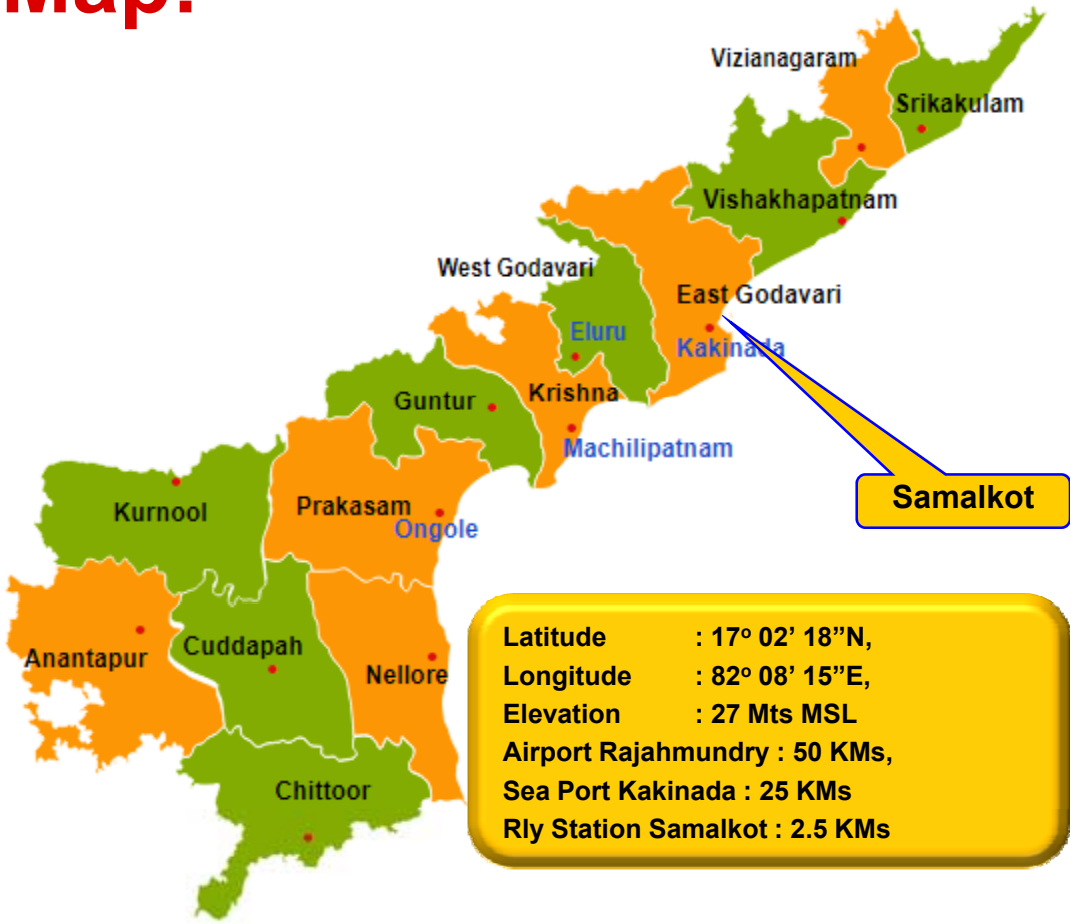
- Project Location
- Project Configuration
- Main Plant & Auxiliaries
- Preservation Process
- Photographs

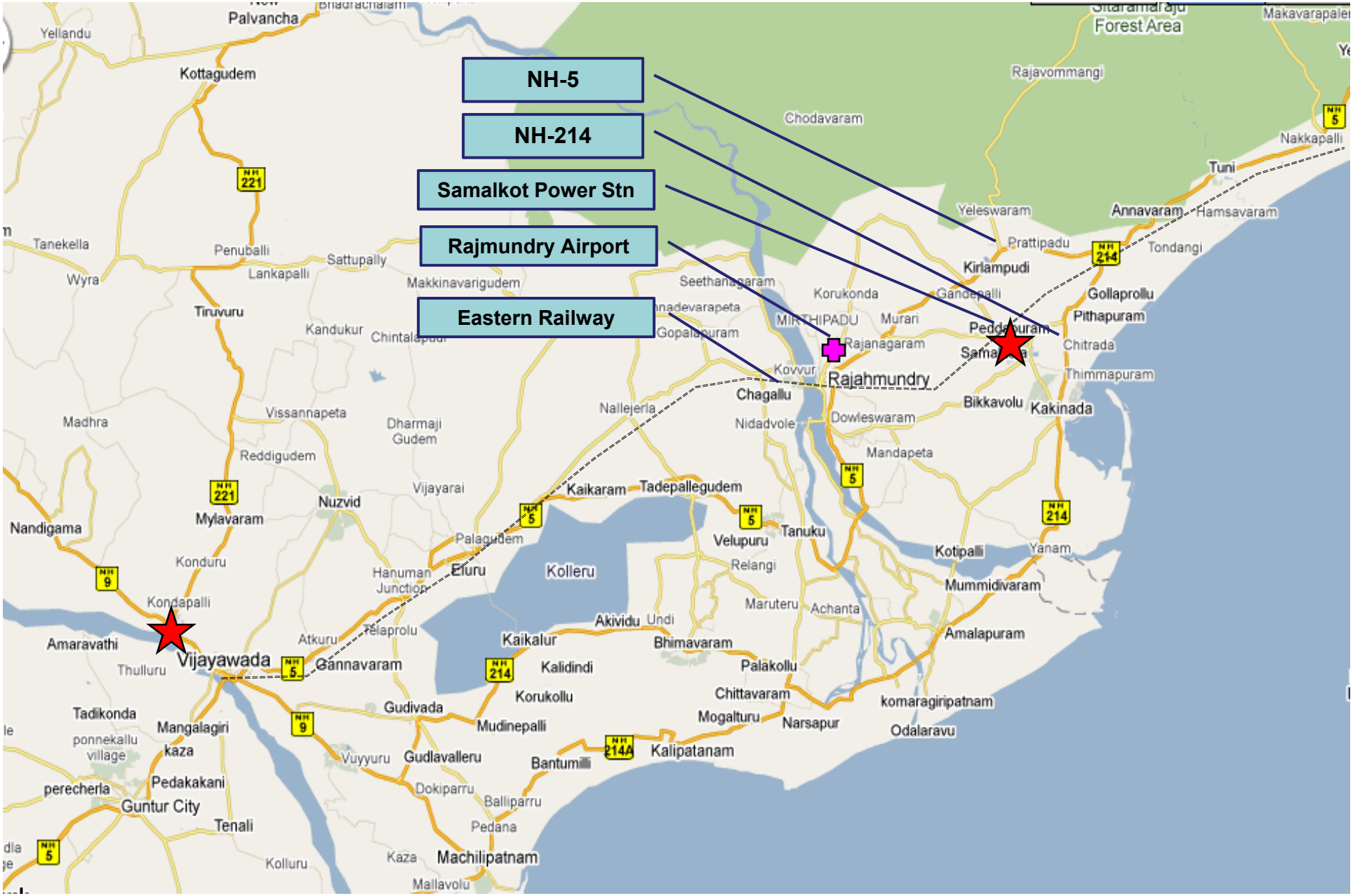
Location Map:



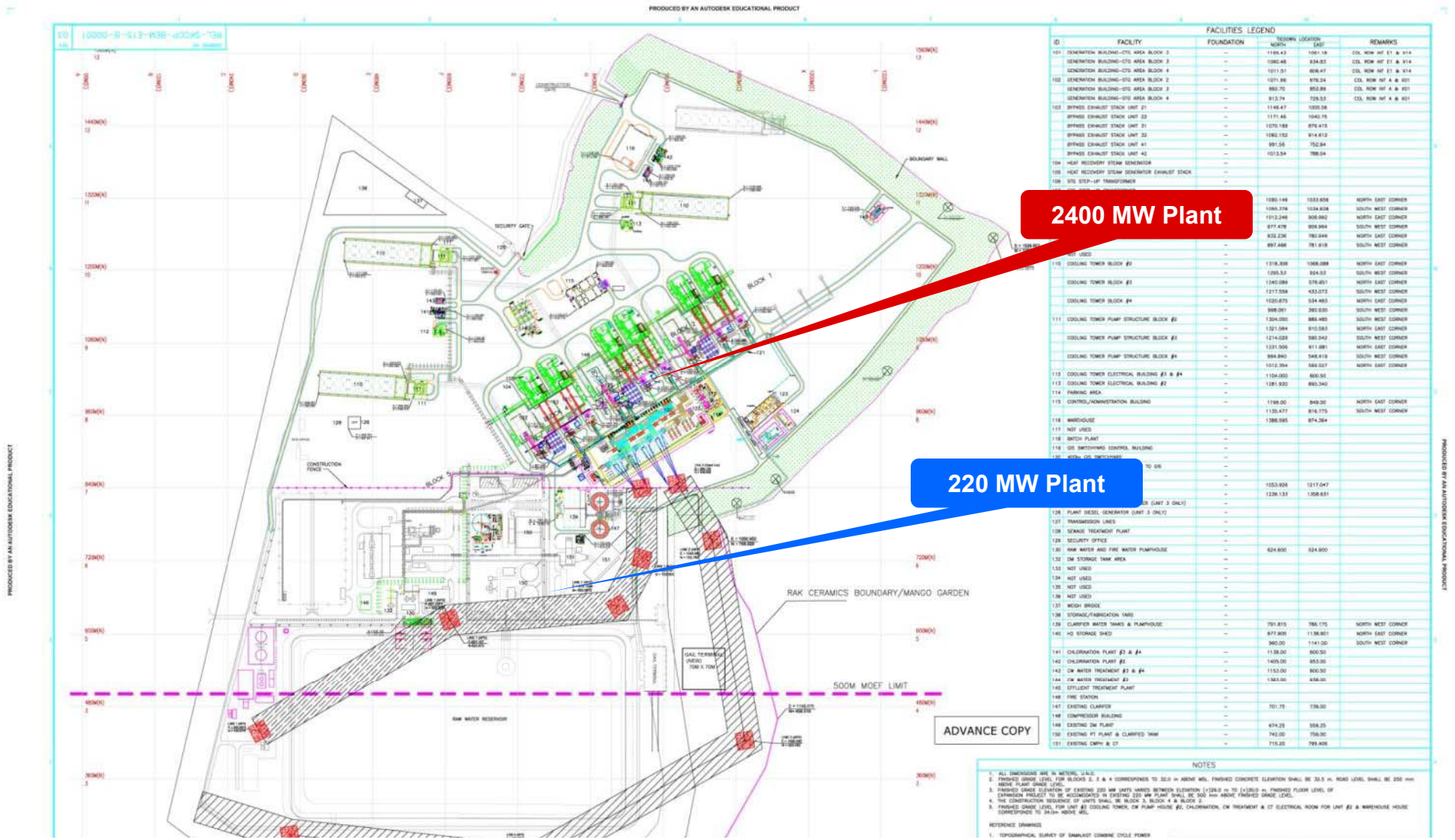
Latitude : 17º 02' 18"N,
Longitude : 82º 08' 15"E,
Elevation : 27 Mts MSL
Airport Rajahmundry : 50 KMs,
Sea Port Kakinada : 25 KMs
Rly Station Samalkot : 2.5 KMs

Andhra Pradesh

Samalkot: Vicinity Map



Samalkot: Layout Plan



Reliance Samalkot

The Project Consists of Three Modules of Combined Cycle Power Generation

Each Module consists of Two Gas turbines – GE 9FA +e USA and

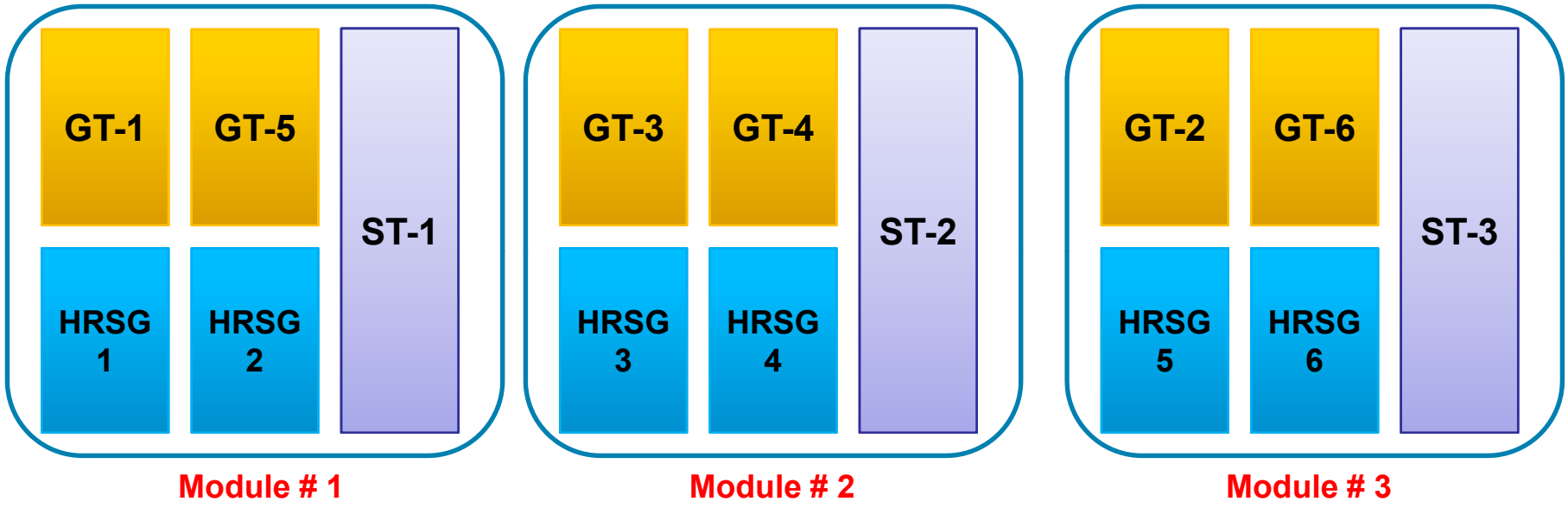
One Steam Turbine – GE D11, two Triple pressure HRSG -CMI USA

Four Gas Turbine Generators Commissioned in Open Cycle, ST & Generators are at Kakinada Sea Port Ltd

Station Configuration

Samalkot Project: Configuration

400 KV Gas Insulated Switch Yard : Common

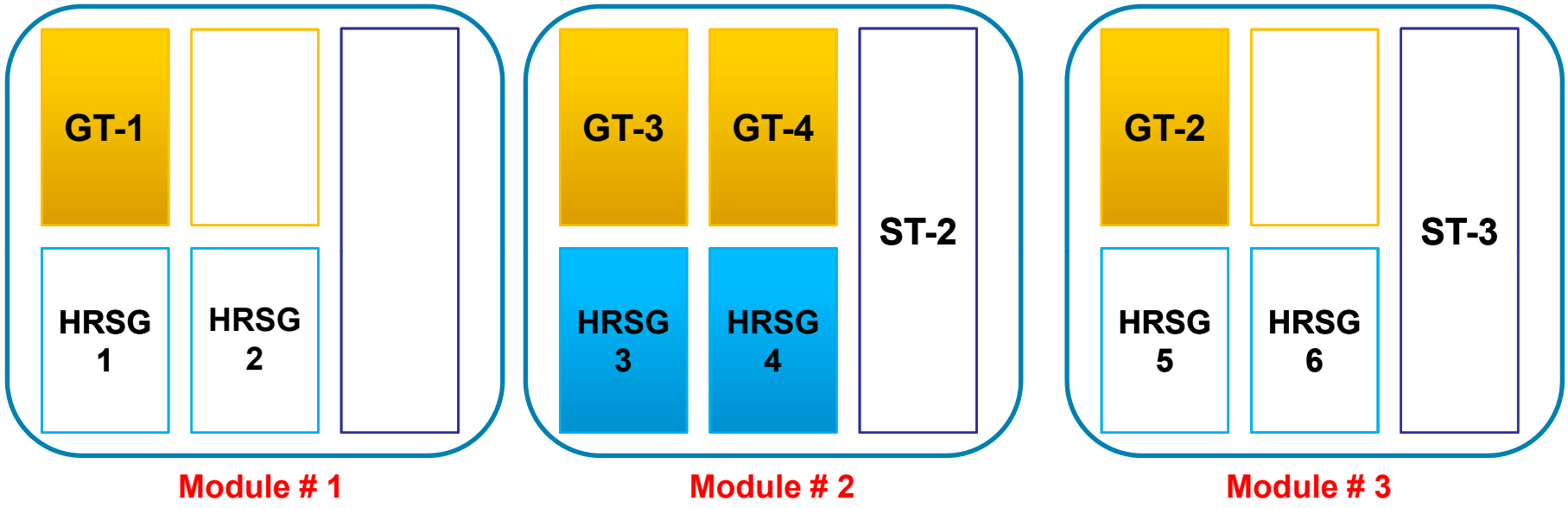


Balance of Plant : Common

Total Plant Consist of 3 Module of identical configuration

Samalkot Project: Configuration

400 KV Gas Insulated Switch Yard : Common



Balance of Plant : Common

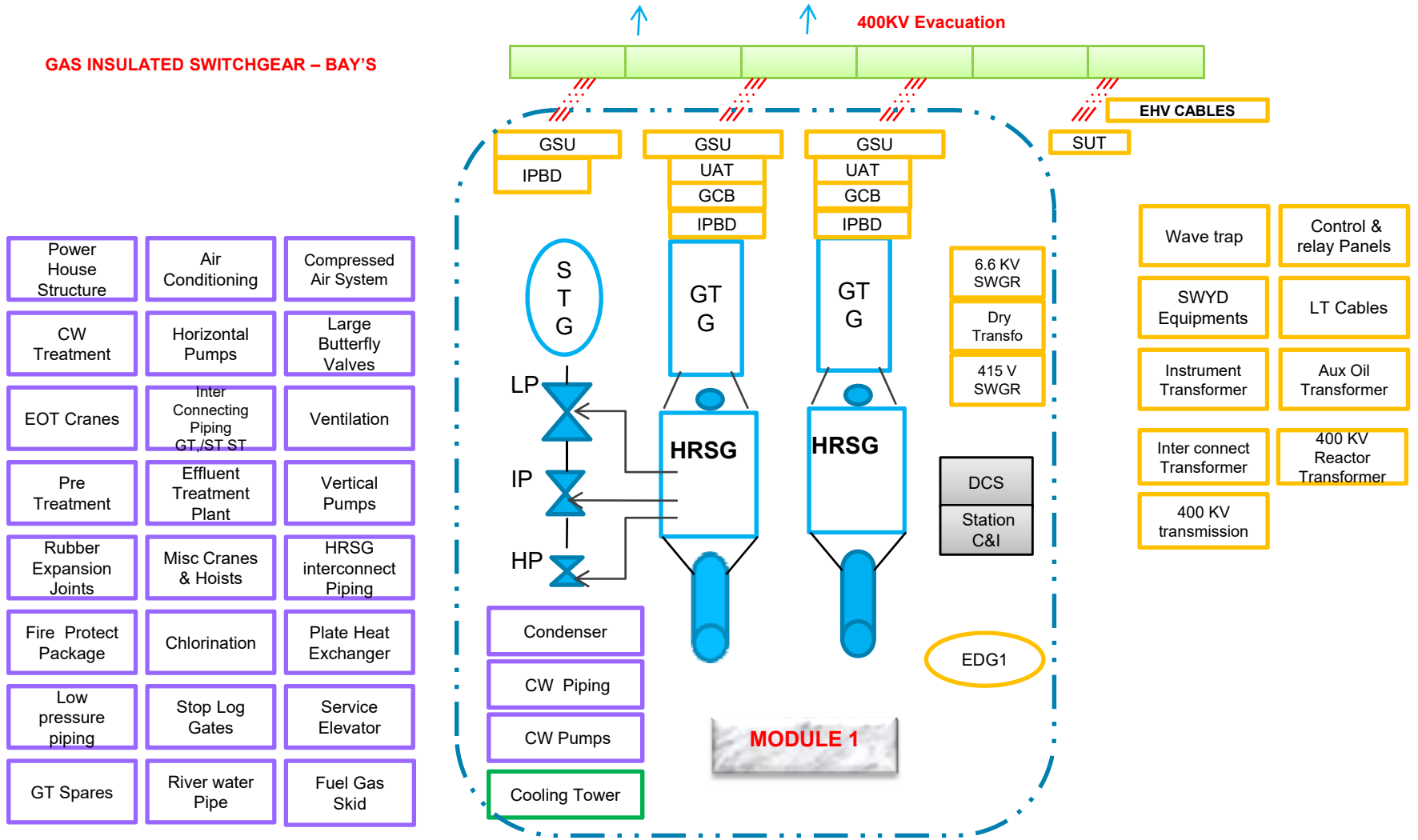
COLOUR FILLED ARE ERECTED EQUIPMENTS

Plant & Auxiliaries

Major Equipment: Specification

Main Equipment	Supplier	Specification
Gas Turbine (GT)	GE, USA	GE 9F.03, DLN2+
Heat Recovery Steam Generators (HRSG)	CMI, Belgium	Triple pressure, 3 drum, Natural Circulation boiler
Steam Turbine(ST)	GE USA	D11 Steam turbine
Condenser	HBG China	De aerating Surface condenser, 2 Pass
Cooling Tower	Hamon, Belgium	IDCT, FRP construction
GIS Switchyard	Xian, China	400KV, SF6 Gas Insulated, Outdoor
Generator Transformers	Hyundai , Korea	TL2049/B21; Outdoor
Dry Type Transformer	QRE, China	Distribution, Indoor
Circuit Breakers	ABB, Sweden	SF6 Gas filled. Indoor.
Plant DCS	Honeywell, India	Experian PKS Indoor
EHV Cables	SFC	400KV, YJLW02; XLPE;

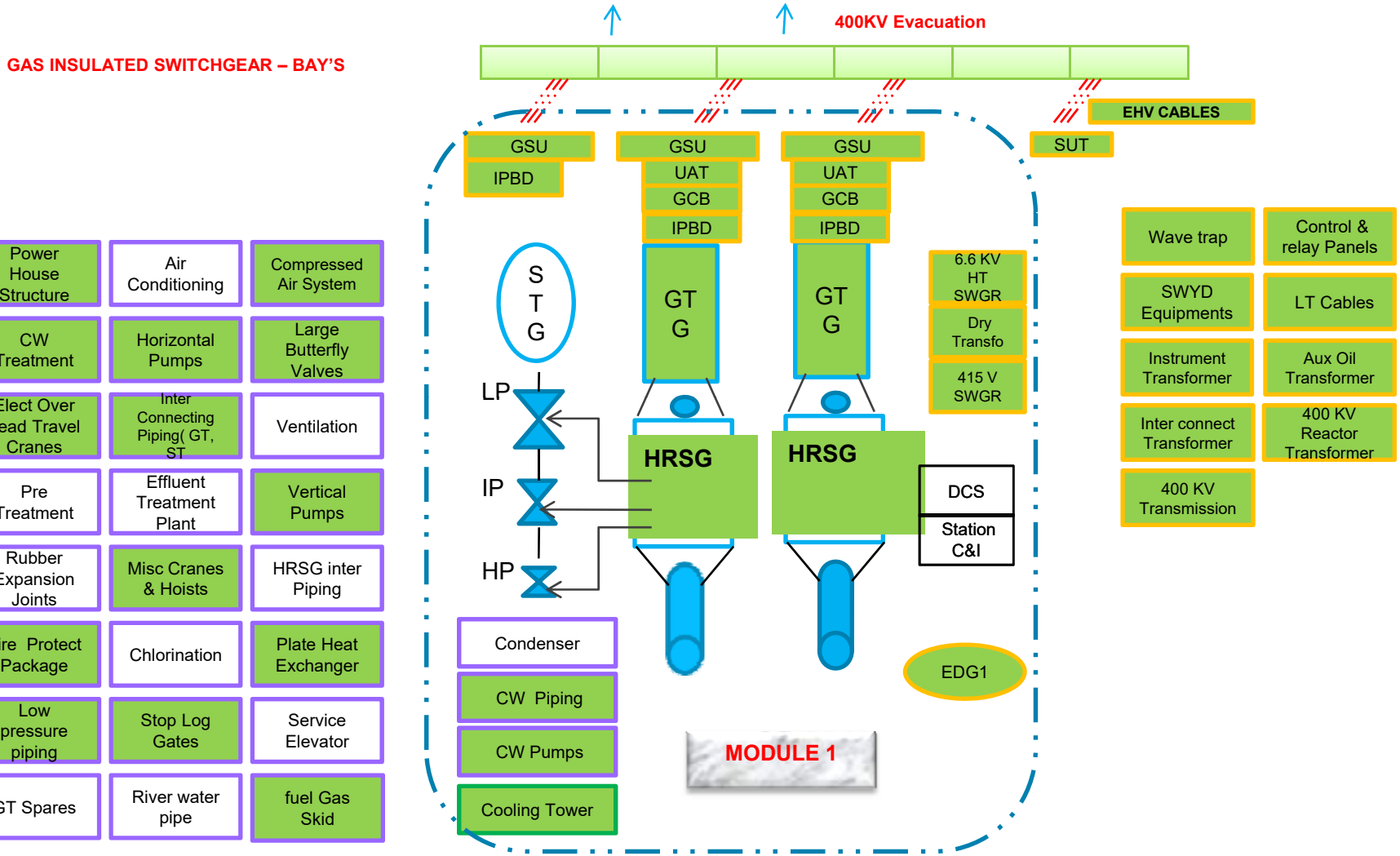
TYPICAL MODULE 2 GTG X 1 STG



Cell Border : Orange – Electrical Packages ; Purple – Mechanical Packages ;

GSU-Generator Step up Transformer; UAT- Unit Auxiliary Transformer ; GCB- Generator Circuit Breaker; IPBD : Isolated Phase bus Duct

TYPICAL MODULE 2 GTG X 1 STG



Cell Border : Orange – Electrical Packages ; Purple – Mechanical Packages ; Cell filled : Green are Partial / full erected packages

GSU-Generator Step up Transformer; UAT- Unit Auxiliary Transformer ; GCB- Generator Circuit Breaker; IPBD : Isolated Phase bus Duct

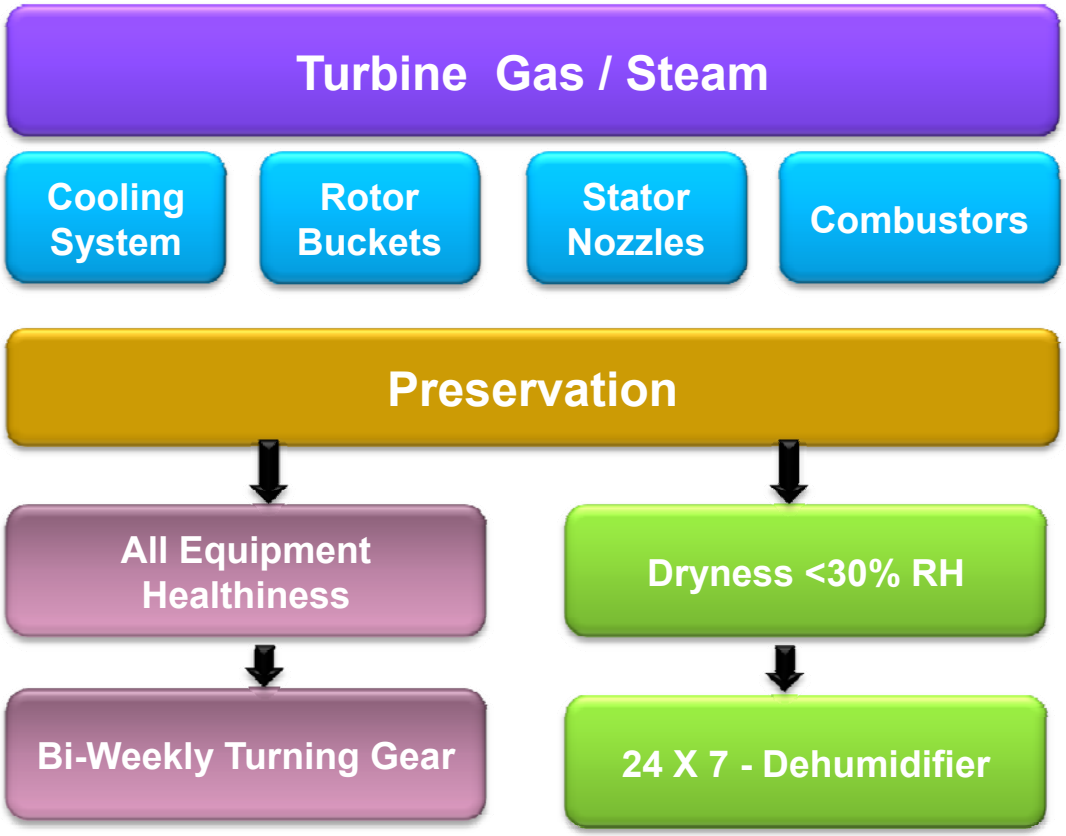
Preservation Methodology

Preservation : Methodology

- OEM Guide lines Referred & Customized to meet site requirement
- Best Industrial Practices in Industry
- Daily , Weekly, Monthly, Quarterly & Yearly Schedules – Preventive and Predictive Operation & Maintenance Checks
- Stringent adherence to SAFETY, at all works. Maintaining ZERO accident record from inception

Preservation: Capital Equipments

1. *Dehumidifier Placed on Capital Equipments*
2. *Turning Gear Operated as per OEM Guideline*



OEM Recommended: Best Practices

Air Intake System

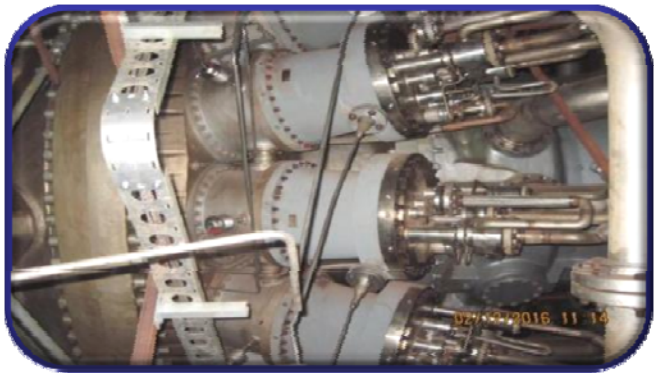
- Tarpaulin covered
- corrugated sheets on Drift Eliminator
- Pulse cleaning & Inspected monthly

Exhaust System

- bypass Stack Capped
- Monitored for Rain Water
- Inspected monthly

Lube Oil System

- Every 6 Months 48 hrs Filtration
- Offline NAS 5 maintained
- GT pumps operated



GT Turning

- Bi –Weekly One hour
- Parameters recorded
- Reported to GE

All Pipe Lines

- N2 Filling Pressure 5~50 psig
- Blinds placed Combustors
- Blinds + N2 fill Purge is Maintain

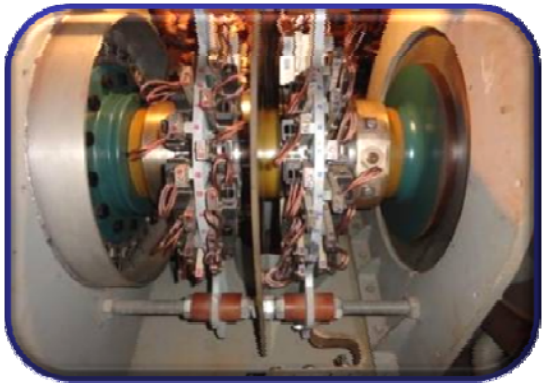
Ventilation System

- Bi-Weekly 10mins Operation-12 fans per GT
- every 3 Months Vibration Record
- Reported to GE

OEM Recommended: Best Practices

- **Generator**
  - Space heater is always ON
  - IR & PI Recording
  - Coolers Charged with N2~ 5 psig
- **Generator H2 & Co2 Systems**
  - H2 & Co2 Isolated
  - Operation & purge Bi-weekly with Dry Instrument air
  - Instrument air
- **400 KV GIS**
  - All Bays SF6 gas pressure checking.
  - Monthly operation of CB, Isolator & ES
  - Records of Operation & PM

- **6.6 KV Switchboard 415 V PMCC**
  - Annualized
  - Inspection & Cleaning
  - Operation of change over Checks
- **Emergency Diesel Gen Set**
  - Trial Operation
  - Black out test ~ 6 monthly
  - Weekly Log of Battery & Preventive Maint.
- **LCI & Exciter package**
  - LCI Cooling water sys in service
  - Resistivity Monitoring
  - Daily Log /pump change over



OEM Recommended : Best Practices

- **Pneumatic Systems**
  - Fort Nightly Checks
  - Preventive Maintenance
  - Stroke Check Record s
- **Hydraulic Systems**
  - Fort Nightly Checks
  - Preventive Maintenance
  - Stroke Check Records
- **Mark Vie**
  - Kept in service
  - Preventive Maintenance
  - Checked Daily Alarm Back up

- **Servers & NW System**
  - Monthly Checking
  - Preventive Maintenance
  - Record
- **Fire Fighting**
  - Liquid Co2 & Fire Water
  - Deluge Spray check ~ 6 monthly
  - Fire Drill & Record
- **All Instruments**
  - Operation cross checks
  - Preventive Maintenance
  - Records

Statutory & other Compliance:

- **Environment**
  - Statutory
  - Ambient air & Emissions
  - Reports to authorities
- **Explosive**
  - PESO License
  - Liquid CO2
  - Daily Records
- **Safety**
  - PTW System
  - Fire protection
  - Daily Record
- **LIE**
  - Periodic Inspection
  - Suggestions
  - Reports to authorities
- **Electrical**
  - CEIG
  - Inspection
  - Compliance Records
- **BoCW**
  - Labor license
  - Checks
  - Regular Record

Preservation : of Static Equipments

- **All Equipment Covered & Repacked: Replenished periodically**
  - ✓ STG, HP/IP & LP turbine covered with sea worthy packing & refurbished periodically.
  - ✓ All Critical auxiliaries were stored at ware house.
  - ✓ Over size cargo was covered with UV treated water proof tarpaulins to safe guard against rust, dust & moisture ingress.
  - ✓ Adequate dosage of desiccant & VCI compound pouches were used to control humidity & corrosion.
- **Antirust Application: on machined surface**
  - ✓ Outer surface of Machined & threaded surfaces is painted with a thin film of corrosion preventative compound or light oil/grease.
  - ✓ Inner surfaces like tube bundles, Drums, Power cycle piping's etc. were fogged with VCI rust inhibitor & desiccant to control the humidity level & minimize corrosion.
- **Preventive Maintenance: Rotating equipment**
  - ✓ Rotating equipment bearing journals, shafts was lubricated & rotated intermittently as per OEM.
  - ✓ Electrical and C&I Equipment: Transformers, HT Motors & control panel's temp & humidity was maintained with the help of heaters & desiccant as per OEM recommendation.

Respective OEM Manuals Referred & Accordingly Preservation Program was Custom tailored to suit Independent Equipments.

Preservation : Un erected equipment

GT & HRSG Auxiliaries Stored in Containers
Non critical equipments stored outdoor covered with UV treated tarpaulin

Preservation : Erected but not commissioned

Accessory Module & Exciter Compartments

Erected but Not commissioned equipment preserved as is condition

Preservation : Erected but not commissioned

By pass stack blanking GT & HRSG End

By pass stack blanking from top

Preservation : BOP Auxiliaries

All the Rotating & Electrical equipments Preserved in Closed Ware house
Rotating equipments being rotated Periodically

Preservation : Electrical Equipments

Critical Motors Space heater charged

Electrical Panels in Charged Cond.

Non commissioned GSU filled with Oil & Under preservation

Preservation : Capital equipment at KSPL

GT, ST & Generators were packed with Multi layered UV treated HDPE VCI tarpaulin along with VCI Powder & Silica gel kept inside, Tarpaulin being Replaced periodically

Site Photographs

Site Photographs : Module # 3

Site Photographs : Module # 3

Site Photographs : Module#2

Site Photographs : 400KV GIS

MAJOR EQUIPMENT DETAILS

Gas Turbine

- Make : General Electric, USA
- Model : PG 9351 FA.03
- Fuel : Natural Gas
- Combustion : Dry Low NOx DLN 2.0+
- Compressor Stage : 18
- Turbine Stage : 3
- Operating Speed : 3000 RPM
- Trip Speed : 3300 RPM
- Starting Means : Static Start
- Air Filtration : Self Cleaning
- Inlet Air Cooling : Evaporative Cooler On/Off condition
- Compressor Cleaning : Offline / Online
- Enclosure : Indoor
- Cooling : Closed Loop
- Nox Emissions :Gas Fuel , 25 ppm ref 15% O2

GT Generator

Manufacturer	: GE
Type	: 324 LU
Prime Mover	: GT 9FA
Cooling Method	: Hydrogen cooled.
Rated Capacity	: 310.725 MVA
Rated Terminal Voltage	: 15.75 kV
Rated stator current	: 11390 A
Rated power factor	: 0.85(lag), capability to 0.95 (lead)
Rated Speed	: 3000 rpm
Rated Frequency	: 50Hz
No. of phase / Connection	: 3 / Wye
Short Circuit Ratio (SCR)	: 0.53
Excitation	:Static Bus Fed EX2100
Terminal Enclosure	: On Top
Seal Oil System	:Scavenging Design

Heat Recovery Steam Generator

- Make : CMI EPTI, USA
- Type : Horizontal, Natural Circulation, Triple Pressure

Parameters	HP	Reheater	IP	IP isolatable Economizer	LP	LP isolatable Economizer
Max. Allowable Working Pressure (Kg/cm2)	149.8	32.8	38.2	76.6	10.2	43.2
Heating Surface Area (m2)	153446	21122	33444	153446	38609	153446
Max Steaming Capacity (Kg/h)	292500	326500	50000	7853	38700	82580

HP/IP Boiler Feed Pump & Motor

- Make : Torishima
- Type & Size : MHB 5/11
- Speed : Variable Speed (nominal 2979 rpm)
- Capacity :352.9 m3/h
- Design Pressure (bar A): : Extraction: 88.4 ; Discharge:247.6
- Hydraulic Balancing :Piston
  - Casing Type / Mount : Diffuser / Centerline
- External Casing : Barrel
- Coupling : Voith

- Motor :
- Make : TECO Taiwan
- Type : AEZW , 6.6KV , 50Hz, 3 Ph
- Method of Starting : DOL
- Frame Size : 450E
- Driver :2700 kW
- Degree of Protection of Enclosure : IP55
- Stator :Wye

Condenser Extraction Pump & Motor

- Make : Torishima
- Type & Size : MMTV 250/5
- Total Head : 295.6 m
- Speed :1485 rpm
- Capacity :949.3 m3/h

Motor :

- Make : TECO Taiwan
- Type : AEHC , 6.6KV , 50Hz, 3 Ph
- Method of Starting : DOL
- Frame Size :500 C
- Driver :1060 kW
- Degree of Protection of Enclosure : IP55
- Stator :Wye

CW Pump & Motor

- Make : WPIL
- Type : Mixed flow non pull out
- Model :VT 49-72
- Total Head : 24 MWC
- Speed :424 rpm
- Capacity :23500 m3/h

Motor :

- Make : CGL
- Type : Squirrel Cage , 6.6KV , 50Hz, 3 Ph
- Method of Starting : DOL
- Frame Size : VTPC 1700
- Driver : 2100 kW
- Degree of Protection of Enclosure : IP55
- Stator :Wye

Steam Turbine

- Make : GE
- Model : D11
- Type : TC-Down flow
- Rated Speed : 3000 rpm
- HP Steam Inlet : 127 Kg/ Cm2 , 566 deg C
- LP Stage Bucket Length : 850.9 mm (33.5 inch)
- Exhaust flow : Down
- Total no of stages
  - High Pressure :10
  - Intermediate Pressure : 8
  - Low Pressure : 5
  - Number of Casings : 2

ST Generator

Manufacturer	: GE
Type	: 324H
Prime Mover	: D11
Cooling Method	: Hydrogen cooled
Rated Capacity	: 324.760 MVA
Rated Terminal Voltage	: 15.75 kV
Rated stator current	: 11904 A
Rated power factor	: 0.85(lag), capability to 0.95 (lead)
Rated Speed	: 3000 rpm
Rated Frequency	: 50Hz
No. of phase / Connection	: 3 / Wye
Excitation	: Static
Terminal Enclosure	: Bottom

Excitation – GTG & STG

- Type : Static Excitation System
- Model : EX2100

- **Static Excitation Transformer**
- Type : Oil filled
- Power Rating : 2500 kVA
- No-Load Voltage (HV/LV) : 6600/900 V
- Rated Current (HV/LV) : 219/1604 Amps
- No Of Phases : 3
- Frequency : 50 Hz

Static Starting System for GT Units

Load Commutated Inverter (LCI)

- Make / Model No. : LS2100
- Power Rating : 14MVA
- Input Voltage : 2080 Vrms
- Input Frequency : 50Hz

Isolation Transformer (LCI Transformer)

- Type : Oil filled
- Power Rating(HV/LV1/LV2) : 7/3.5/3.5 MVA
- No-Load Voltage (HV/LV1/LV2) : 6600/2080/2080 V
- Rated Current (HV/LV1/LV2) : 612/972/972 Amps
- No Of Phases : 3
- Frequency : 50 Hz

Generator Circuit Breaker

- Make : ABB
- Type : SF6
- Model No. : HECS-1OOL Plus
- Quantity : 2 No’s
- Service : Indoor
- Rated Voltage : 25.3 KV
- Rated Frequency : 50 Hz
- Rated Continuous current : 13,000 A
- Rated Duty Cycle : CO-30Min-CO
- Number of trip coils : 2
- Interrupting medium : SF6

Generator Bus Duct

- Type : Isolated phase, continuous
- Service : Indoor / Outdoor
- Rated Voltage : 17.5 KV
- Current rating
  - Main run : 13000 A
  - Tap off run : 1300 A
- Conductor : Aluminum alloy
- Enclosure : Aluminum
- Type of cooling : Air natural

Generator Step up Transformer

- Make : Hyundai
- Type : Oil Filled
- Type of Cooling : ODAF/ONAF/ONAN
- Rated Output : 335/268/201 MVA
- Rated Voltage- HV/LV : 420 / 15.75 kV
- No of Phases : 3
- Frequency : 50Hz

Unit Auxiliary Transformer

Make	: Areva
Type	: Oil Filled
Type of Cooling	: ONAF/ONAN
Rated Output	: 31.5/25 MVA
Rated Voltage- HV/LV	: 15.75 / 6.9 KV
Rated Current HV/LV	: 1154.7A /2635.7A
No of Phases	: 3
Frequency	: 50Hz

Condenser

- Manufacturer : HBG
- Type : Non Deaerating surface- two pass
- No. of passes on tube side : 2
- Size : 23800 m2
- Source of Water : Cooling Water
- Cooling Water Flow Rate : 42849 m3/h
- Shell material : SA 516 Gr. 71
- Tube material : SA249 TP 304
- Tube size :25.4 mm OD (0.7 mm thick)
- No. of Tubes : 11600
- Condensate Flow :732 tph

Cooling Tower

- Make : Hamon
- Type of Fill : Splash type
- Nos. of Cells per tower : 18
- Cell Dimensions : 15.75 m x 15.75 m
- Fill Height : 5.6 m
- Fan Diameter : 9144mm
  - **Cooling Tower Gear Box**
    - Make : SUMITMO Heavy Industries
    - Model No. : YVD050R2-RRFB-11.375
    - No of Gear Box : 18 No's
    - High Rotation Speed : 1480 RPM
    - Low Rotation Speed : 130.1 RPM
    - Drive Motor :
      - Make : WEG Industria SA
      - Type : Sq. Cage Induction
      - Model : 280 S/M
      - Rated output, KW : 75
      - Voltage/Phase/Freq : 415V/3Ph/50 Hz/ 125 A
      - Insulation Class : Class F
      - Speed, RPM : 1480

Fire Protection & Detection System

S.NO	Parameter	Hydrant Pump	Spray Pump	Jockey Pump
1	Number of pumps	3	2	2
2	Number of pumps Working / standby	2W + 1S	1W + 1S	1W + 1S
3	Type of drives			
3.1	Motor driven	2	1	2
3.2	Diesel engine driven	1	1	NA

Reserve Auxiliary Transformer (RAT or SUT)

Make	: Areva
Type	: Oil Filled
Type of Cooling	: ONAF/ONAN
Rated Output MVA	: 31.5/ 25
Rated Voltage- HV/LV KV	: 400 / 6.9
Rated Current HV/LV A	: 45.52A / 2638.85 (ONAF)
	: 36.13 / 2094.33 (ONAN)
No of Phases	: 3
Frequency	: 50Hz

6.6kV Switchgear

- Make : L&T
- Type : Vacuum, draw out
- Service : Indoor
- Rated voltage : 6600V, 3 phase, 3 wire
- Lightning impulse withstand voltage : 60 KV (peak)
- Power frequency withstand voltage : 20 KV (rms)
- Short time rating : 31.5 KA (Sym) for 1 sec

- **Circuit Breaker**
- Type : Vacuum
- Number of poles : Three

Emergency Diesel Genset

DG set manufacturers name	: M/s Sterling Wilson Power gen Pvt. Ltd.
DG set model no. offered	: SGP 1250 P
DG set output at 0.8 pf	:1250 KVA
DG set output voltage	: 415V, 3 phase & neutral
DG set output frequency	: 50Hz
Diesel engine & alternator shaft speed	: 1500 rpm
Make of Diesel Engine	:PERKINS
Model No. of Diesel Engine	:4012 PERKINS
Number of Cylinders	:12 No's vee, 60 Deg
Starting system	: 24 V DC Electric Starting System
Rotation direction	:Anticlockwise
Excitation Voltage	:40 V

400KV GIS

- Supplier : Xian , China
- Quantity :23 Bays
- Rated voltage : 420 kV
- Rated Frequency : 50 Hz
- Rated current : 5000A (Outlet & Inlet)
- Rated power frequency 1 min withstand voltage phase to earth : 680 KV
- Rated lighting impulse withstand volt peak 1.250 µs (Phase to earth) : 1550KV
- Power supply (control Circuit) : 220V DC
- SF6 Pressure : 0.5 MPa

Control System for Gas Turbine Generator and Steam Turbine Generator

Make	:General Electric
Model	:Mark VIE
Type	:Triple Modular Redundant (TMR)
Control Network	:Dual Redundant 10/ 100MB Ethernet Network
System Details	:Mark VIe Panels for each GTG located in Local container (PEECC) and Mark VIe Panels for each STG are located in Central Electrical Room.

Control System for Station Balance of Plant

- Make : Honey well DCS
- System Details : Control hardware located in the CER. HMI located in CCR.