no permissible deviation on Guarantee

For the items indicated below under guarantee shortfall in performance is not acceptable and shall be guaranteed by the Contractor as under compulsory correction. The performance shall be proved under worst grid conditions and/or at variation in fuel composition as specified.

1. Vibration limits for the gas turbine, steam turbine and auxiliaries
2. Noise levels for the gas turbine, steam turbine and auxiliaries
3. Emission level as specified.
4. HRSG steam purity.
5. Capacity of condenser air evacuation plant.
6. Oxygen Content at condenser and deaerator outlets at all specified loads of operation.

For the items indicated above the Contractor shall carry out modifications to obtain the guaranteed performance in case they exceed the permissible limit. As these are primary parameters, they must be corrected even before reliability run is started. And further, these parameters must remain stable throughout the period of reliability run. All works related to correction and subsequent reliability run to prove the stability/reliability shall be completed within the guarantee period with no extra cost to the Owner/Owner's representative.

If finally, in spite of all practicable effort on the part of the Contractor, the stipulated guarantees on these parameters are not established, the Owner/Owner's representative retains the option to reject the equipment. In case the option to reject is exercised by the Owner/Owner's representative which will be binding on the Contractor, the Contractor shall replace the rejected equipment within a reasonable period of time as will be indicated by the Owner/Owner's representative and achieve the performance as guaranteed in the contract.

22.0.0 BID EVALUATION CRITERIA

Refer relevant portion in Volume I – Commercial Specifications.

23.0.0 INTERFACE / HOOK-UP POINTS

23.1.0 Mechanical:

Refer Plot Plan Drg. no 00-5111168-G-001 Rev B , P & ID for HP/MP/LP Process Steam System Drg. No. 20-5111168-M-022 Rev B & Hook-up Details Dwg. No 20-5111168-M-023 Rev B, enclosed with the specification for location & other details.

23.2.0 Electrical:

1. Approximately 10 Nos. (minimum) plant feeders presently connected to existing 11kV switchgear located in the MRSS (Main receiving substation) shall be disconnected and shall be reconnected to new 11kV switchgear of CCCPP. Feeders to be shifted will be identified by the Owner/Owner's representative. Also additional 15 Nos. breaker panel feeders on each bus (Total 30 no. feeders) shall be provided in the new 11kV switchgear for future use.

2. All Power & control cabling shall be disconnected from existing switchgear and reconnected to new 11kV CCCPP switchgear. Cable joints to be considered for power cables and new control cables to be provided. Necessary cable trench, cable racks, cable trays & necessary supporting arrangements to be included in EPC contractor's scope.

3. Existing 66kV transmission line conductor (DOG) for two nos. incoming feeders from GETCO, Ichhapore substation is around 4 kM route length. These conductors shall be replaced with a

new 66kV conductor suitable for power evacuation of minimum 50MVA at 50 deg.C ambient temperature for each feeder. Any replacement of insulators, clamps, connectors or any other ancillary items (at GEB end & ONGC end) required shall be considered in EPC contractor's scope. No modification or replacement of existing tower due to conductor replacement work is envisaged.

4. 2 nos. 66kV transmission line feeders will be terminated in the new 66kV GIS as grid incomer feeders. 2 nos. outgoing feeders from 66kV GIS will be connected to the primary side of the existing 25/31.5MVA, 66/11kV transformers. Any modifications in protection & metering and any control cabling requirement due to the above work shall be considered in EPC contractor's scope.

5. The proposed power plant shall be provided with new 66 kV GIS which will be installed in a new building adjacent to the existing 66kV switchyard as shown in the plot plan.

6. Existing 66kV switchyard equipment shall be demolished with their structures except necessary gantry structures. Existing 66kV line isolators, LAs with their associated structures shall be relocated in front of new GIS room. This arrangement is required so that physical isolation of GETCO lines is possible for maintenance purpose.

7. Existing ABT metering outdoor kiosk shall also be relocated as per GETCO guidelines. Separate metering CT & PT to be considered in 66kV GIS line bays for existing ABT metering which can be used for the tariff metering.Additional ABT check meter to be provided.The CTs/PTs for metering shall be as per the specifications of GEB/GETCO and the EPC contractor shall take the approval of the CTs/PTs from GEB/GETCO.

8. Exiting GTG-3 (25 MW) connected to the existing 11kV switchgear located in MRSS will be disconnected and shall be reconnected to the new 66kV GIS through a new 11/66kV generator transformer.

23.3.0 Control & Instrumentation:

- Provision of remote Operating station of proposed DCS system at existing control room for monitoring of CCCPP operations. Cable, connecting ports, console required for the same shall be provided by supplier.
- Implementation of control and monitoring according to the mechanical hook up/interface.
- Provision for interface/ hook up of existing Fire alarm panel with proposed fire alarm panel shall be made. One common repeater panel shall be provided for existing & new unit at main fire control station, 2 km away from proposed power plant.

NOTE :- General:

1) ***EPC contractor to visit the site and assess all the interface requirements listed above and include the same in their scope before submitting their offer.***

2) ***Any necessary modifications/additions in fulfilling the interface requirements shall be considered in Bidder's scope.***

3) ***During the execution of the contract, any additional claims for either cost or time overrun from the successful EPC Contractor on this count will not be entertained/considered.***

4) ***EPC contractor to consider 12 hrs/day working because of operational restrictions.***

SECTION – 3
PROJECT DETAILS AND GENERAL SPECIFICATIONS

SL.NO.	DESCRIPTION	
1.	**PROJECT INFORMATION**	
	a) Customer	**ONGC Ltd.**
	b) Consultant	**FICHTNER Consulting Engineers (India) Pvt. Ltd.**
	b) Project	**66 KV GIS system for 1 X 51 MW CCCPP for ONGC , Hazira**
1.0	Location	ONGC Limited, Hazira
2.0	Elevation above mean sea level	RL 6.0 above, MSL
3.0	Nearest Railway Station	Surat, 20 KM
4.0	Nearest Airport	Surat, 10 KM
5.0	Nearest Harbour	Magdalla, 20 KM
6.0	Access Road	NH-8 (30 KM)
7.0	Atmospheric pressure at MSL	1.013 bar
8.0	Ambient Temperature	
a)	Max. average dry bulb temperature	45.6 oC
b)	Min. average dry bulb temperature	4.4 oC
c)	Design temperature for electrical equipment / device	50 oC
9.0	Relative Humidity	
a)	Max.	70%
b)	Min.	18%
c)	Average	64%
10.0	Seismic Zone	III (IS 1893)
11.0	Rainfall	
a)	Max. Intensity of rainfall in 24 hrs.	459.2 mm
b)	Period – Monsoon showers	June to September
c)	Average rainfall per annum	1203.5 mm
12.0	Wind data	
	Max. wind speed (as per IS:875) 20-61 kmph for 20 days in a year < 20 kmph for remaining period	62 kmph
	Most predominant wind direction	South -West
13.0	Land	
14.0	Tropicalisation	
	All equipment supplied against specification shall be given tropical and fungicidal treatment in view of the climatic conditions prevailing at site.	
	Tropical protection shall conform to BS: CP-1014-1965 "Protection of Electrical Power Equipment" against climatic conditions.	

Auxiliary Supply

Normal Voltage	Variation in Voltage	Frequency in Hz	Phase/Wire	Neutral Connection
415 Volts	± 10%	50 +3% to -5%	3 phase/ 4 wires	Solidly earthed
240 Volts	± 10%	50 +3% to -5%	1 phase/ 2 wires	One point earthed
110 Volts DC	± 10%	DC	1 phase/ 2 wires	Isolated 2 wire system

2. **General electrical requirement** as per Annexure A (Vol III, Section 3.1 of ONGC specification.(4 pages))

The discharge of pollution in water and air as well as noise levels shall meet with the stipulations of State Pollution Control Board as well as other Acts of the Government under the Ministry of Environment and Forestry. It is a pre-condition that irrespective of what is stated in statutory regulations or any other act or norms, the Specification stipulated environmental qualities standards are the minimum requirements and shall be fulfilled in all aspects.

For control room and offices, noise level shall not exceed 60 dB (A) near to the duct and at other places in the control room/offices noise levels shall not exceed 50 dB (A).

Equipment supplied and all work done including system design and detailed engineering shall also comply with the statutory requirements of the State/Central government and with the Indian Electricity Rules.

Unless otherwise specified, at least 10 % margin shall be considered in equipment sizing over and above the calculated load current/fault current/power requirements.
If not specified otherwise the electrical operational equipment must be designed to meet protection classes stated below.

- HT Switchgear (Indoor) - IP 4X
- LT Switchgear (Indoor) - IP 52
- Control panels (Indoor) - IP 42
- Relay panel - IP 42
- Motors (indoor) - IP 54
- Motors and other equipment located outdoor - IP 55
- Emergency DG (Indoor) - IP 23

Each individual enclosure accommodating electrical equipment which is liable to suffer from internal condensation due to atmospheric or load variations shall be fitted with heating

3. **Standards and Codes of Practice**

All equipment, systems and works covered under these specifications shall be in accordance with all the applicable statutes, regulations, codes and standard specified as well as all such standards, statutes, regulations and safety codes applicable in the locality where the equipment will be installed. Contractor may familiarize themselves with all such requirements.
Complete design including pressure parts, piping, valves and fittings shall meet or exceed all the latest requirements of the Indian Boiler Regulations (IBR), latest Indian Standards /ASME codes,

latest codes and standards as applicable. Any Indian/International standards shall be followed for any imported equipment. For plant layout aspects and area classification requirements OISD standards shall be followed.

The design, construction and testing of all equipment, facilities, components and systems shall be in accordance with relevant standards and codes issued by Bureau of Indian Standards (BIS) and/or reputed international standards and codes as on the date of Award of Contract. A non-exhaustive list of reputed international standards is given below:

a) American National Standards Institute (ANSI)

b) American Petroleum Institute (API)

c) American Society of Mechanical Engineers (ASME)

d) American Society of Testing and Materials (ASTM)

e) American Water Works Association (AWWA)

f) American Welding Society (AWS)

g) British Standards (BS)

h) Cooling Technology Institute (CTI)

i) Deutsches Institut fur Normung (DIN), Germany

j) Gosstandart of Russia (GOST) standards

k) Heat Exchange Institute (HEI), USA

l) Hydraulic Institute Standards (HIS), USA

m) International Electro-technical Commission (IEC)

n) Institute of Electrical and Electronics Engineers (IEEE)

o) International Organisation for Standardisation (ISO)

p) Japanese Industrial Standards (JIS)

q) National Electric Code (NEC), USA

r) National Electrical Manufacturers Association (NEMA), USA

s) Central Electricity Authority (Construction of Electrical Plants and Electric Lines) Regulations, Notification, 20th August 2010 and to those referred therein

t) National Fire Protection Association (NFPA), USA

u) Occupational Safety and Health Administration (OSHA)

v) Tubular Exchanger Manufacturers Association (TEMA), USA

w) VDE association for Electrical, Electronic and Information Technologies (VDE), Germany

x) OISD

Other international Standards, equivalent or superior to the above Standards can also be adopted. However, In the event of any conflict between the requirements of the international standards or codes and the requirements of the BIS standards or codes, the latter shall govern unless specified

elsewhere in the specifications. Any Indian/International standards shall be followed for imported equipment.

The Plants and Electric Lines (within the plant) shall also be designed to comply with the requirements stipulated in.

a) Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006.

b) Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007.

c) Central Electricity Authority (Measures relating to Safety and Electricity Supply),

Regulations as and when these are notified by the Authority.

d) Central Electricity Authority (Safety Requirements for Construction, Operation and

Maintenance of Electrical Plants and Electric Lines) Regulations as and when these are notified by

the Authority.

e) Central Electricity Authority (Grid Standards) Regulations as and when these are notified by the

Authority.

f) Central Electricity Authority (Construction of Electrical Plants and Electric Lines)

Regulations, Notification, 20th August 2010 and to those referred therein

g) Indian Electricity Grid Code issued by Central Electricity Regulatory Commission (CERC) and

h) Applicable State Grid Code issued by appropriate Regulatory Commission.

All material and equipment supplied and all work carried out as well as calculation sheets, drawings, quality and class of equipment, methods of inspection, constructional peculiarities of equipment and parts and acceptances of partial plants, as far as these are beyond the special requirements of the specifications, shall comply in every respect with the technical codes of the above listed codes and Standards.

It shall be the responsibility of the Contractor to take all approvals required and get the HRSG registered under the IBR. In all other cases where IBR does not govern, IS/ASME, Japanese, American, British, German or other international standards established to be equivalent or superior to IS/ASME shall be acceptable with the approval of the Owner/Owner's representative at the time of detailed engineering.

Where there are no standards or regulations, or the standard is not sufficient to meet the need of design and supply, for such items relating to the power plant, the Contractor shall carry out the design, manufacture, supply and installation on the basis of good engineering practice.

During the period of Contract execution, if any standards change, the Contractor shall be responsible to notify the Owner/Owner's representative and provide the basis for the prospect that it would not cause the lowering of quality, performance and service life of the power plant due to alteration of the standard and the latest standards shall be followed by the Contractor.

Further requirements about applicable standards and codes are specified in the detailed technical specifications.

4. SPECIAL TOOLS, TACKLES AND EQUIPMENT

One set of special tools and tackles required unit for the operation, maintenance, inspection and repair of the individual main equipment and auxiliary equipment shall be supplied by the Contractors in sufficient quantity to equip the shift personnel, maintenance personnel and workshop craftsman for commissioning, testing, calibration, modification and maintenance of the unit, List of such special tools, tackles and equipment shall be submitted in the EPC bid.

Special tools and tackles excludes conventional ones and those locally available normally (not those requiring a drawing and considered as those made to order).

The special tools and equipment for maintenance and repair shall be delivered by the Contractor in lockable steel boxes and they shall be marked in an approved manner for identification purposes and a corresponding tool chart shall be supplied with the steel boxes.

The following tools and appliances shall be supplied under this Contract for use by the Owner/Owner's representative:

- two sets of special tools and gauges required for the maintenance of the Plant
- one set of special lifting and handling tackles / appliances required for the maintenance of the Plant.

The tools, tackles and appliances supplied in general, shall not be used for erection purposes by the Contractor and shall be handed over in brand new condition. Damaged tools, tackles, and appliances shall be replaced before handing over.
The exception to this is the special lifting gear which may be used provided that when it is handed over to the Owner/Owner's representative it has not been subjected to more than normal wear and is still fully suitable for its intended use.
Each set of tools, gauges and appliances under category (a) above shall be suitably arranged in fitted boxes of mild steel construction, the number of boxes being determined in relation to the layout of the plant and equipment in question.

If the weight of any box and its contents should be such that it cannot conveniently be carried, it shall be supported on steerable rubber-tyred wheels.

Each cabinet and box shall be painted, fitted with a lock and clearly marked in white letters with the name of the item of equipment for which the tools and appliances contained are intended.

Suitable storage racks shall be provided for all portable lifting tackle supplied under this contract. Suitable lifting lugs, ears or ring bolts, or tapped holes for lifting rings shall be provided on all equipment items where the weight exceeds 15 kg.

All lifting tackle shall be stamped with a unique identification number and safe working load. A test certificate from an approved Authority shall be supplied for each item of lifting tackle.
The Contractor shall provide a schedule of all lifting tackle and tools and appliances being supplied, for the approval of the Owner/Owner's representative.

The Contractor shall provide all runway beams, trolleys, lifting blocks, special slings necessary for the safe and efficient handling and maintenance of the works. Particular attention shall be paid to handling of equipment located at higher elevations safety valves

The tools and appliances with the appropriate storage racks, cabinets and boxes shall be handed over to the Owner/Owner's representative at the time of Taking Over of the complete Plant.

Since the Contract includes site erection, any special tools or appliances required solely for erection shall be provided by the Contractor for his own use and shall remain the property of the Contractor.
Control and Instrumentation: Software with associated hardware required to access instruments or control systems to be provided.

5. CLEANING, PROTECTIVE COATING AND PAINTING

Refer Annexure-D (Vol III /Section 2/ Sub Section 2.15 Surface Preparation and Painting.)

6. INSPECTION, TESTING AND INSPECTION CERTIFICATE

Inspection testing shall be done as per customer specification as per Annexure – B.

7. DOCUMENTATION

Format of Documentation

All engineering documents and drawings shall be of international "A" series sizes, that is, A0, A1, A2, A3 and A4.
One set of CD containing all the drawings in Auto CAD (for final as built drawings) shall also be supplied in addition to hard copies.
Soft copy of all other documents shall be supplied in a CD in PDF or editable format. For review purpose pdf or editable version shall be considered.
Grouped documents shall be provided by size A4, with the inclusion of bigger size drawings which, however, have to be folded as Size A4.

Numbering and Identification of Documents

All the drawings shall be identified through a common way of numbering in accordance with the requirement of contracting. The numbering system of drawings and documents proposed by the Contractor shall be in compliance with the plant identification system and to be agreed with the Owner/Owner's representative. Apart from this, some drawings may also be numbered in the way which the contractor or subcontractors are used to do. But, there shall be a common title Block on all published drawings which include the following contents:

- Owner
- Owner's Engineer
- Project
- Contractor
- System
- Drawing No.
- Sheet No
- Revision No.

The measuring units and dimensions marked on the project engineering drawings shall be of SI system conforming to ISO 1000.
English words shall be used as descriptions on drawings.
In case dimensions are not marked in conformity with the scale of drawings and any dimension on the drawing does not conform to those dimensions and sizes measured through certain scale, the actual marked dimensions shall be applicable.
For revision of drawings, the revised part shall be clearly and definitely shown on the drawing.
For revision of documents which have been grouped together, a brief description shall be a perpendicular line with the margin of the revised copy closely following it.

Provision for Documents

Generally, copies of drawings or documents containing trade secret and drawings with patented nature need not be provided.
However, to know whether the Contractor has performed its obligations, the Owner/Owner's representative has the right to examine those drawings within the Contractor's working scope.
The Contractor shall meet the Owner/Owner's representative's reasonable demands to files and do the following to satisfy the Owner/Owner's representative:

- Contractor will work according to the requirements specified in the contract.
- Contractor's working has been arranged properly and developed according to the plan.
- The quality control system is reliable.
- After receiving all documents necessary for power plant operation and maintenance,

Contractor shall supply equipment and systems.

- Having received all necessary documents for Contractor to perform its legal obligations or other

relevant responsibilities.

Distribution of documents
The source, distribution, no. of copies shall be as per the following document distribution schedule. Annexure –C.

Title block for the Project:

a) Customer	**ONGC**
b) Consultant:	**FICHTNER Consulting Engineers (India) Pvt. Ltd.**
c) Project:	**66 KV GIS system for 1 X 51 MW CCCPP for ONGC , Hazira**
d) Main Contractor	**BHEL**

DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

1) Drawings in 2D and 3D format.
2) Guaranteed Technical Particulars
3) Type Test Reports
4) Manufacturing Quality Plan

DOCUMENTATION SCHEDULE AT CONTRACT STAGE

No. of Copies	A: For Approval
5	Copies of GA drawings (2d and 3D) with projects details, dimension, equipment weight, fixing details, tolerances and terminal details etc.
5	Copies of type test reports
5	Copies of shipping list detailing the description & quantities of all items being dispatched separately, with shipping weights, number of cases and dimensions.
5	Copies of manufacturing and field quality plan.

5	Copies of installation, operation & Maintenance manual.
	B : After Approval and For Information/Distribution.
12	Copies of All drawings
12	Bound sets containing all drawings/manuals, type and routine test reports etc. along with sub-vendor's test reports for all bought out assemblies/components/parts including Internal wiring diagrams and exploded diagrams of assemblies/ parts, shall be furnished.
12	Copies of Installation, Operation & Maintenance manual.
	C: On Completion of Entire works
12	Bound sets of Installation, Operation & Maintenance manual and all as built drawings
12	Set of Computer CD-ROMs (with unbreakable CD Covers) containing all as-built drawings in Auto-Cad version 2008 or later with 2D and 3D drawings, Instruction Manual and GTP.

8. Package, storage

All materials and equipment should be packaged according to the typical environmental conditions during storage. In case of severe conditions, these materials and equipment should be packaged carefully by taking a full and appropriate preventive measure to protect from any damage or wear.

The Contractor and his appointed Subcontractor for installation should guarantee jointly that a good supplementary storage will be carried out within the equipment site controlled by them.
Three classes for storehouse are described as follows:

Storehouse class A items: Special measures are taken to protect the stored goods and the temperature, humidity are controlled within a specified range.

Storehouse class B items: Goods are stored with temperature uncontrolled.

Storehouse class C items: It is an outdoor storage with a drainage system on the ground.

For storehouses of class A and B they should be fireproof, heat resisting, waterproof and well ventilated. They should not be wet and should be provided with good drainage system and preferably with a brick laying or concrete ground. For storehouses of class C, they should not be wet and should be well drained, preferably with a brick laying or crushed stone ground, should be protected from rainfall, salt corrosion, ash and other adverse conditions with a temporary cover or tent if possible

Component surfaces should not be contacted directly with the ground or ground laying material. There should be a layer of oilcloth or wax or other similar materials between the machine surface and ground surface.

All components shall be inspected for their painting, storing, sealing and any damage or wear should be repaired during acceptance and storage periodically. The inspection interval is determined by the component function, applied protection measure and storehouse class.

Many components are provided with a drying agent or sealed in a coverage (polyethylene or insulating cover) containing drying agent. The drying condition shall be inspected during storage in an interval of every 4 weeks.

9. SPECIAL TOOLS, TACKLES AND EQUIPMENT

One set of special tools and tackles required unit for the operation, maintenance, inspection and repair of the individual main equipment and auxiliary equipment shall be supplied by the Contractors in sufficient quantity to equip the shift personnel, maintenance personnel and workshop craftsman for commissioning, testing, calibration, modification and maintenance of the unit, List of such special tools, tackles and equipment shall be submitted in the EPC bid.

Special tools and tackles excludes conventional ones and those locally available normally (not those requiring a drawing and considered as those made to order).

The special tools and equipment for maintenance and repair shall be delivered by the Contractor in lockable steel boxes and they shall be marked in an approved manner for identification purposes and a corresponding tool chart shall be supplied with the steel boxes.

The following tools and appliances shall be supplied under this Contract for use by the Owner/Owner's representative:

- Two sets of special tools and gauges required for the maintenance of the Plant
- One set of special lifting and handling tackles / appliances required for the maintenance of the Plant.

The tools, tackles and appliances supplied in general, shall not be used for erection purposes by the Contractor and shall be handed over in brand new condition. Damaged tools, tackles, and appliances shall be replaced before handing over.

The exception to this is the special lifting gear which may be used provided that when it is handed over to the Owner/Owner's representative it has not been subjected to more than normal wear and is still fully suitable for its intended use.

Each set of tools, gauges and appliances under category (a) above shall be suitably arranged in fitted boxes of mild steel construction, the number of boxes being determined in relation to the layout of the plant and equipment in question.

If the weight of any box and its contents should be such that it cannot conveniently be carried, it shall be supported on steerable rubber-tyred wheels.

Each cabinet and box shall be painted, fitted with a lock and clearly marked in white letters with the name of the item of equipment for which the tools and appliances contained are intended.

Suitable storage racks shall be provided for all portable lifting tackle supplied under this contract. Suitable lifting lugs, ears or ring bolts, or tapped holes for lifting rings shall be provided on all equipment items where the weight exceeds 15 kg.

All lifting tackle shall be stamped with a unique identification number and safe working load. A test certificate from an approved Authority shall be supplied for each item of lifting tackle.

The Contractor shall provide a schedule of all lifting tackle and tools and appliances being supplied, for the approval of the Owner/Owner's representative.

The Contractor shall provide all runway beams, trolleys, lifting blocks, special slings necessary for the safe and efficient handling and maintenance of the works. Particular attention shall be paid to handling of equipment located at higher elevations safety valves.

The tools and appliances with the appropriate storage racks, cabinets and boxes shall be handed over to the Owner/Owner's representative at the time of Taking Over of the complete Plant.

Since the Contract includes site erection, any special tools or appliances required solely for erection shall be provided by the Contractor for his own use and shall remain the property of the Contractor.

Control and Instrumentation: Software with associated hardware required to access instruments or control systems to be provided.

10. Painting, Insulation, Anti-dewing

Anti-corrosive coatings and painting shall be carried out as a pre-treatment to all equipment and parts. The paint system used should coordinate with the painted objects and surrounding conditions of project.

In multi-layer painting system, different painting layers should be selected to make the painting coordinate. If multi-layer painting system is used, various painting layers should have distinct colours so that the later layer can be distinguished from the former one.

After the equipment or apparatus finished preliminary or full painting, it can be supplied to field. After the installation is finished, ground coat must be painted.

Entire painting procedure should be supplied in order to repair the injures of painting coat after the equipment is delivered to field.

Colour strip indication system should be used for pipes. These strips should be painted on the joint of pipes, entrance, valves of pipe. This pipe without outside protection layer should be marked by some colour in whole length.

The principal colour of field equipment should be determined by Owner/Owner's representative and Contractor during execution stage. For Electrical equipment, paint shade shall be as mentioned in the equipment Specification.

Further requirements with regard to painting, insulation, and anti-dewing are specified in the relevant sections in the detailed technical specifications. The specified requirements shall be applied to the whole equipment and facilities of the Contract.

Insulation specification for MPP supplied equipment shall be as mentioned in detailed technical specification.

Language to be used

English shall be used as the general Contract language English translations shall be provided for any code and standards not in English language.
Name plates of equipment and instrument scale shall be marked in English.
Documents for training shall be provided in English.
Danger signs / Exit signs shall be in English, Hindi and Gujarati.

11. CONSUMABLES

12.1.0 Lubricants and greases

All lubricants proposed for the Plant operation shall be suitable for all operating and environmental conditions that will be met on site.
All oils and greases shall where possible be readily available in India.
The number of oils and greases shall be kept to a minimum to the extent feasible. For each type and grade of lubricant recommended the contractor shall list at least three equivalent lubricants manufactured by alternative companies. This will be in line with that suggested by
OEM and outcome will be informed to the Owner/Owner's representative.
In case of imported oils, lubricants and other consumables, the contractor shall indicate the indigenous equivalents to enable the Owner/Owner's representative to arrange subsequent fills. Preference should be given to indigenous oils and lubricants during first filling itself. Short shelf life items if any may be supplied in a phased manner keeping in view of their actual use.
The Contractor shall supply the first fill lubricants and greases, and also shall provide at the Completion Certificate sufficient lubricants and greases necessary for the efficient operation and maintenance of the Plant at full load 24 hours per day for a period as mentioned in the relevant portion of Commercial Specification.

12.2.0 Chemicals and other consumables

Contract includes the supply (by the Contractor) of all chemicals, reagents, resins, and other consumables required for testing, commissioning and setting to work of each section of the Works.
The Contractor shall provide all chemicals and other consumables required for the efficient operation and maintenance of the plant at full load 24 hours per day for a period as mentioned in the relevant portion of Commercial Specification.
The Contractor shall prepare a list of these consumables giving quantities necessary for each section of the works and the recommended suppliers.
The Contractor shall deliver to site sufficient quantities of consumables in his supply to allow for 6 months running of the Works prior to the issue of the Completion Certificate. The delivery of the remainder of the consumables shall be programmed to suit the operational requirements and space availability within the various stores.

12. Plant and Equipment Identification

The contractor shall follow identification system for the whole plant equipment, instruments, facilities and systems as per the Annexure-4 **Guide for Coding Equipment, Documents & Drawings MPP generated drawings, identification system shall be based on MPP standard.**

Labelling

Name plates which are to be firmly fixed on all the equipment, instruments, buildings and structures shall be provided. For equipment of small size, these are to be fixed on the piping or structure adjacent to the equipment. The contents of nameplate are to include the designation and principal parameters of the equipment.

The nameplate within the field shall be made of a high temperature - resistant metallic sheets, with designation permanently engraved on them. Indoor installed equipment (e.g., panels, cabinets, switchgear) shall also be labelled by appropriate name plate.

The form, size, base colour and colour of contents of the name plates and prompting plates will be agreed between the Contractor and the Owner/Owner's representative. It shall be possible for these to be readily seen by the operator. The designation of warning tags shall be different from that of other tags. All buried pipes and cables routes shall be identified with permanent marker.

ANNEXURE - A

VOLUME - III

SUB-SECTION - 3.1

GENERAL ELECTRICAL REQUIREMENT

1.0.0 INTENT OF SPECIFICATION

1.1.0 This specification covers the design, manufacture, assembly, testing at manufacturer's works, packing, transportation to site including transit insurance, unloading, erection, testing & commissioning of Electrical Equipment complete with all accessories for efficient and trouble-free operation of combined cycle captive power project.

1.2.0 It is not the intent to specify completely herein all details of the equipment; nevertheless, the equipment shall be complete and operative in all respects and shall conform to the highest standard of engineering, design and workmanship.

2.0.0 ELECTRICAL SYSTEM DESCRIPTION

2.1.0 The proposed Power plant consisting of one Gas Turbine Generator (GTG) & one Steam Turbine Generator (STG). GTG shall be connected to the new 66kV indoor type Gas Insulated Switchgear (GIS) through a Step-up Generator Transformer using phase segregated bus duct. STG shall be connected to the 66kV Outdoor type Gas insulated switchgear (GIS) through a Step-up Generator Transformer using phase segregated bus duct. Power shall be evacuated from 66kV GIS to the grid through the 66kVoutgoing line feeders. For commissioning of plant the start-up power shall be drawn from grid to the 66kV GIS.

2.2.0 Auxiliary Power supply is envisaged at 11kV & 415V level. Two numbers of Station Transformers are provided for supplying unit loads.

2.3.0 Required numbers of unit and station service transformer (11/0.415 kV) are provided for supplying 415V loads. Electrical Auxiliary power distribution arrangement & Power Evacuation Arrangement is shown in the enclosed **"Key Single Line diagram"(Drg. No. 00-5111168-E-201, 2 sheets).**

2.4.0 One number Black start cum Emergency DG set shall be considered for starting of Gas turbine and safe shutdown of units. During blackout condition Diesel Generator (DG) set shall feed essential loads, same Diesel generator set shall feed unit emergency loads for safe shut down of Units.

2.5.0 To provide uninterrupted power supply to DCS and other Control Panels, a dedicated 110 V AC UPS system shall be provided. To feed essential loads, such as the emergency oil pumps, Control. Supply to Switchgears / Panels, Emergency DC lighting etc, 110 V DC supply backed by DC Batteries shall be provided. DC system shall include 66kV GIS control supply requirements also.

2.6.0 If 125V DC system is required by the Gas Turbine supplier as per manufacturer's standard the same shall also be provided.

2.7.0 Plant communication system shall be provided with Public address system & telephone system.

2.8.0 For all electrical MV/LV/Control panels, Local control panels and Junction boxes, Transformers, etc shall be painted with RAL 7032

ANNEXURE-A

3.0.0 ELECTRICAL SYSTEM DESIGN

3.1.0 The plant shall be designed to operate in islanding mode of operation on tripping of all the grid incoming lines and Steam Turbine generator, so that the Gas Turbine generator unit can be made running with the available plant load under such condition.

3.2.0 The design, manufacture, assembly, shop testing, erection, testing & commissioning as well as performance of the equipment shall conform to the latest edition of relevant IS / IEC specifications.

3.3.0 Before starting manufacture of any equipment the Contractor shall have to take approval of relevant drawings and data from the Owner/Owner's representative.

3.4.0 All equipment supplied and all work carried out including design and detailed engineering shall comply with the statutory requirements local Government as well as Central Government and with the Indian Electricity Rules. The accuracy class of meters, CTs, PTs (inside GIS) for energy accountability shall be as per latest GETCO regulations.

3.5.0 Unless otherwise specified in the respective section, Electrical design ambient for all equipment sizing shall be considered as 50 Deg C dry bulb temperature and 95% RH. All the equipment are required to operate in a highly corrosive environment and highly humid (at costal area) atmosphere.

3.6.0 Unless otherwise specified, at least 20 % margin shall be considered in equipment sizing over and above the calculated load current/fault current/power requirements.

3.7.0 Makes of all Electrical equipment are subject to prior approval by the purchaser. Similar equipment and components shall be of same make. Equipment of same type and rating shall be interchangeable.

3.8.0 The 415V PCC & MCC panels shall be of minimum FORM 3B type of construction.

3.9.0 In respect to the above LV circuit breaker selection, following should be considered as per IEC:-

Utilisation Category	Application
Category A	Circuit-breakers with no assigned short-time rating (e.g Current limiting ACBs and MCCBs) cannot be used if coordination is required with downstream switchboard feeders. Applicable for the outgoing feeders
Category B	Circuit-breakers with assigned short-time rating (e.g ACBs and some Supplier's larger rated MCCBs) that shall be used if coordination is required with downstream switchboard / MCCs. Applicable for the incomer and outgoing feeders.

Outgoing feeders not requiring any coordination for example motor feeders Category "A" MCCB can be considered.

3.10.0 In switchgear for Motor feeders rated 15kW & above an ammeter & transducer shall be provided. All transducers will be of dual output type.

3.11.0 All LT motors rated 90 kW & above shall be controlled through Air Circuit Breakers. LT motors rated below 90 kW shall be controlled by fused contactor. In addition to the above ELCB shall be provided for all 415V motor feeder. Each feeder shall also provided with O/L relay and SPPR relay.

3.12.0 For the motor feeders, the essential auxiliaries shall have contactors with delayed drop out feature adjustable up to 3 sec and necessary auto reset facility and the relay should be of digital type. The

list of motors shall not be limited to BFP, AOP, JOP, lube oil pump, compressors, barring gear and any other drive recommended by GTG,STG & HRSG vendor.

3.13.0 The power cables upto and including 10 sq.mm should be copper conductor and above 10 Sqmm Aluminium conductor may be used. For CT circuits minimum cable size shall be 4sq.mm copper. Minimum size of control cables shall be 2.5sqmm. 20% spare cores shall be provided in all control cables. The maximum no. of cores shall be limited to 27.

3.14.0 The equipment supplied shall meet the requirement of state electricity and Indian grid code.

3.15.0 The Substation Automation System (SAS) shall have provision for interfacing with remote PLDC (Regional Load Dispatch Centre) through suitable gateways with adequate number of ports along with modems at substation level.

3.16.0 Voltage Levels shall be as follows:

- Power Evacuation : 66 kV (±10%), 3 phase, 3 wire 50 Hz, effectively earthed.
- Generation Voltage : Manufacturer's standard Voltage,3 phase,50 Hz
- Plant HT Auxiliary Supply : 11000V (±10%), 3-phase, 3W, 50 Hz, earthed through resistance.
- Plant LT Auxiliary Supply : 415V (±10%), 3 phase, 4 wire, solidly earthed.
- Plant LT Emergency Supply : 415V (±10%), 3 phase, 4 wire ungrounded.
- Plant DC Supply : 110V (+10% to –15%), DC 2 wire unearthed.
- Plant UPS Supply : 110V (±10%), 1 phase, 2 wires 50 Hz, A.C.
- Transducers : 110V DC (For LT boards 230V AC)
- Metering : 110V AC PT Voltage
- Control & protection : 110V, DC 2 wire unearthed
- Panel lighting and space heaters : 240V, 1-phase, 2wires 50 Hz, A.C. with one point earthed.
- Control Supply for Breaker feeders : 110V, DC 2 wire unearthed
- Control Supply for LV DOL modules : 110V, 1 phase, 2 wires
- Permissible Frequency variation for generator : +3% to – 5%
- Permissible Frequency variation for auxiliaries : +5% to – 5%
- Voltage level for AC Motors below 0.2 kW : 240 V, Single phase, 50 Hz, with DOL start.
- Voltage level for AC Motors from 0.2kW up to and including 160 kW : 415 V, 3 phase, 50 Hz, with DOL start.
- Voltage level for A.C Motors above 160 kW : 11000V, 3 phase, 50 Hz, with DOL start.

3.17.0 Design short circuit levels shall be at least the following and has to be supported by calculation:

- Three phase symmetrical short circuit ratings of 66kV System : 40 kA for 3 sec
- Three phase symmetrical short circuit ratings of 11kV System : 44 kA for 3 sec
- Earth fault current for 11kV System : 100A.
- Three phase symmetrical short circuit ratings of 415V System : 50 kA for 1sec
- Short circuit ratings of 110V DC System : 20 kA for 1 sec (min)

3.18.0 Insulation level at various voltages shall be as follows:

66kV System

One minute Power Frequency withstand voltage : 140 kV (rms)
Switching Impulse withstand Voltage : 325 kV (peak)

11kV System

One minute Power Frequency withstand voltage : 28 kV (rms)
1.2/50 Micro sec, impulse withstand voltage : 75 kV (peak)

415 V System

One minute Power Frequency withstand voltage : 3 kV (rms)

3.19.0 Sizing criteria for auxiliary transformers

Design Criteria for Auxiliary Transformer and Generator Transformer

i. The Contractor shall size the auxiliary transformer as per sizing criteria furnished below:

Min. Rating of each Auxiliary transformer (in kVA at p.f.0.8) = 1.2 x (Sum of total connected load + Max of (sum of 20% of total standby loads or the largest standby load) + max of (sum of 50% total intermittent loads or the largest intermittent load))

✓ The auxiliary transformers shall be sized for 2x100%

4.0.0 QUALITY ASSURANCE, TESTING & INSPECTION

4.1.0 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, tested, and commissioned at all the stages, as per approved Quality Plan.

4.2.0 All tests shall be conducted as per relevant IS/IEC/IEEE standards and shall be performed in the presence of purchaser's representative, if so desired by the purchaser. The Bidder shall give at least 15 days advance notice of the date when the tests are to be carried out.

4.3.0 Equipment offered shall be of type tested and proven type. Type test certificates for test conducted earlier on similar rating shall be furnished. Type testing shall be conducted without any cost implication to the purchaser if type testing is not already carried out for any equipment supplied. For the various bought out items test certificates from equipment manufacturer shall be furnished. Routine tests shall be carried out for all the equipment as per applicable standards whether specifically mentioned or not. Specific type tests are to be carried out as specified in individual equipment specifications.

4.4.0 Copies of certified reports of all tests carried out at the works shall be furnished. The equipment shall be dispatched from works, only after receipt of Purchaser's written approval of the test reports.

The charges for carrying out all routine tests shall be deemed to be included in the Bid price. The charge of carrying out each type test/ special test if any shall be given separately in "Unit Price Schedule".

ANNEXURE-B

7.17.0 List of Approved Sub-vendors

Refer Volume IV/Annexure-1/ Section 8.

With full information substantiating the technical acceptability of the proposed change. The Owner/Owner's representative's decision shall be final. Concessions granted shall not absolve the Contractor from any of his responsibilities under the Contract.

8.0.0 QUALITY ASSURANCE, SHOP INSPECTION AND TESTING

8.1.0 General

This section contains general requirements for inspection of material, parts, equipment and workmanship of the plant during manufacture, assembling to demonstrate compliance with specification, codes and standards to ensure overall reliability of plant operation and performance.

The Owner/Owner's representative and/or authorised Representatives shall, at any time, be allowed free and ready access to the Contractor's premises and those of his suppliers as well as to the site installation and the Contractor has to make the plant items available for the purpose of inspecting the specified equipment components and obtaining information as to the progress of the work. Failure on the part of the Owner/Owner's representative, at this or any other time, to discover or reject materials or work which do not meet specified requirements shall not be deemed an acceptance thereof nor a waiver of defects therein.

The approval of the Owner/Owner's representative shall not prejudice the right to reject equipment if it does not give complete satisfaction in service.

8.2.0 Scope

All materials, components and equipments covered under this specification shall be tested at all stages of procurement, manufacturing, erection, commissioning as per a comprehensive quality assurance programme. The requirements of minimum quality plans to be followed by the Bidder in respect of various equipment are specified in detailed technical specification. The Bidder shall draw his own quality plans in line with these requirements and his standard practices and implement such programme after approval by the Owner/Owner's representative.The Owner/Owner's representative shall appoint a Third party inspection (TPI) agency for bought out items/outside inspection.The Owner/Owner's representative will carry out on-site supervision and inspection.

Manufacturing quality plan shall detail out, for all the components and equipments, various tests/inspection to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by contractor's quality control organization, the relevant reference document and standards, acceptance norms and inspection documents raised. during all stages of material procurement, manufacture, assembly and final testing/performance testing.

The Contractor has primary responsibility for ensuring the quality of items of equipment supplied under the contract and remains accountable when manufacture or erection is subcontracted. It is therefore a requirement of the specification that work is only subcontracted to companies with effective quality control organization and that the Contractor monitors the performance of these by the attendance at tests of experienced inspectors employed by the Contractor. The Contractor shall, at the appropriate time, prove that his

material and / or equipment comply with all the requirements of this Section, such proof being the successful completion of tests and inspections. Routine test and type test certificates shall be submitted for each item of equipment, wherever applicable.

All materials, components and equipment supplied under the contract shall be subject to inspection by the Owner/Owner's representative, his representative, Inspectors of Boilers (India) or his authorized Agency or any other Inspector of the Government, should they so require during manufacture, erection and after completion. The necessary inspection charges of the authorized agency of Inspection of Boilers (India) shall be borne by the contractor. The inspection and tests shall include but shall not be limited to the requirements of this section of the specification. Further requirements to be applied are specified in the detailed specification.

The Bidder along with quality plan, shall also furnish copies of the reference documents/plant standards/acceptance norms/test and inspection procedure referred by him in quality plans. These quality plans and reference documents/standards will be subject to Owner/ Owner's representative's approval and will form a part of the contract. In these approved quality plans, Owner/Owner's representative shall identify customer hold points (CHP), indicating tests/checks which shall be carried out in presence of the Owner/Owner's representative's or authorized representative and beyond which work will not proceed without consent of Owner/Owner's representative's in writing.

No materials/equipment shall be dispatched from the manufacturer's works before the same is either accepted subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspections by Owner/Owner's representative or such pre-dispatch final inspection is waived by the Owner/Owner's representative and dispatch is authorized after review of test reports.

All materials used or supplied shall be accompanied by valid and approved material certificates and test and inspection reports duly approved by the Owner/Owner's representative. These certificates and reports shall indicate the acceptable identification number of the material they proposed to certify. The material certified shall also have the identification details stamped on it.

All material used for equipment construction including castings and forgings shall be of tested quality as per relevant codes/standards. Details of results of the test conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedures recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or as specified in detailed specification.

All welding shall be carried out as per welding procedure drawn and qualified in accordance with requirements of ASME Section IX. Welding procedures shall be submitted to the Owner/Owner's representative for approval prior to carrying out qualification test in the presence of I/Owner/Owner's representative

All welders/welding operators employed on any part of the contract either in the Supplier's works or at site or elsewhere shall be qualified as per ASME Section-IX.

Test results of qualification tests and specimen testing shall be furnished to the Owner /Owner's representative for approval. However, wherever required by the Owner/ Owner's representative, tests shall be conducted in presence of Owner/Owner's representative

All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

All the sub-vendors proposed by the Bidder for procurement of major bought out items including castings, forgings, pumps, heat exchangers, semi finished and finished components/equipment-(list of which shall be drawn up by the Bidder along with his offer and finalized with the Owner/Owner's representative) shall be subject to Owner/ Owner's representative's approval.

The type and extent of inspection of items shall be in accordance with the relevant International/Indian Standards/Indian Boiler Regulations and other standards approved by the Owner/Owner's representative, supplemented or amended by the requirements of this section of the specification or as specified elsewhere in the Specification.

8.3.0 Inspection Program and Test Notifications

Before manufacturing commences and not later than 45 days after award of contract, the Contractor shall submit an outline of his proposed inspection program, which shall include all major stages during manufacturing. The inspection and test program shall include for the various items the designation No., name of equipment, part of equipment, the kind of test, test standard, company which carries out the test, place, date and witnesses by the Contractor, third party or Owner/Owner's representative's .

The Owner/Owner's representative will return a copy of the Contractor's proposed inspection program indicating those inspection stages for which notification is required. Notification shall be by Fax or email in a format to be agreed and shall be sent at least 20 days prior to the intended test in accordance with 'Conditions of Contract'. If the Owner/Owner's representative intends to be represented at the test he will provide at least 24 hours' notice and if his representative does not attend on the notified date, the test may proceed unless an alternative date has been requested by the Owner/Owner's representative.

8.4.0 Test Certificate Documentation

The results of all tests shall be certified by the manufacturer, Contractor or independent agency as appropriate.

Document files containing material certificates, welding procedures, test report shall be compiled for each item of plant and shall be suitably identified (including equipment classification reference) and bound.

Three copies of each document file containing inspection reports and certificates of site erection testing activities of a particular item of plant or system shall be supplied to the Owner/Owner's representative prior to commissioning.

Copies of the performance and acceptance test reports shall be prepared and distributed as specified in Clause 'Performance and acceptance test data and reports' of this Section. All documentation as required by IBR shall also be prepared and submitted.

8.5.0 Certification of Equipment by Owner/Owner's representative's

The Personal and travelling costs in connection with the Owner/Owner's representative's inspection and witnessing of tests of equipment, components and material manufactured in India and abroad will be borne by the Owner/Owner's representative.

8.6.0 Codes and Standards

8.6.1 General

The type and extent of inspection shall generally be in accordance with that specified in the standard used for design and construction of the item of equipment supplemented or amended by the requirements of this section of the specification. The Contractor should provide the relevant codes and standard to the Owner/Owner's representative.

8.6.2 Reference to Codes and Standards

Reference to special codes and standards, where designated either directly or as "relevant", is intended to provide a measure of performance, safety, in-shop and on-site testing, and methods of construction and/or installation which must be equalled or exceeded in order to be considered acceptable for use under this specification. If more than a single degree of quality or accuracy is permitted within the scope of particular code or standard, the highest quality shall be applicable and the degree of accuracy commensurate with the intended function shall be selected, but with the understanding that the final decision will be made by the Owner/Owner's representative.

In all instances, the finally accepted applicable code or standard shall be the version last published.

8.6.3 Alternative Standards

Where no appropriate standard is available, tests shall be conducted in accordance with the manufacturer's standard practice, subject to the approval of the Owner/Owner's representative.

In such cases the Contractor shall submit to the Owner/Owner's representative, complete data and a suggested procedure for the testing to be performed. Commencement of manufacture before receipt of the Owner/Owner's representative's approval shall be at the Contractor's risk.

If the proposed procedures are accepted, the Contractor shall provide the Owner/Owner's representative with four additional copies in English before any test is performed.

8.6.4 Derating Standards

The Contractor's attention is drawn to the climatic conditions in the site area. Derating factors shall apply in accordance with the relevant and approved standards if not specified in the contract documents.

8.7.0 Services prior to and During Inspection and Testing

In accordance with and in addition to specified standards the Contractor shall submit procedures for material testing, manufacture, quality control and performance testing as they apply from the procurement phase of raw materials to the finished product. Manufacture commenced before receipt of the Owner/Owner's representative's approval of material specifications and testing procedures shall be at the Contractor's risk.

No inspection shall be valid unless the Contractor and manufacturer are in possession of relevant approved drawings and procedures for the item to be tested. The Contractor on

ANNEXURE-

16.4.1 Document Distribution Schedule - After Placement of Order

Sl. No.	Document	Total Copies	Distribution		
			Owner		Owner's representative
			HQ	SITE	
1.	PERT Network, work schedules, Bar charts, Layout drawings	10	-	5	5
2.	Data, drawings, documents, write-ups, calculation				
	- Preliminary	10	-	5	5
	- Revised	10	-	5	5
3.	Approved drawings and documents.	10	-	5	5
4.	Instruction manuals for erection and O&M	10	-	8	2
5.	As built drawings including O &M manual				
	- Hard Copy	10	-	8	2
	- Soft Copy	-	-	-	-

ANNEXURE - D

SUB-SECTION – 2.15

SURFACE PREPARATION AND PAINTING

CONTENTS

SUB-SECTION – 2.15

SURFACE PREPARATION AND PAINTING

1.0.0 SURFACE PREPARATION

1.1.0 General

This specification covers the general requirements related to the cleaning protective coating and painting of equipment, component and system. The components and/or equipment shall be mechanically and / or chemically cleaned during the following stages of the Contract.

- Cleaning in workshop.
- Cleaning before painting and / or corrosion protection (application of prime coat).
- Cleaning before erection and during installation.

Cleaning of fabricated component items shall be carried out after fabrication and final heat treatment of welding at manufacturer's work or at site, as appropriate.

For cleaning in workshop and before painting mechanical cleaning as opposed to alternative chemical cleaning is the preferred method of for works cleaning except where this is precluded by design or access considerations.

Mechanical surfaces shall be protected during the cleaning operations.

In the event of the surfaces not being cleaned to the purchaser's satisfaction, such parts of the cleaning procedures or agreed alternatives as are deemed necessary to overcome the deficiencies shall be carried out at the supplier's sole expense.

For reclining small areas, hand cleaning by wire brushing may be permitted wire brushless used on austenitic steel bristles.

Austenitic stainless steels, copper and aluminium alloys, cast iron, bimetallic and metallic / plastic items, and components fabricated by spot welding or riveting shall not be chemically cleaned. All weld areas shall be suitably stress relieved before chemical cleaning.

various international standards equivalent to Swedish standard for surface preparation are given in Table-1.

The contractor shall arrange at his own cost, to keep a set of latest edition of the above standards and codes at site.

The paint manufacturer's instruction shall be followed as afar as practicable at all times. Particular attention shall be paid to the following.

a) Proper storage to avoid exposure as well as extremes of temperature.
b) Surface preparation prior to painting.
c) Mixing and thinning.
d) Application of paints and the recommended limit on the intervals between coats.
e) Shelf life for storage.

Any painting work (including surface preparation) on piping or equipment shall be commenced only after the system tests have been completed and clearance for taking up painting work is given by the Engineer, who may, however, at his discretion authorise in writing, the taking up of surface preparation of painting work in any specific location, even prior to completion of system test.

1.2.0 **Tools & Tackles**

All tools, brushes, rollers, spray guns, blast material, hand power tools for cleaning and all equipment, scaffolding materials, shot/sand blasting equipment and air compressor etc. shall be arranged by the contractor at the site in sufficient quantity at his own cost. He shall arrange to his own cost, for suitable paint thickness measuring instrument like Elkometers acceptable to the Engineer (with calibration facilities).

Mechanical mixing shall be used for paint mixing operation in case of two pack systems except that the Engineer may allow the hand mixing of small quantities at his discretion.

1.3.0 **Mechanical Cleaning at Manufacturer's Works**

Mechanical cleaning shall preferably be carried out by abrasive blasting. The Purchaser is prepared to consider alternative methods provided they achieve the necessary surface condition.

1.3.1 **Surface condition**

The Metal surfaces shall be clean and free of mill scale, rust dirt, grease and any other deleterious matter.

Where metal surfaces are to be painted the surface profiles shall conform with the painting specification requirements.

Where this does not apply surfaces shall have a surface texture not coarser than Grade 80 abrasive paper.

1.3.2 **Abrasives**

Abrasives containing silica, silicates of slag, residues shall not be used for water/steam side surfaces of plant except for cleaning sand castings, where hydro blasting with sand may be used.

For austenitic materials only abrasives containing 98% or more of aluminia, $Al_2 O_3$, shall be used.

1.3.3 **Removal of abrasive and debris**:

After cleaning abrasive and debris shall be thoroughly removed from components.

1.3.4 **Alternative Chemical Cleaning at Manufacturer's Works**

The procedure shall comprise of Pre-treatment and Acid treatment.

To achieve cleanliness equivalent to that specified for mechanical cleaning. The procedure to be adopted must meet with the purchaser's approval.

1.3.5 **Protection at Manufacturer's Works**

As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anti-corrosion protection.

All water, air and steam side surfaces shall be protected by the application of approved water soluble corrosion inhibitors, or vapour phase inhibitors that can be subsequently removed by site water washing or steam blowing.

The rate of application of volatile corrosion inhibitors shall be at least 10 grams per square metre or 35 grams per cubic metre, whichever is the greater, except for pipes up to 300 mm diameter for which the minimum application rates shall be 5 grams per square metre.

Immediately after the protective treatment has been applied all vessels and pipes shall be suitably sealed off by discs or caps or approved alternatives to prevent ingress from the surrounds Cylindrical plugs shall not be drive into the ends of pipes. These protective covers shall not be removed until immediately before final connection is made to the associated equipment.

1.4.0 **Weather Conditions**

Painting shall be done only when the surface temperature is above 5°C surface temperature must be at least 3°C above dewpoint to ensure that condensation does not occur on the surface.

Reasonable protection against precipitation, corrosive fumes and vapours shall be exercised for the painting of outdoor parts.

Precautions shall also be taken against solar radiation to ensure that the specified dry film thickness of priming of finish coats is obtained.

Any prime coat exposed to excess humidity, rain, dust etc. before drying, shall be permitted to dry & the damaged area of primer shall be removed and the surface prepared & primed again.

Sheltered or unventilated horizontal surfaces on which dew may collect require more protection, and to achieve this an additional top coat of paint shall be applied.

1.5.0 **Surface Preparation**

In preparing any surface to be coated, all loose paint, dirt, grease, rust, scale, weld slag or spatter or any other extraneous material shall be removed and defects repaired so as to obtain a clean, dry, even surface to receive the priming or finishing coat(s) as called for in the painting schedules. Sharp adges should be rounded especially when tank linings have to be applied.

All machined surfaces, including flange faces, shall be suitably covered to prevent damage during surface preparation.
All surface should be blast cleaned whenever possible.

1.5.1 **Surface preparation methods.**

Bare steel surfaces should be prepared by one of the methods described below in order of preference and in accordance with Swedish Standard SIS 05 5900 or Steel Structures Painting Council, SSPC, Vis1,or DIN 55928, section 4.

1.5.1.1 **White metal blast cleaning**: Sa 3 or SSPC - SP 5

Sa 3 Blast cleaning to bare metal, Mill scale, rust and foreign matter must be removed completely. Subsequently, the surface is cleaned with vacuum cleaner, clean dry compressed air or a clean brush. It must then have a uniform metallic colour & correspond in appearance to the prints designated Sa 3.

1.5.1.2 **Near white metal blast cleaning** Sa 2 1/2 or SSPC - SP 10

Sa 2 1/2. Very thorough blast cleaning. Mill scale, rust and foreign matter shall be removed to the extent that the only traces remaining are slight imperfections in the form of spots or stripes. Subsequently, the surface is cleaned with a vacuum cleaner, clean dry compressed air or a clean brush. It must then correspond in appearance to the prints designated Sa 2 1/2.

Mechanical cleaning should only be used when procedures (a) and (b) are not practicable.

1.5.1.3 **Commercial Blast Cleaning** Sa 2

Sa 2 Blast cleaning until atleast two-thirds of each element of surface area is free of all visible residues. This method of Blasting is suitable for steel required to be painted with conventional paints for exposure to mildly corrosive atmosphere for longer life of the paint system.

1.5.1.4 **Near white metal blast cleaning** P Sa 2 1/2 DIN 55928

Very thorough blast cleaning. Very adhesive coatings remain. From all other surface mill scale and rust are to be removed to such an extent that the only traces remaining are slight imperfections in the form of spots or stripes. Further treatment see Sub b).

1.5.1.5 **Very thorough mechanical scraping and wire brushing** St 3

St 3 very thorough scraping and wire-brushing - machine brushing - grinding - etc. are to be preferred. Surface preparation as for St 2. But much more thoroughly. After the removal of dust, the surface must have a pronounced metallic sheen and correspond to the prints designated St. 3.

1.5.1.6 **Thorough scraping and wire brushing**: St 2

St 2 Thorough scraping and wire-brushing - machine brushing - grinding - etc. The treatment shall remove loose mill scale, rust and foreign matter. Subsequently, the surface is cleaned with a vacuum cleaner, clean dry compressed air or a clean brush. It should then have a faint metallic sheen. The appearance must correspond to the prints designated St 2.

Table -1 (Surface Preparation Standards)

Surface preparation methods	SIS 055900	DIN 55928, Part-4	BS 4232 only for blasting	SSPC-Vis
Blasting ACC to item (a)	Sa 3		First quality	White metal SP 5
Blasting ACC to item (b)	Sa 2 1/2		Second near quality	White SP 10
Blasting ACC to item (c)	Sa 2		Third quality	Commercial blast SP 6
Hand / or power tool derusting ACC to item (f)	St 2		--	Hand tool cleaning SP 2
ACC to items (e)	St 3		--	Power tool cleaning SP 3
Flame jet cleaning		F1	--	Flame cleaning SP 4
Pickling		Be	--	Pickling

Steel structures to be blast cleaned have to be free of pitting and other severely corroded places in accordance with B.S. 4232 and SIS 055900.

The abrasives used for blast-cleaning shall be graded flint, grit, shot or silica sand and shall be such that they will produce an average keying profile on the blast-cleaned surface of not more than 40 microns.

An air pressure of 7 bar (g) at the nozzle shall be used.

After blast-cleaning all accumulated grit, sand, dust etc. must be removed leaving the surface clean, dry and free of mill scale, rust grease and other foreign matter.

In the event of rusting after completion of the surface preparation, the surface must be cleaned again in the manner specified.

Oil, grease, soil, cement, salts, acids or other corrosive chemicals shall be cleaned from steel surfaces, by the use of solvents, emulsions or cleaning compounds. The final wiping shall be with clean solvent and clean rags or brushes. There shall be no detrimental residue left on the surface.

Primed areas which suffer damage must be spot blasted on site to a degree of cleanliness P Sa 2 1/2 before touching up.

Protective coating must be applied as quickly as possible after the completion of surface preparation no matter what cleaning method has been used.

No blast-cleaned surface shall be allowed to remain uncoated overnight.

Steel work protected by shop primer after arrival on site must be cleaned of salt, sand, oil etc. before the coat of paint is applied on site. Shop primer damaged during transport must be rectified by blast-cleaning and coating before application of the site coats.

Wood surfaces shall be sanded clean. All nail holes shall be puttied and sanded before priming.

Concrete: If a protective coating is required, concrete shall be allowed to cure before painting.

1.5.2 **Rub Down and Touch up of Primer**

The shop coated surfaces shall be rubbed down thoroughly with emery paper to remove all dust, rust and other foreign matters, washed, degreased, then cleaned with warm fresh water and air dried. The portions, from where the shop coat has peeled off, shall be touched up and allowed to dry before applying a coat of primer. The compatibility between shop coat and field primer should be ascertained from the paint manufacturer. In case degreasing with white spirits is not effective, the surface should be finally wiped clean with aromatic solvent like xylol or light naphtha.

1.5.3 **Non Compatible Shop Primer**

The compatibility of finishing coat should be confirmed from the paint manufacturer. In the event of use of primer such as zinc rich epoxy, inorganic zinc silicate etc., the paint system shall depend on condition of shop coat. If the shop coat is in satisfactory condition showing no major defect, the shop coat shall not be removed. The touch up primer and finishing coat(s) shall be identified for application by Engineer.

Shop coated (coated with primer & finishing coat) equipment shall not be repainted unless paint is damaged.

Shop primed equipment and surfaces shall only be spot cleaned in damaged areas by means of power tool brush cleaning or hand tool cleaning and then spot primed before applying one coat of field primer unless otherwise specified. If shop primer is not compatible with field primer then shop coated primer shall be completely removed before application of selected paint system for particular environment.

For package units / equipment, shop primer shall be as per the paint system given for particular environment.

In case of existing paint, compatibility between finishing coat and new selected finish coat shall be ascertained before application of finish coat. In case the coat is selected for upgrading existing alkyd coating to high performance coating, then surface preparation can be by manual / mechanical means to remove loose rust, peeled off/damaged paint, but sound old coating need not be removed. It should be touched with red oxide zinc chromate primer wherever it has peeled of before application of the coat. The tie coat shall be applied after 7 days of curing of red oxide zinc chromate primer. If new paint system is not suitable to upgrade existing coating then complete paint shall be removed by mechanical or blast cleaning before application of new coating system.

2.0.0 SCHEDULE OF PRIMER & FINISH COATS

2.1.0 PRIMERS

P-1 Red Oxide zinc chromate primer
P-2 High build chlorinated rubber zinc phosphate primer
P-3 High build zinc phosphate primer
P-4 Etch primer/wash primer
P-5 Epoxy zinc chromate primer
P-6 Epoxy zinc phosphate primer
P-7 Epoxy high build mio paint
P-8 Epoxy red oxide zinc phosphate primer
P-9 Epoxy based tie coat finish coats
P-10 Inorganic zinc silicate coating.

2.2.0 FINISH COATS

F-1 Synthetic enamel
F-2 Acrylic polyurethane paint
F-3 Chlorinated rubber paint
F-4 High build chlorinated rubber mio paint
F-5 Chemical resistant phenolic based enamel
F-6 Epoxy high build coating
F-7 High build coal tar epoxy
F-8 Self priming epoxy high build coating
F-9 High build black
F-10 Heat resistant aluminium paint suitable upto 250°c
F-11 Heat resistant silicone paint suitable upto 400°c
F-12 Synthetic rubber based aluminium paint suitable upto 150°c
F-13 Heat resistant silicone paint suitable upto 600°c

2.3.0 PRIMER

a) Primer (P-1) Red oxide zinc chromate primer

Type and composition	:	Single pack modified phenolic alkyd medium pigmented with red oxide and zinc chromate
Volume solids	:	30 - 35%
DFT	:	20 ~ 40 microns/coat (min)
Covering capacity	:	11-13 sq. m/Lit/coat

b) Primer (P-2) High build chlorinated rubber zinc phosphate primer

Type and composition	:	Single pack Chlorinated rubber medium plasticised with unsaponifiable plasticiser pigmented with zinc phosphate
Volume solids	:	35-40%

DFT	:	50 microns/coat (min).
Covering capacity	:	7-8 sq. m/lit/coat

c) **Primer (P-3)** High build zinc phosphate primer

Type and composition	:	Single pack Synthetic medium, pigmented with zinc phosphate
Volume solids	:	40 - 45%
DFT	:	35 - 50 microns/coat
Covering capacity	:	10 - 12 sq. m/lit/coat
Heat resistant	:	Upto 100 ^{0}C (dry)

d) **Primer (P-4)** Etch primer / Wash primer

Type and composition	:	Two pack of Polyvinyl butyl resin medium cured with phosphoric acid solution pigmented with zinc tetroxy chromate
Volume solids	:	7 - 8%
DFT	:	8 - 10 microns/coat
Covering capacity	:	7 - 8 sq. m/lit/coat

e) **Primer (P-5)** Epoxy zinc chromate primer

Type and composition	:	Two pack of Polyamide cured epoxy resin medium pigmented with zinc chromate
Volume solids	:	40% (min.)
DFT	:	35 microns/coat
Covering capacity	:	11 - 12 sq. m/lit/coat

f) **Primer (P-6)** Epoxy zinc phosphate primer

Type and composition	:	Two pack of Polyamide cured epoxy resin medium pigmented with zinc phosphate
Volume solids	:	40% (min)
DFT	:	35 microns/coat (min)
Covering capacity	:	11 - 12 sq. m/lit/coat

g) **Primer (P-7)** Epoxy high build MIO paint (Intermediate coat)

Type and composition	:	Two pack of Polyamide cured epoxy resin medium pigmented with micaceous iron oxide
Volume solids	:	50% (min)
DFT	:	100 microns/coat (min)
Covering capacity	:	5.0 sq. m/lit/coat

h) **Primer (P-8)** Epoxy red oxide zinc phosphate primer

Type and composition	:	Two pack of Polyamide cured epoxy resin medium pigmented with red oxide and zinc phosphate
Volume solids	:	42% (min)
DFT	:	30 microns/coat (min)
Covering capacity	:	13 - 14 sq. m/lit/coat

i) **Primer (P-9)** Epoxy based tie coat

(Suitable for conventional alkyd based coating prior to application of acrylic polyurethane / epoxy finishing coat).

Type and composition	:	Two pack of Polyamide cured epoxy resin medium suitably pigmented
Volume solids	:	45-60%
DFT	:	40 microns/coat (min)
Covering capacity	:	10 - 12 sq. m/lit/coat

j) **Primer (P-10)** Inorganic Zinc silicate coating

Type and composition	:	Two pack of Self cured Ethyl - silicate solvent based Inorganic Zinc coating.
Volume solids	:	60% (min)
DFT	:	65-75 microns/coat
Covering capacity	:	8-9 sq.m./lit/coat

2.4.0 **FINISH COATS**

a) **Finish coat (F-1)** Synthetic Enamel

Type and composition	:	Single pack Alkyl medium pigmented with superior quality water & weather resistant pigments
Volume solids	:	30 - 40%
DFT	:	20 - 25 microns/coat (min)
Covering capacity	:	16 - 18 sq. m/lit/coat

b) **Finish coat (F-2)** Acrylic Polyurethane paint

Type and composition	:	Two pack Acrylic resin and isocyanate hardener suitably pigmented.
Volume solids	:	40 % (min)
DFT	:	30-40 microns/coat
Covering capacity	:	10-12 sq.m./lit/coat

c) **Finish Coat (F-3)** Chlorinated Rubber paint

Type and composition	:	Single pack Plasticised chlorinated rubber medium with chemical & weather resistant pigments.
Volume solids	:	30 % (min)
DFT	:	30 microns/coat (min)
Covering capacity	:	10 sq.m./lit/coat

d) **Finish Coat (F-4)** High build chlorinated rubber MIO paint.

Type and composition	:	Single pack Chlorinated rubber based high build pigmented with micaceous iron oxide.
Volume solids	:	40-50 %
DFT	:	65-75 microns/coat
Covering capacity	:	6-7 sq.m./lit/coat

e) **Finish Coat (F-5)** Chemical Resistant Phenolic based Enamel

Type and composition	:	Single pack Phenolic medium suitably pigmented.
Volume solids	:	30-40%
DFT	:	25 microns/coat (min)
Covering capacity	:	15 sq.m./lit/coat

f) **Finish Coat (F-6)** Epoxy High Building Coating

Type and composition	:	Two pack Polyamide cured epoxy resin medium suitably pigmented.
Volume solids	:	55-65%
DFT	:	100 microns/coat (min)
Covering capacity	:	6.0-6.5 sq.m./lit/coat

g) **Finish Coat (F-7)** High build coal tar Epoxy.

Type and composition	:	Two pack Polyamine cured epoxy resin blended with coal tar.
Volume solids	:	65 % (min)
DFT	:	80-125 microns/coat
Covering capacity	:	6.0-6.5 sq.m./lit/coat

h) **Finish Coat (F-8)** Self priming epoxy high build coating (complete rust control coating)

Type and composition	:	Two pack Polyamido-amine cured epoxy resin suitably pigmented. Capable of adhering to manual prepared surface and old coatings.
Volume solids	:	65-85%
DFT	:	100-125 microns/coat
Covering capacity	:	4-5 sq.m./lit/coat

i) **Finish Coat (F-9)** High build black.

Type and composition	:	Single pack Reinforced Bituminous composition phenolic based resin.
Volume solids	:	55 - 66 % (min)
DFT	:	100 microns/coat (min)
Covering capacity	:	5.5 – 6.0 sq.m./lit/coat

j) **Finish Coat (F-10)** Heat Resistant Aluminium Paint Suitable upto 250°C

Type and composition	:	Dual container (paste & medium) Heat resistant special Ole Ore resinous medium with leafing aluminium.
Volume solids	:	20 - 25 %
DFT	:	20 microns/coat (min)
Covering capacity	:	10 - 12 sq.m./lit/coat

k) **Finish Coat (F-11)** Heat Resistant Silicon paint suitable 250 - 400°C.

Type and composition	:	Single pack of Silicon resin based with aluminium flakes
Volume solids	:	15-25 %
DFT	:	20 microns/coat (min)
Covering capacity	:	7-12 sq.m./lit/coat

l) **Finish Coat (F-12)** Synthetic Rubber Based Aluminium Paint suitable upto 150°C.

Type and composition	:	Single pack of Synthetic rubber medium combined with leafing Aluminium.
DFT	:	20-25 microns/coat (min)
Covering capacity	:	9.5 sq.m./lit/coat

m) **Finish Coat (F-13)** Heat Resistant Silicon paint suitable 500 - 600°C

Type and composition	:	Single pack of Silicon resin based with aluminium flakes.
Volume solids	:	25-35%
DFT	:	20 - 25 microns/coat (min)
Covering capacity	:	12 - 14 sq.m./lit/coat

3.0.0 PAINT SYSTEM

SL. NO.	SURFACE/LOCATION	TEMP. °C	SURFACE PREPARATION	PAINT SYSTEM			PER COAT MICRONS Dft	APPLICATION	
				COAT	NO. OF COATS	GENERIC TYPE		IN SHOP	ON SITE
1	Structural steel work, piping (oil + water) tanks outside surface, transmission towers, cranes, steel floors, galleries, stairways, outdoor.	upto 130°C	Sa 2½	Prime	2	P6	35	x	
							35	x	
				Intermediate	1	P7	100		x
				Finish	1	F2	50		x
						Total DFT	**220**		
2	Structural steel work, piping, indoor and outdoor	130 to 200°C	Sa 2½	Prime	1	F9	75	x	
				Intermediate	1	F9	20		x
				Finish	2	F11	20		x
							20		x
						Total DFT	**135**		
3	Structural steelwork, piping, un-insulated carbon steel, indoor and outdoor	200 to 400°C	Sa 3	Prime	1	F9	75	x	
				Intermediate	1	F12	20		x
				Finish	1	F12	**20**		x
						Total DFT	**115**		
4	Structural steel work, piping (oil + water), tanks, indoor	upto 130°C	Sa 2½	Prime	2	P6	35	x	
							35	x	
				Finish	1	F6	100		x
						Total DFT	**170**		

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SL. NO.	SURFACE/LOCATION	TEMP. °C	SURFACE PREPARATION	PAINT SYSTEM			PER COAT MICRONS Dft	APPLICATION	
				COAT	NO. OF COATS	GENERIC TYPE		IN SHOP	ON SITE
5 (a)	Structural steel work in the battery rooms, Chlorination plant and water treatment plant (extreme aggressive atmosphere)	Ambient	Sa 3	Prime	2	P8	30	x	
							30	x	
				Finish	2	F6	100		x
							100		x
						Total DFT	**260**		
(b)	Un-insulated - equipment, tanks and piping etc.	upto 80°C	Sa 3	Prime	2	P3	35	x	
							35	x	
				Finish	2	F6	100		x
							100		x
						Total DFT	**270**		
6	Steel tanks inside surface (total) for oil storage	normal	Sa 2½	Prime	2	P3	35	x	
							35	x	
				Finish	2	F6	100		x
							100		x
						Total DFT	**270**		
7	Steel tanks inside surface (total) for water storage (potable and distilled water)	normal	Sa 2½	Prime	2	P2	50	x	
							50	x	
				Finish	2	F3	30		x
							30		x
						Total DFT	**160**		
8	Cast iron water pipe lines-outside surface, buried in the soil	upto 60°C	Sa 3	Prime	2	P8	30	x	
							30	x	
				Finish	3	F7	125		x
							125		x
							125		x
						Total DFT	**435**		

SL. NO.	SURFACE/LOCATION	TEMP. °C	SURFACE PREPARATION	PAINT SYSTEM			PER COAT MICRONS Dft	APPLICATION	
				COAT	NO. OF COATS	GENERIC TYPE		IN SHOP	ON SITE
9	Steel pipes inside surface such as cooling water lines	upto 60°C	Sa 2½	Finish	4	F7	125		x
							125		x
							125		x
							125		x
						Total DFT	**500**		
10	Water pipelines - outside surface, indoor	upto 60°C	Sa 3	Prime	2	P2	50	x	
							50	x	
				Finish	3	F3	30		X
							30		X
							30		X
						Total DFT	**190**		
11	Oil pipelines - outside surface, above ground	upto 90°C	Sa 3	Prime	2	P3	50	x	
							50	x	
				Finish	2	F6	100		x
							100		x
						Total DFT	**300**		

3.1.0 Colour Code for Piping

The colour code scheme is intended for identification of the individual group of the pipeline. The system of colour coding consists of a ground colour and colour bands superimposed on it. The colour coding for the identification of pipelines should comply with the standard and shall submit for Owner/Owner's representative's approval. (For colour code for piping and fire equipment refer Annexure-1).

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Notes :

1. Covering capacity and DFT depends on method of application. Covering capacity specified above are theoretical. Allowing the losses during application, min specified DFT should be maintained.
2. All primers and finish coats should be cold cured and air dried unless otherwise specified.
3. Selected chlorinated rubber paint should have resistance to corrosive atmosphere and suitable for marine/saline environment.
4. All paints shall conform to relevant Indian Standard and shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation, quality and workmanship should be ensured.
5. Technical data sheets for all paints shall be supplied at the time of submission of quotations.
6. In case of use of epoxy tie coat, manufacturer should demonstrate satisfactory test for inter coat adhesion. In case of limited availability of epoxy tie coat (P-9) alternate system may be used taking into consideration the service requirement of the system.
7. All primers should be top coated immediately as per manufacturer's recommendations.
8. In ONGC Hazira complex no sand blasting or shot blasting shall be done. All equipment shall be protected with anti-corrosive coat and after final painting only shifted to project site for further erection. Touch – up painting for the damage area during transportation can be done at project site.

3.2.0 **Specific Requirement**

3.2.1 Following paint schedules shall be followed :

- Acid resistant paint for DM plant building / structure, neutralisation pit, battery room, other corrosive area.
- Synthetic enamel paint for Structural steel, structural sheds, window grills, hand railings, etc.
- Epoxy high build paint for DM plant equipment with piping valves.

3.2.2 All steel work not embedded in concrete to be given one coat of commercial grade zinc chromate primer before painting.

3.2.3 Synthetic enamel paint :

a) General building / structure :

• Surface preparation	:	ST – 2 according to Swedish standard SIS 055900
• Primer paint	:	Two coats of Zinc phosphate in phenolic alkyd medium (DFT = 35 microns / coat)
• Finish paint	:	Two coats of Synthetic enamel (DFT = 25 microns / coat) confirming IS 2932, 1974.

b) Part of steel structure embedded in concrete :

• Surface preparation	:	ST – 2 according to Swedish standard SIS 055900 One coat of port land cement slurry.

c) Epoxy high building coating:

• Epoxy zinc phosphate primer	:	two coats of 35 DFT per coat.
• Epoxy high build coating	:	one coat of 100 DFT.

SECTION -4
TECHNICAL DATA REQUIREMENTS

Control and Relay panels

1 Name & country of Manufacture of panels

2 Manufacturer's type & and designation

3 Type of construction (Simplex / Duplex)

4 Thickness of sheet steel
(I) Front

(ii) Back

(iii) Sides

5 Degree of Protection

6 Name of the manufcaturer of relays

7 DC Voltage of the relays

8 Make and model of static (0.2 accuracy class type) energy meters

9 Confirm whether offered C&R panel manufacturer and protective relays have tested commissioned and they are in successful operation for at least two years in 400kV System

TRANSMISSION LINE PROTECTION

Numerical Distance protection Scheme

1 Name & country of Manufacture

2 Manufacturer type & designation

3 Switched or Non switched type (is it with separate measurement for single / three phase faults)

4 Setting range of offset feature

5 Whether relay is having self monitoring feature

6 Whether relay is compatible for PLCC equipment and can be used for permissive/ under reach/over reach/ Blocking scheme

7 Suitable for single & three phase trip

8 Type of shaped characteristic

9 No. of tripping contacts with making capacity of 30 amps for 0.2 seconds

10 In case 16 contacts as per above clause are not available with the distance relay offered, type of tripping relay being offered

11 Maximum operating time for at 50% of the reach setting of 2 ohms and 10/20 ohms (with CVT) including all trip relays, if any (Bidder is required to enclose isochronic curve with CVT on Line)
a) at SIR = 4
b) at SIR=15 (3 Phase faults)
c) at SIR =15 (other faults)

12 IDMT earth fault relay meeting Normal Inverse charcteristics as per IEC 60253 is being offered as built in feature for 400/220 kV Lines

13 If no type of IDMT relay being offered

14 Built in feature offered with the relay (Yes/No)
a) Disturbance Recorder
b) Fault Locator
c) Over voltage (one stage only)
d) Auto reclose relay along with dead line charging and check synchronising

STATIC Distance Protection Scheme

1 Name & country of Manufacture

2 Manufacturer type & designation

3 Switched or Non switched type (is it with separate measurement for single / three phase faults)

4 Setting range of offset feature

5 Whether relay is having self monitoring feature

6 Whether relay is compatible for PLCC equipment and can be used for permissive/ under reach/over reach/ Blocking scheme

7 Suitable for single & three phase trip

8 Type of shaped characteristic

9 No. of tripping contacts with making capacity of 30 amps for 0.2 seconds

10 In case 16 contacts as per above clause are not available with the distance relay offered, type of tripping relay being offered

11 Maximum operating time for at 50% of the reach setting of 2 ohms and 10/20 ohms (with CVT) including all trip relays, if any (Bidder is required to enclose isochronic curve with CVT on Line)
a) at SIR = 4
b) at SIR=15 (3 Phase faults)
c) at SIR =15 (other faults)

12 IDMT earth fault relay meeting Normal Inverse charcteristics as per IEC 60253 is being offered as built in feature for 400/220 kV Lines

13 If no type of IDMT relay being offered

14 Built in feature offered with the relay (Yes/No)
a) Disturbance Recorder
b) Fault Locator
c) Over voltage (one stage only)
d) Auto reclose relay along with check synchronising relay (for 132 kV Lines)

Directional O/C and E/F Relay

1 Name & country of Manufacture

2 Manufacturer type & designation

3 Three over current and one E/F element(s) are whether independent or composite units

4 Type of relay Electromechanical/ static/ Numerical

5 Whether charateristics will confirm to IEC255-3

6 Directional sensitivity

7 Overcurrent unit setting range

a) Inverse time

b) High set inst. Unit

8 Earth fault unit setting range

a) Inverse time

b) High set inst. Unit

9 VT fuse failure relay/ feature included for Alarm

Line Over voltage Protection relay

1 Name & country of Manufacture

2 Manufacturer type & designation

3 Type of Relay (Electromechanical/ Static Numerical)

4 Operating indicator provided

5 Operating time

6 Resetting time

7 Whether monitors all three phases ?

8 Built in feature of Main 1/Main 2 distance relay is offered. If so which stage is offered as built in

Distance to fault locator

1 Name & country of Manufacture

2 Manufacturer type & designation

3 Built in feature of Main 1/Main 2 distance relay is offered

4 Maximum registering time

5 Whether direct display unit provided

6 Whether both phase to phase fault & phase to earth fault measuring units included

7 Whether" On - Line" type

8 Accurcay for typical conditions defined under technical specifications

Disturbance Recorder
a. Acquisition unit

1 Name & country of Manufacture

2 Manufacturer's type & and designation

3 No. of Analogue Channels

4 No. of Digital recording Channels

5 Built in feature of Main 1 / Main 2 distance relay offered

6 Pre Fault memory (milli seconds)

7 Post Fault memory (seconds)

8 Total storage memory in seconds

9 Sampling Frequency

10 Resolution of event channels (msec)

11 Time display present?

12 Data output in COMTRADE is available

b. Evaluation Unit

1 Name & country of Manufacture

2 Manufacturer's type & and designation

3 No. of acquisition unit that can be connnected to one evaluation unit

SECTION -4
TECHNICAL DATA REQUIREMENTS

4 Technical paramters of evaluation unit
a. Processor & Speed
b. RAM & Hard Disk Capacity
c. Additional facilities
d. Details of Printer

5 Details of Power supply arrangement for acquistion unit (including printer)

Auto Reclose Relay

1 Name & country of Manufacture

2 Manufacturer type & designation

3 Electromechanical / Static / Numerical

4 Auto Reclose relay along with dead line charging and check synchronising relay offered as part of distance relay

5 Suitable for single & three phase ?

6 Single phase dead time setting ranges

7 Three phase dead time range earth faults

8 Reclaim time seting range

Auto Reclose Relay (FOR NEW SUBSTATION ONLY)

1 Name & country of Manufacture

2 Manufacturer type & designation

3 Electromechanical / Static / Numerical

4 Auto Reclose relay along with dead line charging and check synchronising relay offered as part of distance relay

5 Suitable for single & three phase ?

6 Single phase dead time setting ranges

7 Three phase dead time range earth faults

8 Reclaim time seting range

TRANSFORMER PROTECTION

Differential relay

1 Name & country of Manufacture

2 Manufacturer type & designation

3 Second harmonic restraint feature provided ?

4 Whether three instantaneous units provided

5 Operating current setting range

6 Bias setting range

7 Operating time at 5x setting current

8 Resetting time

9 How ratio / phase angle corrections are being done (inter posing transformer / internal feature in the relay)

Restricted Earth Fault Relay

1 Name and country of Manufacturer

2 Manufacturer type and designation

3 Operating time at 2 x setting

Overfluxing relays

1 Name & country of Manufacture

2 Manufacturer type & designation

3 Whether inverse time operating charcateristics provided ?

4 Maximum operating time

5 Accuracy operating time

6 Resetting time

Directional O/C and E/F Relay

1 Name & country of Manufacture

2 Manufacturer type & designation

3 Whether charateristics will confirm to IEC255-3

4 Directional sensitivity

5 Overcurrent unit setting range

a) Inverse time

b) High set inst. Unit

6 Earth fault unit setting range

a) Inverse time

b) High set inst. Unit

REACTOR PROTECTION

Differential relay

1 Name & country of Manufacture

2 Manufacturer type & designation

3 Second harmonic restraint feature provided ?

4 Whether three instantaneous units provided

5 Operating current setting range

6 Bias setting range

7 Operating time at 5x setting current

8 Resetting time

9 How ratio / phase angle corrections are being done (inter posing transformer / internal feature in the relay)

Restricted Earth Fault Relay

1 Name and country of Manufacturer

2 Manufacturer type and designation

3 Operating time at 2 x setting

Back up Impedance Protection Relay

1 Name & country of Manufacture

2 Manufacturer type & designation

3 Whether charateristics will confirm to IEC255-3

4 Directional sensitivity

5 Overcurrent unit setting range

a) Inverse time

b) High set inst. Unit

6 Earth fault unit setting range

a) Inverse time

b) High set inst. Unit

SECTION -4
TECHNICAL DATA REQUIREMENTS

GENERAL PROTECTION / MONITORING EQUIPMEMT

Trip circuit supervision relay

1 Name & country of Manufacture

2 Manufacturer type & designation

3 Whether preclosing and post closing supervision provided ?

4 Time delay

High Speed Trip Relays

1 Name & country of Manufacture

2 Manufacturer type & designation

3 Contacts ratings
   a) Make & carry continously

   b) Make & carry for 0.5 sec

   c) Break
      I. Resistive load

      ii. Inductive load (With L/R = 40 msec)

4 Operating time at rated voltage (maximum)

5 Resetting time

6 Whether supervisory relays included

SECTION -4
TECHNICAL DATA REQUIREMENTS

Local Breaker Back - up protection

1 Name & country of Manufacture

2 Manufacturer type & designation

3 Operating time

4 Resetting time

5 Setting range
(I) Current
(ii) Time

Bus bar Protection (APPLICABLE FOR NEW STATION ONLY)

1 Name & country of Manufacture

2 Manufacturer type & designation

3 Type of relay

4 Principle of operation

5 Operating time

6 Resetting time

7 Setting ranges

(I) Current
(ii) Time

8 Whether it will cause tripping for the differential current below the load current of heavily loaded feeder (Bidder shall submit application check for the same)