

Scope of Work For the Equipment Supplier

Table of Contents
Chapter 1 Plant Description

- A. MAIN EQUIPMENT
 - 1. Gas Turbine Package and Relevant Auxiliaries
- B. Electrical and Mechanical Balance of Plant (E/M BOP)
 - 1. Mechanical BOP Equipment
 - 2. Electrical BOP Equipment and Common Systems
 - 3. I&C BOP Equipment
- C. Supply of First Filling, Spare Parts, Tools, Miscellaneous
- D. Civil Work
- E. Installation Work
- F. Test and Commissioning
- G. Training
- Performance Guarantee

Plant Description

The project consist of two (2) Gas Turbine Generator sets with the components and services as mentioned in the detailed.

The plant will be constructed, erected and commissioned near Farahabad (Sari) city in Mazandaran Province.

The plant is consisting of design and construction of totally 108 MW (nominal) *

The gross gas turbine generator output measured at generator terminals of each unit will be nominally about 54 MW at ISO conditions of 15°C, 60% relative humidity and 1013 mbar pressure with fuel gas consumption.

* The procurement of the plant will be in the Employer scope of work.

A. MAIN EQUIPMENT

1. Gas Turbine Package and Relevant Auxiliaries

One heavy duty, axial flow, single shaft gas turbine fitted on a common base with its accessories is built for weatherproof conditions, the enclosure is provided with thermal and acoustical insulation, heating and ventilation.

1.1 Gas Turbine Compartment

- a. Multi stages, single shaft axial flow compressor
- b. Air inlet plenum and ducting of compressor
- c. Modulated inlet guide vane (IGV)
- d. Dual fuel nozzles (without fuel oil auxiliary systems)
- e. Ignition system with spark plugs
- f. Three stages axial turbine
- g. Two bleeding valves of compressor and solenoid valves
- h. Flame detectors
- i. Vibration sensors for protection
- j. Thermocouples on bearing
- k. Speed sensors
- l. Turbine shell and exhaust frame blowers
- m. Turbine supports
- n. Load coupling
- o. Exhaust plenum and ducting coating on first stage bucket
- p. Fuel gas combustion system
- q. Gas turbine instrumentation

1.2 Auxiliary Systems per Gas Turbine

1.3 Air intake system

- Filter house with ladder and platform for inspection and service
- Inlet plenums
- Self-cleaning type air filter
- Bird screen
- Weather hood
- Anti-implosion doors
- Interconnecting duct with expansion joint, damper, silencer and support
- Steel structure and ducts
- Instrumentation
- Lighting System

1.4 Exhaust Gas System

- Exhaust ducting
- Exhaust silencer
- Exhaust plenum extensions
- Expansion joints
- By-pass stack with silencer
- Insulation
- Lighting System

Diverter Box, including diverter damper, hydraulic actuating system, seal air system and guillotine damper.

1.5 Gas Fuel System

- Speed/ratio valve and control valve
- Servo valve
- Starting-failure draining valves
- Natural gas strainer
- Fuel gas emergency stop valve
- Vent valves
- Gas filter
- Piping
- Instrumentation

1.6 Gas oil package skid

- Fuel oil injection pumps
- Duplex filter
- Emergency stop valve
- Control valve
- Leakage oil pump
- Leakage oil tank
- Flow meter

1.7 Gas Fuel Off-base System

- One (1) duplex coalescing filter with automation drain
- One (1) orifice type flow compensating totalizer (in accordance with ISO 5167)
- One (1) safety shut off valve + vent valve

1.8 Lubrication Oil System

- Lube oil tank
- Shaft driven main lube oil pump
- Full flow AC motor-driven auxiliary lube oil pump
- Emergency lube oil pump (one DC motor-driven)
- Duplex lube oil filters
- Safety valves, pressure regulating valves
- Oil level indicators, temperature switches, pressure switches and piping
- Lube oil heater
- Instrumentation
- 2x100% Lube oil cooler.

1.9 Hydraulic Oil System

- Hydraulic oil tank (common with lube oil tank)
- Shaft driven hydraulic oil pump
- Accessory hydraulic pump
- Safety valves
- Change-over duplex filter and valves
- Manifold
- Hydraulic oil Cooler (common with lube oil cooler)
- Duplex hydraulic oil filters
- Piping
- Instrumentation

1.10 Cooling and Sealing Air System

- Two fans cooling turbine casing
- Pneumatic isolating valve

- Orifice and piping
- Instrumentation

1.11 Compressor Washing Skid

One Portable skid with local electrical panel, cable and plug, including:

- One washing skid including:
 - One (1) water pump (centrifugal pump)
 - One (1) Tank with drainage valve
 - One (1) pressure gauge (downstream the pump)
 - One (1) electrical panel
- Tank made of stainless steel includes:
 - One heater
 - Thermos switch
 - On high- and low-level switch
 - One tabular level indicator
 - One vent
 - One drainage valve

1.12 IGV system

- IGV actuating device
- IGV servo-unit
- Hydraulic control modules
- Accumulator
- Transmitter for travel
- Solenoid valve and piping

1.13 Gas Turbine Packaging

1.14 Enclosure

- Acoustic enclosure around gas turbine and accessory compartments
- A bridge crane (one ton capacity) in the auxiliary compartment for maintenance.
- Lighting system in gas turbine enclosure and accessory compartments

1.15 Compartment Ventilation and Heating

- Vent fans and heating system for turbine and accessory compartments

1.16 Starting and Cool-down System

- MV starting AC motor (6.6 KV) for Gas Turbine
- Hydraulic torque convertor
- Manual rotor turning device

1.17 Gas Turbine Cooling System

- One (1) battery of water to air fin fan coolers with AC motor driven fans (with one extra motor fan for the complete battery)
- Two (2 X100%) shaft driven water circulating pump
- Atmospheric expansion tank with floating valve and steel structure
- Corrosion inhibitor
- Instrumentation

1.18 Load Gearbox Compartment

- Load gearbox
- Gearbox base

- Acoustic enclosure
- Ventilation
- Lighting and firefighting devices

1.19 Piping System

1.20 Fire and Gas Detection and Extinguishing System

- Fire-fighting devices in gas turbine enclosure and accessory compartments
- CO2 Fire Fighting and Detection System for turbine and generator enclosure (bearing rooms) and power control center (included LCC)
- CO2 cabinet, control and alarming device and piping
- Primary and secondary CO2 cylinders
- Piping and nozzles
- Fire and gas detection system

1.21 Couplings

- Flexible auxiliary coupling
- Auxiliary gear box connecting between starter and turbine shaft
- Gas turbine load coupling
- Load gear box, mounted between the gas turbine and the generator:
- Separate base
- Lubricating system integral with gas turbine
- Vibration sensors for protection
- Thermocouples on bearing
- Connected to generator with rigid coupling

1.22 Multi-shaft Accessory Gear and Over-speed Bolts

1.23 Lube oil Purifier

1.24 Wedge Plates and Anchor Bolts

- All special packing plates for the unit erection, regulating shims and anchor bolts (including ordinary leveling plates and the embedded parts)

1.25 Walk-Way on the Unit

- Walkway grid, railing, staircase etc.

1.26 Generator and Auxiliaries

Generator Package with Following Characteristics/ Auxiliaries

1.27 Totally Enclosed Water- to-Air Cooled (TEWAC) Generator

a. Rated apparent power (min.)	MVA	65
b. Rated voltage	kV	11
c. Rated power factor (lagging) -	0.85	
d. Rated power factor (leading) -	0.9	
e. Rated frequency	Hz	

- | | |
|---|---|
| f. Stator & rotor insulation class: | F |
| g. Stator & rotor temperature rise class: | B |

1.28 Generator Bearings

- Pedestal bearing support
- Two lube bearings
- Roll out bearing capability without removing rotor
- Insulated collector and bearing
- Offline bearing insulation check with isolated rotor

1.29 Monitoring Devices

- Two (2) velocity vibration probes at turbine end, Two (2) at collector end
- Two (2) Proximity vibration probes at turbine end, Two (2) at collector end.
- Two velocity vibration probes at vertical and horizontal position with 90° angle between two probes. Two proximity vibration probes with angle 90° between two probes and 45° with respect to vertical position.

1.30 Generator Gas Cooling

- Cooler Configuration
- Four (4) vertically mounted coolers
- Coolers located on generator roof
- Raised cooler face flanges
- Generator Gas Cooling System Characteristics
- Generator output with one cooler at each side out of service (% of rated output) %100
- API661
- Maximum cooler pressure capability: 60 psi at water side
- 30 % Ethylene Glycol + 70% Demine water
- Fouling factor 0.00009 (m²K/W) at water side
- Cooler Construction Materials
- 90-10 copper-nickel tubes
- Carbon steel tube sheets
- Carbon steel water box and coupling flanges with epoxy coating
- Aluminum cooler tube fins

1.31 Generator Off-base Water-Cooling System

- Air type generator water fin fan coolers
- 2x100% pump with all of required accessories
- Filter
- Expansion tank
- Piping and valves

1.32 Generator Lube Oil Systems

- Common with Gas Turbine Lube Oil System.

1.33 Jacking Oil System

- A Jacking oil pump with accessories
- Pressure filters
- Flow divider
- All required Valves (Pressure safety valve, Check valve)
- All required high pressure Piping
- All Instrumentation and wiring inside battery limit

- All other Jacking oil piping and devices within the Jacking oil system and between the lube oil system and electrical generator and etc.

1.34 Generator Packaging, Enclosures, and Compartments

1.35 Busduct

Refer to 6.4

1.36 Generator Excitation System

Refer to 6.3

1.37 MV cell for Generator Output, consisting:

- Generator outgoing CTs and VTs, GCB,
 - Outgoing feeder to the unit transformer,
 - Generator neutral components (including Neutral tie (if any),
 - CTs for protection,
 - Neutral grounding by transformer and LV resistor)
- Also refer to 6. (Electrical Main Equipment)

1.38 Power Transformers

Refer to 6.5 to 6.7

1.39 Protection, Measuring & Metering

- For the generator, step-up transformer, unit transformer

Refer to 6.8

1.40 DC System

Refer to 6.12

1.41 MV Switchgear

Refer to 6.9

1.42 LV Switchgears/Boards

Refer to 6.10

1.43 Unit Cables and Cable Accessories

1.44 Control Equipment for Power Units

1.45 Gas Turbine Controller and Failsafe Protection and Trip System

- Redundant automation processor for closed-loop control
- I/O modules

- c. Failsafe system for protection and trip functions
- d. All necessary protection circuits based on requirement of turbine manufacturer
- e. Failsafe I/O modules
- f. 2 out of 3 schemes for below mentioned protection systems:
 - Over-speed protection
 - Automatic control during normal operation, connection to grid, emergency shut-down and abnormal conditions
 - Other types of control (e.g. speed /load control, exhaust temp. control, valve lift control, inlet guide vane pitch control, ETC.)

1.46 Gas Turbine Function Group Automatic and Operational Protection System

- a. Redundant automation processor for open-loop and sequence control
- b. Functions and operational protection functions, e.g.
 - Start-up and shut-down sequence control of the gas turbine
 - Open loop controls for the gas turbine related auxiliary systems
 - Generation of alarms and interlock
- c. I/O modules

1.47 All Necessary Field Instrumentation for GTG, its Auxiliaries and Accessories

1.48 Emergency Pushbuttons

1.49 Special I&C functions (built in DCS)

- a. Online GTG performance calculation
- b. Sequence of Event Recording with 1 msec. time resolution for fast dynamic signals
- c. Vibration monitoring system
- d. Speed measuring system
- e. Flame monitoring
- f. Fuel gas flow measurement

1.50 I&C CABLES

1.51 Terminal Station with 1 monitor in desktop version, printer, keyboard and mouse (which will be located in Local Control Connex and can be moved to the Central Control Room).

1.52 Implementation of Control of all GTG-related Auxiliary and Accessory System (according to GTG Manufacturer Practice)

1.53 Implementation of Control of all GTG-related Electrical Systems/Interface (according to GTG Manufacturer Practice)

1.54 Signal Exchange Between GTG Control System and HVSS (if required)

1.55 Necessary Signal Exchange with SCADA

1.56 Necessary Signal Exchange between GTG Control System and BOP (if Any)

1.57 Operation and Monitoring System (Based on Siemens System)

1.58 Engineering System

1.59 Bus Equipment

1.60 DCS Timing Synchronization including GPS

1.61 Software and Documentation

2. ELECTRICAL, MAIN EQUIPMENS

SCOPE OF SUPPLY

General note:

- All mentioned rating values hereafter are minimum and shall be adjusted according to proposed requirements by contractor.
- Latest edition of IEC/IEEE standards shall be followed by contractor.
-

2.1 Generator packages consist of:

- Each package consists of:
- Stator
- Rotor
- Generator instrumentation
- Coolers
- Generator neutral grounding including transformer and resistor (NGT)

2.2 GTG Starting system

- A complete set of equipment shall be provided for starting of each GTG:
Both "Cranking Motor" or "SFC system" are acceptable based on GTG manufacturer practice.

2.3 Generator excitation system

Excitation system could be "Brushless" or "static:

- Static excitation system consisting of:
 - Excitation transformer
 - Redundant power converter
 - Redundant Automatic voltage regulator (AVR)
 - Control cubicle.
- Brushless excitation system consisting of:
 - Rotating rectifier
 - Pilot exciter (i.e. PMG) with protection
 - Redundant AVR
 - Control cubicle with HMI

2.4 Non segregated bus duct complete with accessories

- One set of Non segregated bus duct for each GTG units consists of:
 - Generator connection to the NSBD
 - Step-up Transformers, LV side connection to the NSBD
 - Connection to the Auxiliaries (GTG Unit transformer, excitation transformer,)
 - GCB connection to the NSBD

2.5 Step up transformers complete with accessories

Note: Minimum rating at worst site condition is mentioned below and in any case the transformer rating curve in function of ambient temperature shall lie above generator output curve over the whole site ambient temperature.

- For each GTGs units consists of: (Minimum rating at worst site conditions)
75 MVA, 11/66+, -8×1.25% KV oil immersed type transformer:
 - Two winding power transformer

- Insulating oil filling
- Oil conservator with dehydrating breather
- ONAN/ONAF cooling (ONAN to ONAF rating ratio must be greater than 0.75)
- On load tap changer on the HV side
- HV oil-air bushing
- HV neutral bushing
- Bushing current transformer in HV bushing and neutral bushing
- Control cabinet with control and protection devices
- Grounding terminals
- Transformer monitoring (alarm and signaling) equipment as follows:
Buchholz relay, oil level indicator, oil temperature, winding temperature indicator, pressure relief device

2.6 Unit transformer complete with accessories for GTG

- For each GTG consists of: (Minimum rating at worst site conditions)
10 MVA, 11+,-2×2.5%/6.3 KV type:
 - Two winding power transformer
 - ONAN cooling
 - Off-circuit Tap changer on the HV side
 - HV bushing for MV Frame connection, 11 kV
 - LV bushing for cable connection, 6 kV
 - LV neutral bushing
 - Grounding terminals
 - NGR
 - Temp. Sensors

2.7 Auxiliary transformer complete with accessories

- For each GTG consists of: (Minimum rating at worst site conditions)
400 KVA, 6+,-2×2.5%/0.42 KV type
General specification of Aux. Transformers:
 - Two winding power transformer
 - ONAN cooling
 - Off-circuit Tap changer on the HV side
 - HV bushing for MV Frame connection, for GTG
 - LV bushing for cable connection, 6 kV
 - LV neutral bushing
 - Grounding terminals

2.8 Generator, step-up transformers protection, metering, measuring and synchronizing system.

Note: Following protection systems regarding Step-up transformer should be provided only if implementing step-up transformer is necessary.

- Numerical protection system for generator including:

ANSI Code	Generator Protection
87G	Generator differential protection
87M	Overall differential protection (if applicable)
64S1	Stator earth fault-(90-95) %
64R	Rotor earth fault
32R	Reverse power relay

37L	Low forward protection
51N	Neutral over-current (if applicable)
24	Over excitation protection, U/f
40	Under excitation protection
51V	Over current voltage restraint
59	Over voltage protection
27	Under voltage protection
81.0	Over frequency protection, two stages
81.1	Under frequency protection, two stages
46	Negative phase sequence protection, two stages
64S2	Stator earth fault-100%
49S	Generator stator overload
86	Lock out relay (software)

• Numerical protection systems for generator transformer including:

ANSI Code	Generator Transformer (step up transformer) Protection
87T	Generator Transformer differential protection
87TN	HV restricted earth fault protection
51N	HV neutral earth fault protection
50/51	HV inverse time overcurrent & instantaneous o/current protection
24	Voltage/Hertz protection (over excitation)
86	Lock out relay (software)

- Transformer Buchholz Trip (external signals)
- Transformer OLTC Buchholz Trip (external signals)
- Transformer wiring temperature Trip (external signals)
- Transformer oil temperature Trip (external signals)
- Transformer pressure relief Trip (external signals)

- Synchronization and generator measuring equipment
- Generator metering and measuring equipment
- Synchronizing equipment

2.9 MV switchgears

- One MV Switchgear shall be provided to supply all MV loads of plant, including GTG starting system, GTG Aux, Transformers, BOP Aux. Transformers, etc. consist of:
 - 1 Set of 12KV (6 KV system voltage), 1250 A, 25KA/3Sec, with Bus-coupler and equipped with HSBT
 - All required protection, measuring, earth switch and other necessary devices to safe & Normal operation of MV network
 - No. of feeders, ratings and other specification as per Key SLD

2.10 LV switchgears / boards (MCC)

- LV switchgear/MCC with two incomings (normal and emergency) for each GTG as per SLD

2.11 Generator circuit breakers completed with all required accessories for each GTG

Each GCB consist of:

- SF6 circuit breaker
- Motorized series disconnecter
- Motorized earthing switches on both sides
- Motorized disconnecting switch for static frequency converter (if applicable)
- Surge arrester on transformer side
- Surge capacitors
- Potential transformers
- Control cubicle

2.12 DC system

•DC system for each GTG unit consists of:

- 2×100% battery chargers
- 1×100% Nickel/Cadmium battery, 2-hour backup time
- One distribution board/

2.13 VAC UPS system

•UPS system for each GTG unit consists of:

- Inverter
- by pass transformer (if applicable)
- Static switches
- One distribution board

Note: Voltage levels for DC and AC UPS to be defined according to GTG units Manufacturer Practice.

3. Instrumentation and Control Equipment

3.1 Gas Turbine Scope (for each GTG)

- Gas Turbine Controller and Failsafe Protection and Trip System
 - Redundant automation processor for closed-loop control functions, e.g.
 - Combined speed/load control
 - Gas turbine exhaust gas temperature control
 - Valve lift control
 - Inlet guide vane pitch control
 - I/O modules
 - Failsafe system for protection and trip functions
 - Integrated 2x 2-out-of-3 over-speed protection circuit
 - Failsafe I/O modules
- Turbine Function Group Automatic and Operational Protection System
 - Redundant automation processor for open-loop and sequence control functions and operational protection functions, e.g.
 - Start-up and shut-down sequence control of the gas turbine
 - Open loop controls for the gas turbine related auxiliary systems
 - Generation of alarms and interlock
 - I/O modules
- Special Measurements
 - Vibration measurement system
 - Speed measurement system
 - Flame monitors at the combustion chambers

- Fuel flow measurement system

3.2 Common I&C Scope of Work

▪ **Emergency Pushbuttons**

- According to the manufacturer practice (Lockable emergency push buttons)

▪ **Signal Exchange Between the Units Control System and HVSS**

- Hardwired signal interface via dry contacts (for digital signals) and isolation in analog cards (for analog signals)
 - Dry contacts and isolation for signals from DCS to HVSS will be provided by DCS supplier
 - Dry contacts and isolation for signals from HVSS to DCS will be provided by the HVSS supplier
- Bi-directional (hardwired I/O) signal exchange
- Limited up to 180 binary and analogue signals in all for units

▪ **Signal Exchange between the Units Control System and SCADA**

The signal exchange shall be via one of the followings selected by Contractor:

- Bi-directional hardwired signal interface via dry contacts (for digital signals) and isolation in analog cards (for analog signals)
- Bus connection from control system to RTU over serial link by means of IEC 870-5-101 protocol.
- Limited up to 200 binary and analogue signals in all for each units Reg. No.293423

▪ **Operation and Monitoring System**

- Redundant Processing Unit in the CCR (two sets)
- Operator terminals (1 for each GT in PCC), each with 1 color LED monitor 21" (for OTs in CCR) and 19" (for OTs in PCC), keyboard and mouse
- LED Video Wall 92" (4x46")
- A4 Laser b/w printers (1 for each unit in CCR and 1 for each GT in PCC)

3.4 Common I&C Scope for plant (One lot for the plant unless otherwise specified here below)

▪ **Special Function**

- Sequence of Event Recording with 1 msec. time resolution for fast dynamic signals (function will be implemented in DCS)

▪ **Programming Unit**

- One set PG for the plan

▪ **E/M BOP Automation Processor**

- One redundant automation processor for common plant functions
- I/O modules

▪ **Operation and Monitoring System (OM650)**

- Redundant Server Unit in the CCR with DVD drive (one set)
- Shift engineering station with 1 color LED monitor 21" in desktop version, keyboard and mouse (one set for plant)
- Color printer (A4) (1 in the CCR)

- **Engineering / Diagnostic System in the CCR**
 - Engineering/Diagnostic station with color LED monitor 21", keyboard, and mouse and one A4 B/W printer
 - DVD R/W for system and program backup
- **Instrumentation**
 - All necessary field instrumentation for GTG, Cooling and their auxiliaries
- **I&C CABLES**
 - Engineering of I&C cables which are most applicable in power plant, will be based on following I&C standard cable types:
 - JE-Y (St) Y n×2×0.8 mm
 - LI7YC7Y
 - n×2×0.75 mm²
 - JE-LIYCY n×2×0.5 mm²
 - NYY-J n×2.5 mm²
- **Bus Equipment, Peripherals**
 - Bus Cables
 - Necessary network components such as OSM's
 - 1 bus clock
 - GPS
- **Furniture**
 - Operator desk inside of the CCR for installation of the computer equipment and peripherals
- **Software and Documentation**
 - I&C documents for main machine is according to the manufacturer standard for documentation (i.e. function and hardware diagrams)
 - I&C software (system and application programs)

Note: The scope of supply of control system as offered in this section is based on T2000 system (SIEMENS/MECO). However, the scope may be changed if different vendor (e.g. MECO) or system (e.g. MAPCS) is selected. The scope of supply of control system based on different vendor (e.g. MECO), will generally cover similar functions.

B. Electrical and Mechanical Balance of Plant (E/M BOP)

1. Mechanical BOP Equipment

1.1 Auxiliary boiler

One saturated steam boiler shall be considered, including:

- Pressure parts, non-pressure parts
- Super heater module (integrated or external)
- Steel structures, supports, insulations, cladding, platforms, ladders, galleries.
- Stack (exhaust)
- Lifting lugs, lashing, landing & skid, beam & reinforcement devices
- Individual firing equipment including dual fuel burner, ignition system, fuel oil control unit, gas train unit, pilot system.
- Fuel oil supply system including daily tank, oil filter/ strainer & fuel oil transfer pumps
- 2×100% feed water pumps with minimum recirculation system

- One deaerator & feed water storage tank with steam press. / temp. regulation system
- Individual sampling/ chemical dosing system
- Blow down & drain system
- All piping, hangers, supports, insulation, valves, traps, cladding, connections, etc.
- Auxiliary steam supply line from auxiliary boiler to common header and various consumers

According to the site weather condition, the boiler and other mechanical parts of the system will be installed indoor.

1.2 Fuel system

▪ Fuel gas system:

The Fuel gas is supplied to the plant boundary by client. The scope starts from outlet flange of main gas pressure reducing station within the plant boundary. The system can be categorized generally as below:

- Main Gas pressure reducing station (Owner Scope of work)
- Fuel gas pipeline within power plant to GTGs and other consumers.
- Secondary Gas Pressure Reducing Station (2x100%) with pressure level required by Bop consumers
- Necessary isolating valve, flanges, vent & drain
- Adequate Injection Nozzles for Nitrogen purging

▪ Fuel oil system:

- Fuel Oil Unloading and Storage System
 - Unloading bays for simultaneous unloading of 4 oil tankers complete with Hose connections & couplings
 - Fuel oil underground reservoir tank (100 m³)
 - 2x100% vertical pumps
 - One (1) common duplex filter at common outlet header of pumps
 - 1x100% fuel oil transfer pump at fuel oil return header from storage tanks
 - 2x 6000 m³ Fuel oil storage tank (fixed roof)
 - Steam Coils for storage tank
- Fuel Oil Forwarding System
 - One (1) common duplex manual cleaning type filter for common suction header of forwarding pumps
 - 2x100% Gas oil forwarding pumps for each gas turbine, (one pump is operating and another one is standby for each GTG)
 - Accumulator(s)
 - Gas oil pipeline to gas turbines & other consumers
 - 2x100% Fuel oil pumps to BOP fuel oil daily tanks

1.3 Fire protection system

▪ Firefighting System:

- Foam system for main fuel oil tank(s)
- Cooling system for main fuel oil tank(s)
- Automatic, supervised dry pipe open head spray nozzle deluge system for:
 - Main transformers
 - Unit transformers
 - Cable basement (unit control container of gas turbine)

- Automatic, supervised dry pipe, closed head, sprinkler pre-action systems for:
 - Cable galley of CCB
 - Cable gallery of steam portion switchgear

- Automatic, wet pipe, sprinkler system for:
 - Fuel oil system of Auxiliary boiler
 - Fuel oil tank of Diesel generator
 - Fuel oil tank of Fire water diesel pumps
 - Fuel oil forwarding pumps

- Foam/Water Indoor Hydrants for GT hall
- Fixed Automatic Foam/Water system for GT Combustion Chambers, Fuel oil package, hydraulic skid and Lube oil tank in gas turbine hall
- Hose reel or Indoor Hydrants for:
 - All industrial Buildings (except electrical buildings)
 - Administration Building and Canteen

- Portable Dry chemical and/or CO2 Extinguishers for all buildings
- Outdoor hydrant for whole plant area
- Automatic fixed carbon dioxide system for:
 - Unit control container of gas turbine
 - GT Generator Enclosure

- **Fire Water Supply and Distribution**
 - Firefighting pumps consist of:
 - Motor driven fire water pump (2X 50%)
 - Diesel engine fire water pump (2X 50%)
 - Motor driven jockey pump (2x100%)
 - Pressure Tank
 - Relevant Control Panels
 - Water distribution ring

- **Fire Alarm and Detection System**
 Analogue Addressable system Panel for:
 - Fire detection
 - Visible and Audible Alarm management
 - Fire Extinguishing Management
 - Communication with other systems (DCS, GTG Local Fire Panels)

- **Fire Detection equipment:**
 - Point and Beam Smoke Detectors
 - Smoke detectors
 - Heat detector
 - Multi-detectors (smoke/heat)
 - Point and Line Heat Detectors
 - Manual Call Points
 - Gas detector
 - Flame Detector

1.4 Crane(s), hoist(s) and monorail(s)

- One (1) double girder overhead crane with auxiliary hoist for GT hall
- Two (2) Under Slung overhead Crane for GT hall lube oil area
- Overhead (Electrical) single girder for GT intermediate shaft
-
- Monorail Manual Chain Hoist for:
 - HVAC room
 - Fuel oil forwarding pump Building
 - Auxiliary boiler Buildings
 - GT Generator enclosure (one for each GTG)
 - Fuel oil unloading pump house
 - Jib crane for each GT air intake

1.5 Heating, Ventilation and Air conditioning (HVAC) System

- Heating is provided for:
 - All rooms with staff attendance
 - Areas & rooms where a minimum temperature is required due to freezing protection
- Ventilation and heating for:
 - Turbine buildings
 - Electrical & mechanical modules where necessary
 - Pump houses
 - Miscellaneous rooms
- Air conditioning is provided for accommodation of staff &/or system protection according to manufacturer standard. Appropriate package air conditioning with cooling and heating systems shall be provided for central control building for the control room, switchgear rooms, offices and electronic equipment rooms. Redundant system will be provided for system protection.

1.6 Water and Waste Water System

▪ Raw Water transferring System

Raw water is supplied from a reliable water source which could be a well or flange of raw water pipeline within the power plant boundary. outlet

▪ Raw water transfer system, including:

- Water piping from the well pump outlet header or outlet flange of raw water pipeline located within site boundary limit to the raw water/fire water storage tank
- Raw/fire water tank (capacity: 2000 m³)

▪ Pretreatment system

- 2x100% raw water transfer pumps from raw water storage tank to pre- treatment Plant.
- 2x100% dual media filters (with complete back wash facilities) Two (2) Air blowers

▪ Potable/service water supply and distribution system

- Potable & service water supply and distribution system, including:
- Potable water distribution system comprising potable water pumps (2x100%), necessary piping, filters, metering, valves and relevant equipment within plant boundary
- Service water distribution system comprising service water pumps (2x100%), necessary piping, valves and relevant equipment within plant boundary
- Disinfection system (including two mixing tanks and two dosing pumps each one 100% duty for dosing calcium hypochlorite)
- One (20 m³) elevated tank (common for potable & service water)

▪ **Neutralization System comprising**

- One (1) neutralization tank.
- Two (2) full duty recirculation and discharge pump complete with pH control
- Acid and caustic adding facilities
- Necessary pipe work and valves, supports and fittings associated with above supply.
-

Water laboratory

- Water laboratory including:
- Equipment for water laboratory
- Lab ware for water laboratory
- Chemicals for water laboratory
- Furniture for water laboratory

▪ **Waste Water & Sewage System**

- Oily-water separators
 - The areas that produce oily water are:
 - Turbine hall (turbine and auxiliary systems)
 - Containment areas around outdoor oil filled transformers (main and unit transformers)
 - Auxiliary service area (aux. boiler station and other auxiliary system)20
 - Fuel Oil storage tank(s) area
 - Other those may produce oily water

The scope includes:

- Gravity oil separators
- Portable pumps
- Required piping, oil sump and valves
- Sewage Treatment System (biological treatment)
 - Sewage collection system
 - Sewage treatment package

- Clean Drains Collection System

It includes roof drains, plant clean drains and outdoor open drains that collect rain water. A system of open drains network will be used to direct the drain water from the entire power plant (normally considered uncontaminated clean drains) by gravity to the nearest point of surface water drainage outside the plant boundaries.

- Chemically Contaminated Drains and Evaporation Pond

1.7 Heat Tracing

1.8 Piping Equipment

- Interconnecting piping, fittings, supports and valves between the components / equipment / systems supplied by contractor
- Insulation and cladding and painting (Where required)

2. Electrical BOP Equipment and Common Systems

2.1 Auxiliary transformers complete with accessories

- 2x2000 KVA, 6±2×2.5%/0.42 KV oil immersed type transformers

2.2 Emergency Diesel Generator with synchronous grid capability

- 1x500KVA, 400V, prime duty, at worst site condition, emergency diesel generator will be provided with:
 - Diesel engine, water-cooled, with exhaust gas turbo charger
 - Fully pressure-lubricated system
 - Fuel supply and injection system
 - Air intake and exhaust system with exhaust gas pipe and silencers
 - Synchronous generator completes with excitation system
 - Complete in every respect for housing the emergency diesel generator set in the emergency diesel container
 - One daily fuel tank for 8 hours operation
 - One control panel equipped with start/stop controller, instrumentation and metering including:
 - Control and monitoring equipment for normal operation, start-up and shutdown
 - Generator protection
 - Automatic synchronizing unit

2.3 LV switchgears / boards and related protections

- 1 Set of 400V, 3150A, 63KA-1Sec with bus coupler (Common BOP Board as per SLD)
- Normal and emergency LV distribution boards/MCCS as per power plant requirements.

2.4 DC system

- VDC system for common consists
 - 2x100% battery chargers
 - 1x100% lead acid battery bank, plante type, or Ni-Cd two-hour backup time
 - One distribution board with bus coupler
 - Cells mounted earthquake proof on stands or racks

2.5 230 VAC UPS system

- UPS system for common loads consists of:
 - 2x100% Inverters
 - 1x100% by pass transformer
 - Two static switches
 - One distribution board

2.6 Lighting and small power systems

2.7 Communication system (Telephone, Paging, LAN)

2.8 Primary & Secondary Earthing and lightning protection system

2.9 Cables with all related accessories

2.10 Cable trays, ladders and conduits with all related accessories

2.11 Air craft warning lighting system

2.12 Electrical heat tracing (if applicable)

2.13 Cathodic protection (for gas pipe line if buried underground)

The substation will include all indoor and outdoor equipment for the specified bays and feeders as following:

- Bus bars (Short circuit rating: 50A-1Sec.) (Cost impact will be finalized according to MOM 97.02.02 item no.5)
- High voltage equipment including circuit breakers, disconnectors / earthing switches, current transformers, capacitive voltage transformers, line traps with line matching unit, lightning arresters with counter (as per SLD)
- Substation Control and monitoring System (SCS system), DCS system with protocol of IEC61850
- Synchronizing, Protection and Metering system
- Outdoor and indoor lighting system
- Interconnection between various equipment's, interconnection and interface between power plant & substation
- MV, LV Power and control cables
- Cable trays, conduits, cabling and wiring the equipment
- Grounding system
- Lightning protection system
- Registration number 245227 (Siamese Johnny
- Kharma Power Generation Company
- Morning Energy Development Co. Reg Nu 393423
- Lightning arrester for all incoming & outgoing feeders
- Complete P.L.C and telecommunication system and accessories
- Complete SCADA equipment, RTU and accessories
- Protection, control and measuring systems, equipment
- Event and Fault recording systems
- One 100kVA Emergency Diesel Generator Set
- Two 250kVA LV Auxiliary Transformers
- AC switchgear system
- Two sets of 110V Ni-Cd battery system with four hours discharged time and one charger for each set of battery
- One set of 48V Ni-Cd battery system with four hours discharged time and two sets of battery chargers
- Fire detection system for substation building
- Manual firefighting system (CO2 and portable dry chemical extinguishers) for substation building
- All of the interface cables between power plant and substation
- Junction boxes, terminal boxes, marshalling kiosks and all facilities for the establishment of new substation
- Dry contacts and isolation amplifiers for signals from HVSS to power plant DCS will be provided.
- Overhead line conductors and gantries from power plant main transformers to 230kV substation (with all connection and fitting accessories).
- Commercial Energy Meters for each incoming / outgoing feeders
- Substation marshalling interface panel in substation (AVB01)

Note: All electrical rating values are preliminary and they shall be verified during detail design phase based on plant requirement and calculation.

3. I&C BOP Equipment

3.1 Control systems and instrumentation (local) for mechanical and electrical BOP

- Local control panels or desks (where required)
- Field instrumentation such as transmitters, switches, meters, gauges and necessary hook ups for BOP
- The necessary I&C cabling, junction boxes, trays and accessories
- Control valves, solenoid valves
- Signal exchange with DCS for supervision and/or control of mechanical and electrical BOP systems in Central Control Room (where required)

3.2 I&C Software

- System and application programs according to the manufacturer's recommendation

3.3 CEMS (Continuous Emission Monitoring System)

- Extractive (four channel common for two gas turbines and two HRSGs) CEMS (Nox, Sox, CO) for gas turbines and HRSGs stacks

3.4 CCTV (Cost impact of CCTV instead of 6 guard towers will be considered).

- Power Plant boundary fence
- IP-Based

3.5 One E/M for BOP (Additional Work)

- A monitoring work station at CCB for BOP

3.6 Fuel Gas flow meter (0,5% accuracy) including flow computer at plant entry (Additional Work)

C. Supply of First Filling, Spare Parts, Tools, Miscellaneous

- Initial Fill (up to PAC) of:
 - Lube and hydraulic oil
 - Transformer oil
 - GTG auxiliary cooling water inhibitor
 - CO2 cylinder filling
 - Gas turbine compressor cleaning washing agent
 - Silica gel for compressed air dryer
 - Welding electrode
- Commissioning and start-up spare parts
- Five-year spare parts
- Touch-up painting
- Temporary provision at site for construction utilities
- Temporary provision of all site labor and tools required for construction, erection and installation of CONTRACTOR supplied equipment, system, and structure
- Bascule

D. Civil Work

The civil works included in the contract shall consist of the design, detailing, supply of material and full construction works of the various foundations, structures, buildings, etc.

The extent of the civil works consists of the following items:

1. 2 Indoor gas turbine/generator units and bypass stacks foundations
2. Gas turbines hall
3. Local control and electrical containers (for gas portion) foundations
4. Central control building
5. Main and unit transformers foundations and fire walls

6. Foundation of auxiliary transformers
7. Fin fan coolers foundations
8. Pipe racks, trenches and sleepers
9. Cable racks, trenches and duct bank system
10. Civil work of Fuel oil unloading bays and shelter (shelter is additional work)
11. Fuel oil forwarding pumps building
12. Fuel oil storage tank foundations and common dyke (Note: Fuel oil storage tank foundations and common dyke instead of fuel oil storage tank foundation and dyke are additional work)
13. Reservoir tank (2000 m³) for fire and raw water considering requirements of fire pump packages
14. Foam station building
15. Workshop and store building
16. Auxiliary boiler foundation(s) and building(s)
17. Oily, clean & waste water collection systems civil work
18. Internal roads (according to the attached general layout)
19. Internal fence for transformers (if required) and secondary GPRS
20. Secondary GPRS foundation and shelter
21. N2 Injection system foundation and shelter (if system with container is not provided)
22. 2 Boiler feed pumps building
- 23 Central heating building
24. Diesel generator package foundation
25. Administration building
26. Canteen building including prayer room
27. Gate house
28. Mobilization & demobilization
29. Landscaping, including graveling (technical and non-technical), walkways and green area
30. Fire station, first aid and guard house
31. Open parking (including parking access roads) and sheltered parking (inside power plant)
32. L.V. switchgear room (if required)
33. Water treatment building including water chemical laboratory
34. Sewage treatment package foundation
35. Oil separators
36. Elevated water tank foundation
37. HV substation central control building
38. HV substation civil work with bay control rooms

E. Installation Work

Included in the scope is installation of the equipment, systems and units supplied under this contract.

F. Test and Commissioning

The standard workshop inspection and testing, site testing, commissioning, performance testing, pre-trial tests and trial run testing of the units and equipment as per manufacturer standard practice, and delivery of the test certificates

Performance test shall be performed based on ISO 2314/PTC 46 and the manufacturer instruction and procedure, commissioning will be carried on as per Manufacturer instruction manuals.

J. Project Management

1. Home and site project management
2. Scheduling for document supplied
3. Scheduling for equipment supplied
4. Monitoring of the entire activities within scope
5. Delivery of monthly status reports
6. Coordination of activities

G. Training

Training of the client operation staff according to the Manufacturer standard practice

Performance Guarantee

- All values of the table of this page marked by an asterisk (*) are considered as guarantee values and shall be approved in performance test. Other data are estimated performance data and are only for information.
- The following tables Data shall be filled out completed by the contractor:
(A1*, A2*, B1, B2, C1, C2)
- Site design conditions for performance data: as per Appendix No. I
- Fuel compositions for design and performance purposes: as per Appendix No.2 and 3

GROSS POWER OUTPUT: (1) (Measured at generator terminals, at 100% base load and site design condition for GTG Units):

		Unit		
			Fuel gas firing	Distillate oil firing
1	Each GTG		A1*	B1
2	Each GTG Auxiliary power consumption and losses (Expected) ⁽¹⁾	KW	C1	C2

GROSS HEAT RATE: (1) (Measured at generator terminals, at 100% base load and site design condition for GTG Units/Block):

		Unit		
			Fuel gas firing	Distillate oil firing
1	Each	KJ/KWh	A2*	B2

Note (1): As per ISO 2314, only the Auxiliary power consumption of the equipment's which are in continuous operation and absolutely necessary for power generation

Appendix No.1:

Design Performance Parameters

Item No.	Design Performance Parameters	Unit	Data	
1	Site Location		ZIMAVAR	
2	Site Elevation	m	15	
3	Design Relative Humidity		78.6	
4	Design Ambient Temperature		18	
5	Design wind velocity at 10 meter above round	m/s	3	
6	Cooling System Type			
7	Fuel Specification		As Appendix 2 fuel as	As Appendix 3 fuel oil
8	Fuel LHV	kJ/kg	48944	42900
9	Fuel Supply Temperature		15	15
10	Mode of Operation		Base load	
11	GT Inlet Pressure Loss	mbar	10/10 in Simple/Combined Cycle Mode of Op.	
12	GT Exhaust Pressure Loss	mbar	10/30 in Simple/Combined Cycle Mode of Op.	
13	GT Inlet Temperature (TIT)		1060	
14	Generators Power Factor		0.8	
15	Turbines Speed	rpm	3000	
16	GTG		GTGs are new and clean and within their first 200 EOH. If the performance test is carried out after 200EOH, the effect of degradation will be considered according to the respective correction enclosed in proposal.	
17	Standard for Performance Testin		ISO 2314	

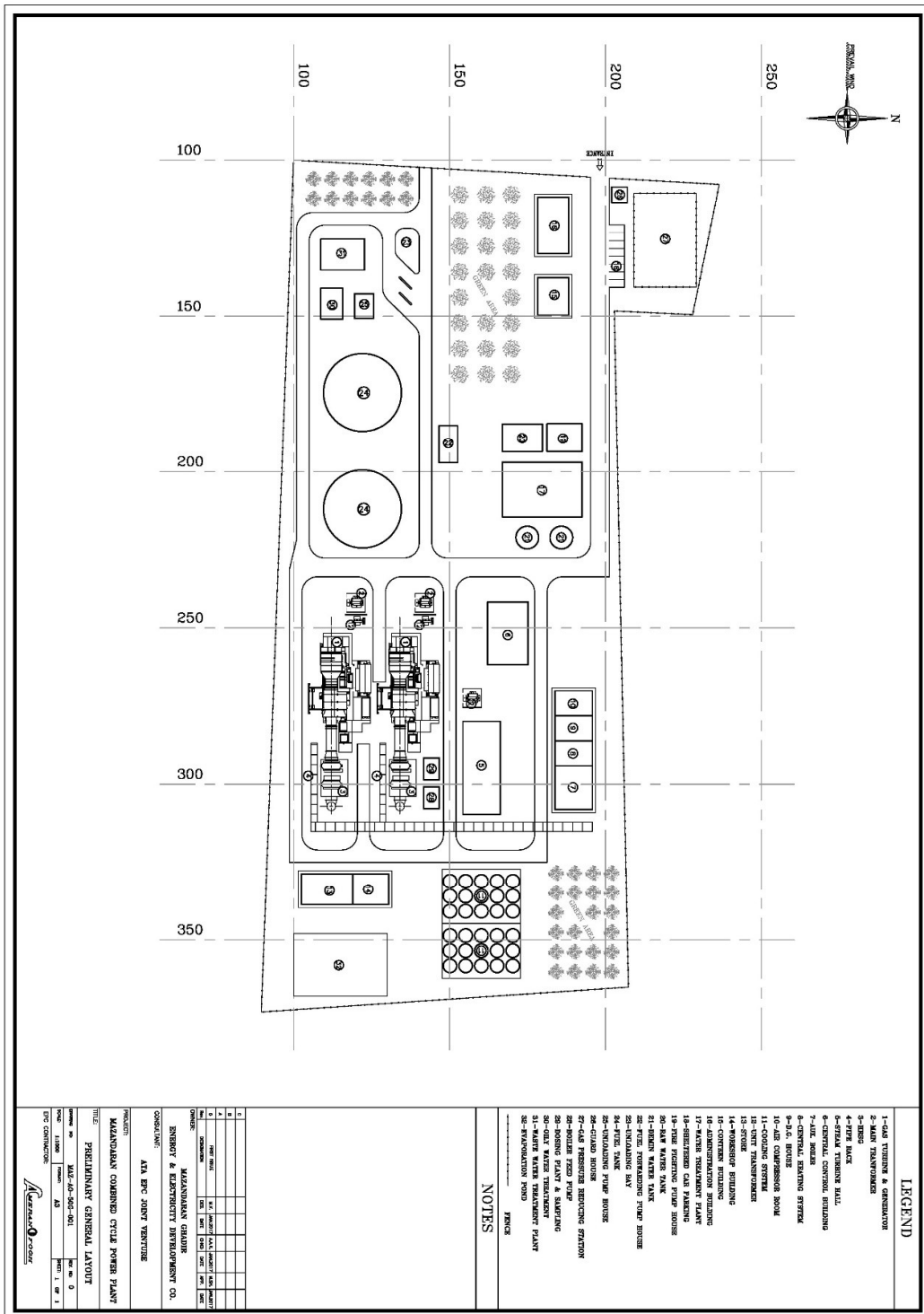
Appendix No.2:**Table 1 Natural Gas Analysis**

Parameter	Unit	Ave
CH4	Mol%	91.5
C2H6	Mol%	2.9
C3H8	Mol%	0.86
C3H6	Mol%	0.02
C4H8	Mol%	0.15
C5H10	Mol%	0.03
C6H6	Mol%	0.01
C4H10	Mol%	0.13
N2	Mol%	3.5
CO2	Mol%	0.9
ارزش حرارتی خالص	MJ/SCM	33.95
ارزش حرارتی کل	MJ/SCM	37.66
دانسیتته جرمی	Kg/SCM	0.74
وزن مخصوص	-----	0.60
جرم مولکولی	Gr/mole	17.51

Appendix No.3:

Table 2 • Distillate Oil Analysis (TBA)

Appendix No.4: GENERAL LAYOUT



Appendix No.5: SINGLE LINE DIAGRAM