



DEALERS & IMPORTERS OF POWER PLANTS & ALLIED MACHINERY

402, 4th Floor, Bezzola Commercial Complex, V.N. Purav Marg, Sion Trombay Road, Chembur, Mumbai – 400071, INDIA.

Tel: Off : +91 22 2523 4478 / 67973677
Fax : +91 22 2523 5386
E mail : enquiry@corponit.com
Website : www.corponit.com

TECHNICAL DETAILS OF 1 x 13 MW EXTRACTION-CONDENSING TYPE STG SET

Annexure– 1

TECHNICAL SPECIFICATIONS 12 MW TG SET

PART – A MECHANICAL

STEAM TURBINE

Design:

Type	:	Multistage, impulse, uncontrolled extraction cum condensing
Casing split	:	Horizontal
Rotor type	:	Solidly forged & machined rotor with integral disks
Shaft seal	:	Labyrinth
No. of governing valves	:	four
Bearing support	:	two pedestals
Rated speed	:	Turbine / Alternator – 6000/1500rpm
Total inlet flow max.	:	60 TPH
Condensing flow	:	7 - 50 TPH
Extraction flow / pr. / temp.	:	0 – 52.7 TPH / 4.6bar @202~219 deg. C
Max. Capacity power	:	13.157 MW
Design inlet steam Pressure	:	48.0 Kg/cm ² (g)
Design inlet steam temp.	:	460 deg. C

Oil system:

- Oil:

Governing oil pressure	:	10bar g
Lube oil pressure	:	1.5barg
Oil type	:	ISO VG 46
Oil quantity for initial fill and flushing	:	7 cubic meters
Oil reservoir capacity	:	8 m ³ inclusive of 1 m ³ of overhead lube. Oil tank capacity
Retention time	:	10 minutes
Material of oil reservoir	:	C-steel
Material of oil piping from Tanks to Pumps to filters	:	SS 304
Material of oil piping from Filters to bearings	:	SS 304
Material of oil piping from Bearings to reservoir	:	SS 304
(All the oil wetted pipe lines to be of SS 304)		

- Main oil pump:

- Type : Screw type
- Operating speed : 2000rpm
- Capacity : 800 lit/min
- Driver : low speed gear shaft
- **Auxiliary oil pump:**
 - Type : Screw
 - Operating speed : 2970
 - Capacity : 800 lit/min
 - Driver : AC motor 415V 47KW
- **Auxiliary lubrication oil pump: one**
 - Type : Screw
 - Operating speed : 1450rpm
 - Capacity : 600 lit/min
 - Driver : AC 415V 5kw
 - Pressure: 0.2Mpa
- **Emergency oil pump:**
 - Type : Screw type
 - Operating speed : 1450
 - Capacity : 600 lit/min
 - Driver : DC Motor 110V 5.5KW
 - Pressure: 0.2Mpa
- **Oil cooler:**
 - Design code : HEI
 - Type : Shell and tube
 - Oil inlet temperature : 55 degC 60 deg.CMax.
 - Oil outlet temperature : 45C
 - Tube material : SS 304
 - Tube sheet material : C-steel with SS 304 explosion bonding having machined surface of minimum 5 mm thick
 - Baffles & Tie Rod : SS-304
 - Oil flow Capacity : more the 1000 lit/min
 - Mounting : Horizontal
- **Lube oil filter:**
 - Element type : stainless steel & Cleanable
 - Oil flow Capacity : 1200 Lit/min
 - Oil filtration Capacity : 40 mil
 - Mounting : vertical
- **Oil Vapour Extractor:**
 - Type : Centrifugal type
 - Capacity : suitable capacity
 - Driver Mounting & flange : AC motor 415V 0.2KW on top of oil tank

Bearings:

- **Journal Bearings**
 - Type : ellipse
 - Material : white metal
- **Thrust Bearings**
 - Type : Michell
 - Material : white metal

Governing System:

- **Governor:**
 - Type : Wood Ward 505E with DSLC for load sharing
 - Inputs (critical) : 2 speeds from MPU-1 & 2
 - Control range : 300 to 7200rpm
 - Control accuracy : As per NEMA class D
 - Speed droop : 0 to 10% (programmable)
 - Power supply : 110 V DC
 - Accessories : 2 Magnetic speed MPU & 2 Elec.-hydraulic converters CPC
- **Hydraulic Accumulator:**
 - Type : Nitrogen gas filled
 - Working fluid : by turbine
 - Capacity : 16 Liters
- **Governing oil filter** : **Duplex type with on line change over facility having necessary valves for equalizer, vent and drain facilities.**
 - Element type : stainless steel & Cleanable
 - Oil flow Capacity : 8 lit/min
 - Oil filtration Capacity : 10 mil

Safety devices:

- **Over speed trip:**
 - Type : Woodward Protech
- **Low lube oil pressure trip:**
 - Type : pressure switch
- **Low control oil pressure trip:**
 - Type : pressure switch
- **High thrust wear trip:**
 - Type : electronic Bently
- **High exhaust pressure trip:**
 - Type : pressure switch
- **Hand trip:**
 - Type : mechanical released
 - Operation : mechanical engaged
- **Solenoid trip:**
 - Type : Solenoid operated block & dump valve
 - Operation : De-energise to trip & energise to open
- Axial Displacement (Turbine) : Thru 2 redundant axial probes
- Radial Vibration : (Turbine -2, Alternator -2, Gear box - 4) Through redundant i.e. 2 probes for each Radial Vibration parameters i.e. 16 probes
- Electronic Over speed : Through 505 E
- Emergency Push Buttons : One set at local + one set at remote

Trip Logic : For the Low lube oil pressure trip, low control oil pressure trip, High Exhaust Pressure trips: 2 out of 3 sensors & trip logic to be provided

- Bearing Temperature High : Through 8 journal + 01 Thrust bearing temperature sensor (all duplex type)
- Live Steam Temperature : From 2 out of 3 temperature sensors

All trips to have sensors and circuitry for pre alarm & all trips to have first out alarm on the Hardwired Alarm Annunciator (through interposing relays)

GEARBOX

Design:

- Type : Double helical, single reduction
- Input / Output speed : 6000/1500
- Ratio : 1 : 4
- S.F. : 1.3
- Accessory : Air breather

COUPLINGS

- **High Speed Coupling**
 - Type : Non – Lubricated steel laminated flexible
- **Low Speed Coupling**
 - Type : Non – Lubricated steel laminated flexible

ACCESSORIES

- **Barring gear:**
 - Type : Auto disengage and manual engage
 - Driver : AC motor (2.2 kW, 415 V, 3 Phase)

Turbine connections: refer to turbine layout drawing

For	Number	Size	Rating	Orientation
Inlet steam	During detail engg.	During detail engg.	ANSI 900 # RF	During detail engg.
Extraction steam	During detail engg.	During detail engg.	ANSI 300# RF	During detail engg.
Exhaust steam	During detail engg.	During detail engg.		During detail engg.

Noise level : less then 90 dB (A)

Weights (Approx.)

- Weight of rotor : ALL THIS DATA TO BE GIVEN DURING DETAIL
- Weight of upper half casing : ENGG.
- Weight of gearbox :
- Weight of base plate :
- Weight of turbine (including Gearbox) :

Pl. specify the EOT crane capacity requirement for efficient maintenance of STG set.

CONDENSING SYSTEM

STEAM SURFACE CONDENSER

- Design code : HEI / TEMA (Thermal) & ASME (Mechanical)
- Type : Shell and tube
- Capacity : 50 Ton Per Hour
- Construction : two flow (having provision for 50% isolation & other 50% in

	:	operation)
Fouling Factor	:	0.0003 M2.Hr.deg C/Kcal)
Hot well retention time	:	(min. 3 minutes reqd.)
Tube fixing	:	Expanded (Welded)
Tube material	:	SS 304
Baffles and tie rods	:	SS 304
Tube sheet material	:	C-steel with SS 304 explosion bonding having machined Surface, of minimum 5 mm thick
Water box & Shell material	:	C-steel
Mounting	:	Distance piece between turbine outlet to condenser inlet to be supplied with gasket (4 sets) and nut bolts & washers
Base support for condenser	:	Spring supports of proper spring rate are to be supplied along with base plates to be mounted on civil foundation with jack screw arrangement for alignment.

WATER EJECTORS

Suction medium	:	Air / Water
System elements	:	2 x 100% ejectors
Accessory	:	Centrifuge water pump 2 X 270t/h@ 3bar g (1 Working + 1 S/By) with mechanical seal
Material of nozzle	:	SS 304
Material of shell & diffuser	:	Gray Iron

CONDENSATE EXTRACTION PUMPS

Type	:	KSB (2 X 100%) (one running & one standby with necessary piping & valves)
Mounting	:	horizontal
Driver	:	AC Motor – 415V 3phase
Type of seal	:	Mechanical seal of appropriate face combination with proper cooling/flushing plan (make John crane/ Burgmann)
Type of coupling	:	Flexible
Type of lubrication	:	Oil

PART – B ELECTRICAL

1. AC GENERATOR AND ELECTRICAL PANELS

- All details and specs. given below

TECHNICAL DATA FOR 12 MW ALTERNATOR

GENERATOR

GENERATOR shall be a three-phase brush less synchronous turbo-alternator of four poles with circulating air cooling via water cooler(SS Tube), with foundation parts and with two slide bearings.

Type	: QFW-12-4 (Brushless)
Active output	: 12000kW
Cos ϕ	: 0.80
Rated current	: 787.3A
Rated voltage	: 11000 \pm 10% V
Rated speed	: 1500min ⁻¹
Phase connection	: 4Y
Frequency	: 50Hz +/- 5%
Ends of winding	: 6
Short circuit torque	: 454 kNm
Generator protection	: IP54
Leakage Reactance	: $X_e=0.1544$
D-Axis reactance of armature reaction:	$X_{ad}=2.2738$
Quadrature-axis reactance of armature	: $X_{aq}=2.2738$
D-Axis synchronous	: $X_d=2.4282$
Quadrature-axis synchronous reactance:	$X_q=2.4282$
D-Axis transient	: $X'_d=0.2592$
D-Axis sub-transient	: $X''_d=0.2169$
Negative phase-sequence reactance	: $X_2=0.2410$
Zero phase-sequence reactance	: $X_0=0.0644$
Efficiency	: 96.8%
Short circuit ratio	: 0.457
Resistance of stator winding 75°C	: =0.00422 Ω
Resistance of rotor winding 75°C	: =0.3969 Ω
Time Constants:	
Exciting winding at stator winding open circuit	$T_{d0}'=4.828s$
Exciting winding at stator winding short circuit	$T_d'=0.515s$
Excitation Values	
No-load excitation	$I_{ff0}=118.8A$ $U_{ff0}=57.5V$
Excitation at rated loading	$I_{ffn}=372.2A$ $U_{ffn}=176V$

Turbo-alternator is equipped with resistance thermometers Pt of 100 ohms 0□ for remote temperature measuring.

Location: 6+1 reserve pcs in stator winding and stator core.

2 pcs for cold air

1 pc for hot air

Thermometer ends are led out on the common terminal board on the right hand-side of stator (viewed from coupling).

1 pc bearing temperature sensor in each bearing--the ends led out the respective pedestal.

The insulation of stator and rotor winding is of thermostatic type, insulation class “F” with heat insulation of class “B” at atmospheric temp. of 50 deg. centigrade temperature rise of 120 i.e. delta of 70 degree.

Standard and Tolerance: acc. to IEC34-1, IEC34-3.

The Weight of total generator 42000kg

Air cooler

Circular air cooler is placed upper the machine and is dimensioned for the following operational conditions:

Capacity	: 450kW
Foiling factor	: 0.0003 M2.Hr.deg.C/Kal
Design pressure	: 0.4MpaG
Return pressure	: 0.3MpaG
Operating water pressure	: 0.4MpaG
Necessary water quantity in m ³ /h approx.	: 120m ³ /h
Water pressure drop approx.	: 80kpa
Inlet temperature of cooling water at inlet of cooler	: 33 deg. C
Cold air temperature	: 40 deg. C
Arrangement of cooling tubes	: horizontally
Number of cooling parts	: 4

Excitation system

Brushless AC exciter

Type	: TFL75-10/125
Mounting arrangement	: IMB3
Protection type	: IP54

Speed	: 1500r/min
Frequency	: 125Hz
Capacity	: 75KVA
Power Factor	: 0.89

AVR

Two channel AVR run in single or in parallel mode with a facility of bumpless transfer (from main to auxiliary and provision to take out one AVR in running)

- Accuracy (in steady state) : $\pm 0.5\%$
- Reactive current component settable : $\pm 10\%$
- Voltage regulation in range : 80-120%

Operation conditions:

Clean and non-aggressive environment

The range of operation temperatures : $+5 \sim +50$ deg.C

Relative humidity : 80% at 30 deg. C

(Max. 15g water/m³)

SUPPLY SCOPE

(1) Three phase synchronous Generator 15000 KVA, 11000V 0.80 P-F, 1500 RPM.

Insulation Class F.

Ambient temperature 50⁰C.

Burshless Excitor.

(2) Generator water cooler of SS 304 tubes, tie rods, baffles and tube sheets.

(3) AVR with 2 nos(Basler make digital type). with bump less transfer from main to auxiliary and having Provision for removal of the defective AVR on line.

(4) Special tools for erection and maintenance of the Generator.

GENERATOR INSPECTION TESTS

Following tests will be performed for customer inspection:

1. Measuring of insulation resistance and temperature probes.
2. Measuring of ohmic resistance of winding and temperature probes.
3. Measuring of no-load characteristic.
4. Determination of no load losses.

5. Measuring of phase sequence and voltage symmetry.
6. Determination of short-circuit losses.
7. Test of overloading with 150% in stator current for a period of time of 30s.
8. Measuring of bearing vibration.
9. Test of stator winding insulation with 50Hz voltage of size $U_{\text{test}}=2U_N+1\text{kV}$.
10. Test of rotor winding insulation with 50Hz voltage of size $U_{\text{test}}=10U_{\text{FN}}$ (min. 1.5kV max. 3.5kV).

SPARE PARTS

- 1) One piece of generator bearing
- 2) Three pieces of rotating rectifier diodes for positive direction
- 3) Three pieces of rotating rectifier diodes for opposite direction
- 4) Two pieces of temperature measuring elements for bearings

a. Electrical control Panels.

- All the control wires in electrical and instrument panels shall have identification tag nos. on both ends and at incoming & outgoing TB's.
- GGEGC shall supply the following electrical panels and breakers.

1. Draw out type MCC having incomer ACB (Schinder make) of 800 Amp and out going feeders of required auxiliary equipments having 1 no. spare of each type feeder. The MCC shall be designed with following specifications.
 - a. 3 Phase, 4 wire, 415 volt +/- 10%.
 - b. Control and indication voltage 1 phase 110 volt AC (To be taken from the MCC through 415/110 volt control transformer mounted in the MCC).
 2. 110 volt DC Battery charger having float and boost charger and with following details.
 - a. Input supply - 3phase, 4 wire 415 volts.
 - b. Out put - 110 volts 40 Amp.
 - c. Batteries - Maintenance free 150 AH.
 - d. Out put distribution board – suitable for the distribution of DC power for the EOP and other panels and having at least one spare out going feeder of each type.
 3. 11 KV out put 1250 Amp (Siemens make) VCB breaker with required metering and protection relays suitable for 12 MW Generator. Control, indication and protection supply for the VCB shall be 110 Volt DC.
 4. LA.SC & PT panel with CTs and Pts for following applications and capacitors for surge compensation.
 - a. Metering.
 - b. Protection.
 - c. Excitation.

5. Excitation panel

The exciter panel shall have two numbers Digital AVRs with both working with a facility of automatic bump less change over from main to auxiliary in case of failure and their should be the provision in the system to take out any of the AVR in running condition for any maintenance / breakdown.

6. Generator protection and metering panel.

- a. Generator protection and metering panel shall have following protections through numerical relay.

- i. Differential protection.
- ii. Reverse power both active and reactive power.
- iii. Loss of excitation.
- iv. Negative phase sequence.
- v. Over current.
- vi. Over voltage.
- vii. PT fuses failure.
- viii. Stator earth fault.
- ix. Rotor earth fault.
- x. Under and over frequency.
- xi. Turbine tripping in case the out put VCB trips by any unknown reason and the interlock should have defeating facility.

b. Metering or protection and metering panels shall have following meters.

- i. 3 Nos. 270 degree ammeters in 144x144 mm size.
- ii. 3 Nos. 270 degree Voltmeters in 144x144 mm size.
- iii. 1 No 270 degree PF, KW, KVAR, KVA, PF and Frequency meters in 144x144 mm size.
- iv. Tri-vector meter/ Power analyzer in class 0.5 accuracy.
- v. DC excitation and amperes meters.
- vi. Temperature meter scanners for alternator winding, bearings and alternator air coolers in and outlet air.
- vii. Alarm annunciator with first out feature for all the electrical protections and having 20% spare windows for future.

7. Neural Grounding panel.

- a. Motorized neutral grounding panel shall be there having required capacity resistance and there shall be the interlock in the system as mentioned below.
 - i. To close the NGR whenever synchronizing breaker trips in running or the system is not synchronized.
 - ii. To trip the NGR on closing of the Synchronizing breaker.

8. Synchronizing load sharing panel.

- a. The synchronizing panel shall be there with digital synchronizing and load sharing (Both active and reactive) with KW and drop mode selection to run the machine in synchronizing mode with similar kind of generators and with the utility. Woodward DSLC system shall be used for synchronization.
- b. The synchronizing panel shall have double frequency, voltmeters, synchronous scope and synchronizing check through PLC /relay for smooth and safer operation.

9. DC Motor starter.

Required capacity DC starter shall be supplied for emergency oil pump.

- 10. Control, protection and metering supply shall be 110 volt DC.
- 11. All the panels shall be free standing having powder coated painting, lighting with door interlock and space heaters.
- 12. All the panels shall have cooling fans mounted on the top and having suction through filters.
- 13. LT motors shall have the design basis as mentioned below.
 - i. Insulation class - F
 - ii. Temp rise class - B
 - iii. Service factor - 1.15
 - iv. Ambient temp. - 50 deg. C
 - v. Voltage - 415volt+/10%.
 - vi. Frequency - 50+/-5%
 - vii. Painting - Anti corrosive

14. Based upon the above details and subsequent discussions held with the panel manufacturer and GGEGC, following documents shall be submitted to IGL for approval within 15 days of contract finalization:

- GA drgs.
- Schematic wiring diagrams with tag nos. of wires.
- Bill of material and make of components with rated capacity.
- Write up on KW mode & speed mode operation.
- Relay coordination & settings.
- Single line diagrams.

- **STG set shall run in parallel with the similar kind of Generators or with Grid Power. Therefore the control logic shall be developed accordingly through required selector switches etc.**
- **Total detailed engineering including compatibility with existing system shall be in GGEGC scope.**

TURBINE CONTROL PANEL

Turbine control panel shall house the following:

- Electronic governor with keyed-in operating program
- Condenser hot well level indicator cum controller
- Relay based hard wired turbine safety interlocks and trip logic
- Remote controls comprising of selector switches, ammeters, push buttons & indicating lamps for:
 - AOP motor
 - EOP motor
 - CEP-1 & 2 motors
 - Barring gear motor– to be confirmed
 - Gland condenser extraction fan
 - Vapor extractor motor
- Push buttons for turbine speed raise and lower
- Turbine remote trip/reset push buttons
- Temperature scanner for indicating for Monitoring turbine and gearbox bearing temperature
- Alarm annunciator for Turbine fault monitoring with 20 % spare windows.
- The panel shall be complete with AC supply & DC supply on /off control switches, indicating lamps.

TURBINE GAUGE PANEL

Turbine gauge panel shall house the following gauges:

- Pressure gauges for:
 - Inlet steam
 - HP Wheel case
 - Extraction steam
 - Exhaust steam
 - Lube oil
 - Control oil
- **Temperature gauges for:**
 - Inlet steam
 - Extraction steam

GENERAL SPECIFICATIONS OF INSTRUMENTS

- **Pressure and Temperature Gauges (Make ASHROFF / Nagona / U S Gauges)**
 - Dial : 150 mm circular
 - Scale : 270 Deg. arc with black pointer
 - Type : Bourdon (pressure gauge)
Mercury in steel (temperature gauge)
 - Accuracy : +/- 1 %
 - Over range protection : 125 %
 - Accessories : Shatter proof safety glass
- **Pressure Switch (Make Emmerson / Yokogawa / United Electric control)**
 - Sensor type : Bellows
 - Material of case : Die cast aluminium
 - Material of bellows : SS-316
- **Pressure Transmitter (make Emmerson / Yokogawa)**
 - Type : 2 wire, capacitance & electronic (Make Yokogawa / Emmerson)
 - Input : Direct
 - Output : 4 – 20 mA
 - Material for process connection internals : SS-316
- **Resistance Temperature Detectors (Make MINCO)**
 - Element type : PT-100, 3 wire
- **Solenoid Valve**
 - Power supply : 110 V DC
 - Operation : De-energise to open
 - Type : 2 way, universal ports
- **Level Switch (Magnetroil)**
 - Type : Magnetic float
 - Material of body & float : AISI-304
 - Material of case : Die cast Aluminum
- **Level Transmitter**
 - Type : DP transmitter
(2 wire, capacitance & electronic)
 - Input : 0 to 750 mm WC
 - Output : 4 – 20 mA
 - Material for process connection internals : SS-316
- **Level Control Valve (Make Fisher)**
 - Type : Single seat and globe
 - End connection : Flanged
 - Actuator type : Pneumatic diaphragm with spring
 - Packing material : PTFE
 - Plug characteristic : Equal percentage
 - Plug material : SS-316+Stellited
 - Seat ring material : SS-316+Stellited
 - Diaphragm material : Neoprene rubber

- | | | |
|---------------|---|--|
| Stem material | : | AISI-304 |
| Yoke material | : | Cast steel |
| Action | : | Air to close (Re-circulation line)
Air to open (By-pass line) |
| Accessory | : | Positioner
Air lock-up relay |
- **Level Indicating Cum Controller (Make Yokogawa / Honeywell)**

Type	:	PID Control
Input	:	4 – 20 mA
Output	:	4 – 20 mA
Input & output display	:	Digital bar graph
Power supply	:	230 V, AC, Single phase
 - **Current to Pneumatic Converter (make ABB / Moore)**

Supply	:	Air at 1.5 Kg/cm ² g
Input	:	4 – 20 mA
Output	:	0.2 to 1.0 Kg/cm ² g (air)
Enclosure	:	Die-cast aluminum alloy body
Accessory	:	Pressure gauges for supply & output
 - **Temperature Scanner (Make Honeywell / Masi Bus)**

Power supply	:	230 V, AC, Single phase
Input	:	PT-100, 3 wire RTD
Display	:	Channel No. & bearing / winding temperature
Display mode	:	Auto / Manual
Scan rate	:	Programmable
Accuracy	:	+/- 1 Deg.C
 - **Alarm Annunciator (Make Ronan / Toyo Electric)**

Type	:	Modular, plug-in cards, interchangeable with 20% spare window
Input protection	:	Optical isolation provided through up to couplers
Colour of window	:	Milky white (pre-trip alarm) Red (Trip alarm)
Power supply	:	110 V DC
Fault initiation	:	Make to alarm
Accessories	:	Electronic hooter and Push buttons for Test, Acknowledge & Reset
 - **Air Filter Regulator (Make SHAVO / NORGREL)**

Filter element	:	5 microns
Element material	:	Sintered bronze
Body material	:	Cast aluminum

CONTROL & INSTRUMENTATION

The following field instruments will be provided on the equipments

TURBINE

- Dial type pressure gauges for
 - (a) MOP , AOP & EOP discharge
 - (b) Gland Steam Header
Gland Steam return lines

- Dial type diff. Pressure indicator with switch for monitoring DP across lubrication oil filters
- Pressure Switches for:
 - (a) Lube oil pressure very low trip & alarm
 - (b) Control Oil pressure low alarm
 - (c) AOP auto cut-in & cut out
 - (d) EOP auto cut-in & cut out
 - (e) Transparent Level Gauge for Oil Tank
- Dial type temperature gauges for
 - (a) Gear box bearing oil
 - (b) Oil cooler inlet & outlet
- RTD's for
 - (a) Turbine bearing oil
 - (b) Gearbox bearing oil

CONDENSING SYSTEM

- Condenser hot well level control system complete with :
 - Level Transmitter
 - Level Indicator cum controller
- Control Valves
- I to P converters
- Air filter regulators
- Dial Pressure gauges for
 - CEP discharge
 - Motive water to ejector
 - Condensate vapour to ejector
- Pressure switches for
 - Condensate header pressure control & CEP auto-start interlock
 - Condenser pressure high trip and alarm
- Dial type temperature gauges for
 - Condensate after hot well
 - Condensate after inter/after condenser of ejectors (prefer water ejector)
 - Transparent level gauges for condenser hot well
- Level Switches for :
 - Condenser hot well level low alarm and CEP dry run interlock
 - Condenser hot well level high alarm
 - Pneumatic and impulse piping with fittings for interconnection within battery limits

GENERATOR

- a) Dial type pressure gauge for lube oil – one only at pipe line of lube oil at generator
 - Dial type temperature gauges for
- b) Bearing oil – 1 per bearing
 - Hot air & cold air – at Inlet and out let
 - Temperature sensors for :
- c) Winding temperature (embedded RTDs) – 4 per phase
 - Bearing oil temperature (duplex RTD) – 1 per bearing
 - Hot air & cold air – 1 each per collar

- d) Temperature scanner to monitor Generator winding and bearing oil temperature– same as control panel

PLC BASED FOLLOWING INSTRUMENTS:

- e) Inlet pressure and temperature Transmitter
- f) Exhaust Pressure & Temp. Transmitter
- g) Control Oil pressure Transmitter
- h) Lube oil Pressure and Temp. Transmitter

FULL TRAIN VIBRATION MONITORING SYSTEM – (Bently Nevada 16 points, Model : 3500 Series with Redundant Power Supply)

- Locally mounted CW instruments

TURBINE CONTROL PANEL

- (f) TC panel shall house electronic governor , alarm annunciator for turbine faults, temperature scanner for turbine and gear box bearing temperature monitoring , remote controls for all auxiliary motors of turbine (AOP, EOP and barring gear), condenser hot well level controls, turbine safety interlocks & trip logic and turbine speed controls (push buttons)
- (g) The control panel shall have PLC.

TURBINE GAUGE PANEL

- (h) TG panel shall house the pressure and temperature gauges for various operating parameters, speed indicator and speed raise and lower push buttons for turbine. Impulse piping with fittings shall be supplied loose for interconnection between field tap-off points and gauge panel.

Local Push Buttons Stations

- Local Control stations with on/off buttons for :
- AOP 1 & 2 motors
- EOP motor
- CEP –1 &2 motors
- Barring Gear motor
- Vapour extractor motor
- Water ejector pumps

PLC

- a) The PLC system should be provided of Rockwell Automation (Model : Control Logix 5555 with Flex I/Os) having **RS VIEW** man machine interface system having PC operating stations (2 nos.) and one engineering station having interchangeability for either.
- b) The above system should have following configuration:
 - The details of PC as operator and engineering station.
 - The PC should be of **DELL** make, server grade having redundancy levels in power supply (SMPS), RAM having memory of 1 GB (combo drive) and hard disc should be 3 nos. having hard disc redundancy (1 + 2) called as **RAID**.
 - The screen of PC should be 21 or 24 inch size.
 - The PLC should have redundancy levels in power supply, processor level and communication levels mounted on separate chassis having hot change over during fault in PLC to the other without any disturbance or trip.
 - The PLC should have 20% spare IO cards and should have minimum 30 graphics.

- The PLC should give the trends for 100 to 200 mili sec.
- The above system should be provided with adequate printing system for trends and events.

Misc. Instrumentation points

- Spares Seals & Gasket – Min 2 sets to be supplied as commissioning spares for the steam control valve, control valve, bearing temp. sensors – min 1 of each type. vibration and speed probes – min 1 each type
 - Instrument Cables- specification Armoured type , FRLS double compression type
 - Field JB and instruments will be whether proof to IP –65 type
 - Pressure transmitter –specifications is ex-proof housing and digital LCD display
 - Interface with MCC signals shall be through interposing relays for discrete signals and through serial isolators for analog signals.
 - 2 out of 3 logic for all trips. In addition separate pre alarm for all trips
 - 2 way / 3 way valve manifold for transmitters/ Gauges
- **Following trips to have indication on PLC & annunciator panel**
 - Axial displacement of Turbine
 - Radial displacement of Turbine
 - Over Speed (mechanical & Electronic over speed)
 - Low lube oil pressure
 - Low control oil pressure
 - High (condenser) exhaust pressure
 - Manual trip (mechanical)
 - Emergency buttons
 - Trip due to various alternator faults
 - Live steam pressure low
 - Live steam temperature low
 - Bearing temperature high
- **Monitoring and alarm parameters –**
 - Low lube oil sump level
 - Hot well level low and high
 - All motor status (running / installed) on PLC and annunciator panel
 - Lube oil temperature high
 - Extraction Pressure Low
 - All pre trip alarms
 - Electrical related alarms
 - Turbine exhaust temperature high
 - Cooling water pressure low
 - Lube oil filter differential pressure
 - Instrument air pressure low
 - Condensate water temperature high indication
 - Low lube oil pressure
 - Low control oil pressure

MISC. SCOPE:

1. All foundation bolts, base frames, chalk plates, shims, jack bolts, levelers and sole plates etc. required for erection & alignment of equipments in vendor's scope.
2. Operation & maint. Manuals – 6 sets in hard copies and 2 sets in soft of each item.

3. One set of commissioning spares including all type of fuses, indication lamps, overload relays and contactors along with total supply of STG & bought out items of your sub vendor.
4. 2 years operational and consumable spares.
5. All types of expansion bellows at inlet / outlet of turbine / generator connections for steam / water / oil / air etc. where ever necessary.
6. All impulse tubing to be of SS 304.
7. All the companion flanges for the equipments being supplied to be in vendor's scope.
8. All the utilities i.e. auxiliary power, control power, cooling water, instrument air etc. to be specified.
9. All panels to have exhaust fans for air circulation / cooling.