

# PROPOSAL

Presented To:

**CORPOELEC**

For

**TERMOZULIA  
Fr 7EA Power Plant**

*By*



Proposal No. T-9002

March 11, 2009

**This document is privileged and contains confidential information intended for use only by  
(Customer name)**

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## **Section 1.0 Introduction**

ProEnergy EPC Services (PES) hereinafter termed "Contractor" is submitting this Proposal Technical Scope Document (TSD) to ENELVEN (Owner) in response to the proposed Frame 7EA Simple Cycle Power Project to be located at the General Rafael Urdaneta Termoelectric Complex south of Maracaibo, Venezuela. This proposal is for the Engineering, Design, Procurement, Construction, Start up and commissioning of the Simple Cycle Project.

This TSD is submitted with the understanding that CORPOELEC has purchased (2) Gas Fuel GE Model 7121 Frame 7EA (60Hz) Gas Turbine Generator packages. The Contractor will transport the gas turbine packages and accessories to the Port of Maracaibo and then on to the site. The Contractor will convert the Gas Turbines to Dual Fuel however the price of this conversion is not included in this proposal. The Contractor will supply and transport to the Venezuelan site the associated Balance of Plant Equipment.

The TSD addresses the requirements for utilizing both natural gas and # 2 Diesel fuel in the gas turbine generators. The natural gas and diesel fuel must meet the GE specifications for large turbine fuel requirements.

The plant will utilize the following owner furnished major equipment:

- Two (2) GE Model 7121 Frame 7EA Gas Turbine Generators
- One (1) 13.8KV / 230KV Generator Step Up Transformer
- One (1) 230KV SF6 Breaker

The various sections included in this TSD address the Scope of Supply, Equipment Specifications, Plant Process Description, Expected Plant Performance, Design Basis, Warranties, Schedule, and Proposal Drawings.

**THIS DOCUMENT IS CONFIDENTIAL. IT IS DESIGNED AND INTENDED FOR THE PROJECT OWNER'S USE ONLY. THIS DOCUMENT IS FOR THE SOLE PURPOSE OF EVALUATING PROENERGY EPC SERVICES' PROPOSAL ON THIS SIMPLE CYCLE POWER PLANT.**

## **Section 2.0 Scope of Work and Equipment List**

### **2.1 The Scope of Work for the proposed project is generally outlined as follows:**

2 Major Equipment – Owner will supply Two (2) GE Model 7121 Frame 7EA Gas Turbine Generators with auxiliaries and One (1) 13.8KV to 230KV Generator Step Up Transformer (GSU) and a 230 KV substation / switchyard.

2.1.1 Contractor will transport from the US to the Port of Maracaibo, Venezuela. A more detailed description of the Frame 7EA scope is attached.

2.1.2 Contractor will provide the Balance of Plant which includes the following outlined list of major equipment and deliver them to site:

- One (1) Oily Water Separator with Waste Oil and Waste Water Tank
- Diesel Fuel Forwarding Pumps and Filtration
- Modular Climatized Control Building

The contractor will design and install the facility as described in the following sections of this document. The design will include the necessary Civil, Foundations, Structural, Mechanical, Electrical, Instrumentation, and Control System to install the above listed equipment.

2.1.3 Balance of Plant – The contractor proposes to furnish and install the Balance of Plant equipment and materials, which comprises the following:

- Complete design of the facility including civil, foundations, structural, buildings, mechanical, electrical, instrumentation and control.
- Contractor will provide design and oversight for the Civil works but Owner will provide the material and labor for the Civil Works
- Owner will provide site preparation and civil work.
- Contractor will provide concrete foundations, plant gravel, and fencing if required.
- Contractor will provide roads and removal pads as shown.
- Contractor will provide Installation of the complete Power Plant with the inter-ties as described later in this document.
- Contractor will provide mechanical installation of the various items of equipment with the associated inter-ties of treated water, natural gas, liquid fuel, instrument air, waste water, and Fire Water.
- Contractor will provide installation of the plant including the 230 KV high voltage GSU, 230KV SF6 breaker, 230KV disconnect, dead end tower, grounding, lightning protection, and cathodic protection.
- Contractor will provide Instrumentation and Control Systems including plant instrumentation, metering, and Plant DCS.
- Contractor will install Owner supplied buildings including:
  - GTG PEECC Buildings
  - PDC Building

- Contractor will furnish and install following Buildings:
  - Modular Climatized Control Building
- Contractor will also supply the following:
  - Natural Gas Interconnect Piping to Owner's Header System Adjacent to Plant
  - Liquid Fuel Interconnect Piping to Owner furnished Day Tank adjacent to Plant
  - Treated Water Interconnect Piping to Existing Owner furnished Header System
  - Treated Water Day Storage
  - Instrument Air Interconnect Piping to Existing Owner furnished Header System
  - Waste Water Interconnect Piping to Existing Owner furnished Header System
  - Fire Water Interconnect Piping to Existing Owner furnished Header System
  - Plant fire Water Underground Piping System with Monitors, Hydrants, Etc.
- Project Management, QA/QC, Safety and Training.
- In addition, the Contractor will perform:
- Plant commissioning, check out, start up, and training with Vendor Technical Representatives present.
- Plant Performance, Reliability, and Environmental Testing.
- Furnishing of plant documentation including Vendor Information, Warranty, Engineering, Turnover documents, O&M Manuals and As Built Drawings.

## 2.2 Equipment List - Detailed Division of Responsibility

Material/Responsibility	Qty	Description
<b>OWNER</b>	2	GE Model 7121 Frame 7EA (60Hz) Gas Turbine Generators with Associated Equipment as Coming From Southhaven Including:
	1	Electrical PDC Building
	2	13.8 KV 5000 amp Gas Turbine Generator Breaker NEMA 3R
	1	230 KV SF6 Circuit Breaker
	1	230 KV Disconnect Switch
	1	13.8 KV / 480 V 3000 KVA Station Service Transformer
	1	13.8 KV / 4160 V 3380 KVA Station Service Transformer
	2	480 V GTG MCC
	1	480 V Distribution board
	2	230KV Dead End Towers
	1 Lot	230 KV Insulators and ACSR Cable Bus & Fittings
	1	13.8 KV / 230 KV Generator Step up transformer (2 ea. GTG capacity)
	1 Lot	Project Site free and clear of rock and ground water
	1 Lot	Removal of all unused building foundations, underground piping, etc.
	1 Lot	Site Preparation, Rough Grading, Excavation, and final grading
	1 Lot	Natural Gas Fuel Tie in Point at Plant Boundary with measurement
	1 Lot	#2 Diesel Fuel Supply and Day Tank adjacent to Plant
	1 Lot	Treated Water Supply to Inter-tie Point
	1 Lot	Treated Water for Commissioning and Startup
	1 Lot	Instrument Air to Inter-tie Point
	1 Lot	Waste Water Disposal Line at Inter-tie Point
	1 Lot	Permits for Environmental, Transportation, Building, Construction, Operations, etc.
	1 Lot	Construction & Commissioning Water and 480V three phase power
	1 Lot	Access Roads to site
	1 Lot	Import Duties and Taxes
	1 Lot	Construction lay down area adjacent to project site
	1 Lot	Architectural Treatment and landscaping
<b>CONTRACTOR</b>		
<b>Civil</b>		
	1 Lot	Plant Concrete Foundations
	1 Lot	Plant Paving, Gravel and Pads for Turbine and Generator removal.
	1 Lot	Local Subcontractor(s) Civil Material and Craft Labor
<b>Buildings</b>		
	1	Modular Climatized Control Building
<b>Mechanical</b>		
	2	100% Treated Water Forwarding Pumps
	6	Demineralized Gallon Water Storage Tanks, 21,000 Gallon each
	2	100% Demineralized Water Forwarding Pumps for Turbine Wash
	1	Oily Water Separator
	1	Waste Oil Tank, 10,000 Gallon.
	1	Waste Oil Delivery Pump
	1	Waste Water Tank, 10,000 Gallon
	1	Waste Water Delivery Pump

Material/Responsibility	Qty	Description
<b>Contractor (cont'd)</b>		
<b>Mechanical</b>		
	2	Liquid Fuel forwarding Pumps
	4	Liquid Fuel Filters
<b>Electrical</b>		
	1	480 V BOP MCC
	1	480 V Distribution Board
	1 Lot	BOP 480 V / 120 V Transformers, Lights, Panels etc.
	1	UPS System for Control Room
	4	Welding Receptacles
	1	Plant Grounding Grid
	1 Lot	Lightning Protection
	1 Lot	Cathodic Protection for underground steel piping
	1 Lot	Area Lighting
<b>I&amp;C</b>		
	1 Lot	Plant Instrumentation
	1	Plant DCS System
<b>Construction</b>		
	1 Lot	Construction Tools, Rental Equipment & Rental Cranes
	1 Lot	Temporary Power Distribution
	1 Lot	Local Subcontractor(s) Electrical & Mechanical Craft Labor
	1 Lot	Transportation of all Contractor supplied BOP equipment
	1 Lot	Construction Offices, Storage, Temporary Facilities and Utilities
	1 Lot	Lubricants, Chemicals, Filters, etc. for Plant Commissioning
	1 Lot	Balance of Plant Start up and Commissioning Spare Parts
<b>Engineering</b>		
	1 Lot	Conceptual and Detail Design Engineering (Total Plant)
<b>Project Management</b>		
	1 Lot	Project Management with QA/QC, safety, and training
	1 Lot	Plant Commissioning and Testing
	1 Lot	Overall Plant Training

## Section 3.0 Plant Major Equipment Description

The following is a brief description of equipment and the proposed manufacturer for the balance of plant equipment. Note: Items identified by (\*) are part of the Southaven Plant purchased by CORPOELEC.

### 3.1 Mechanical Equipment

3.1.1 Two (2) each natural gas fueled GE Model 7121 Frame 7EA Gas Turbine Generator (See Scope of Supply in Appendix 12.1) – Supplied by Owner (\*). These units will be converted to dual fuel by Contractor however the price for this conversion is not included in this proposal.

3.1.2 Exhaust Stack - Free standing vertical exhaust stacks will be furnished by Owner (\*) and installed by Contractor. The stack will be internally insulated with silencer.

Scope of supply is as follows:

- Expansion joint
- Transition duct
- Elbow duct with access door
- Emissions ports
- Ladders and platforms
- All bolting hardware, gaskets, and field insulation
- Painting per Owner selected color

Typical design characteristics of the stack to be provided are as follows:

Approximate Stack Height	100 feet
Near field silencing-at 3ft/5 ft above grade	85 dB(A)
Far field silencing –at 400ft/5ft above grade	59 dB(A)
Exterior Casing Material	ASTM A36 carbon steel
Interior liner material	409 stainless steel
Insulation material	High temperature ceramic fiber

3.1.3 Lube Oil Cooling Water Coolers for Two Gas Turbines with – Two (2) 100% lube oil cooling sump pumps Supplied by Owner (\*).

3.1.4 Natural Gas – Contractor will install fuel gas scrubbers, heaters, and regulators which will be furnished with the (2) each gas Turbine Generators. Contractor will run fuel gas interconnect piping to the Owners' pipeline header system located adjacent to the Power Plant. The Owner will be responsible for the actual tie into the existing pipeline.



- 3.1.5 Liquid Fuel – Contractor will modify the (2) each Gas Turbines to run on liquid fuel complete with all package piping, instrumentation, etc. however the price for this conversion is not included in this proposal. Contractor will furnish and install redundant liquid fuel forwarding pumps from the Owner furnished day tank along with redundant liquid filters for each gas turbine.
- 3.1.6 Treated Water – Contractor will install Treated Water interconnect piping to the Owners' pipeline header system. The Owner will be responsible for the actual tie in. Contractor to furnish and install 126,000 gallons of Treated Water Tanks with redundant forwarding pumps to supply the inlet air fogging system and the turbine water injection system. This will include redundant Treated Water Filters for each Turbine.

Treated Water will meet the following specifications:

	6.0	Limit	Test Method
Total Matter, PPM, Max	5		ASTM D1888
Dissolved Matter, PPM, Max	3		ASTM D1888
PH*	6.0-8.0		ASTM D1293
Conductivity*, Micromhos/CM 25°C, Max	0.5-1.0		ASTM D1125
Sodium + Potassium	0.1		ASTM D1428
Silicon Dioxide, PPM, Max	0.1		ASTM D859
Chlorides, PPM, Max	0.5		ASTM D512
Sulfates, PPM, Max	0.5		ASTM D516

\* Measured when water is free of carbon dioxide.

- 3.1.7 Fire Water – If required, the contractor will install Fire Water interconnect piping to the Owners' pipeline header system. The Owner will be responsible for the actual tie in. The contractor will furnish and install the underground fire water piping system complete with Monitors and Hydrants for the plant.
- 3.1.8 Oily Water Separator – Contractor will furnish an Oily Water Separator as manufactured by Highland Tank to receive the drains from the Gas Turbines, GSU, and other oily water sources. The separator will have a gravity flow rate of 150 GPM. Waste Oil from the Oily Water Separator will be routed to a 10,000 gal storage tank with a forwarding pump to pump oil to a waste oil truck. The waste water will be routed to a 10,000 gal waste water tank with a forwarding pump which will pump the waste water to the waste water pipeline header system adjacent to the plant.
- 3.1.9 Instrument/Service Air – Instrument and Service air will be supplied by the Owner through it existing header system adjacent to the plant. Contractor will supply and install the instrument air system within the plant up to the inter-tie point.
- 3.1.10 Piping, Piping installation and Piping Insulation-The piping for the facility will be fabricated and installed per the Power and Boiler Piping Code, ANSI B31.1. The fuel gas and steam piping shall be installed in accordance with ANSI B31.1 Power Piping.

All pipe welds to be done by individuals certified to ASME Section IX. Piping materials will be provided according to the piping specifications that can be found in the Appendix under Section 12.6.

Fuel gas, oil, water, and hydraulic pipe welds will also be performed in accordance with ASME. Acceptance criteria will be indicated in ANSI B 31.1.

All underground carbon steel piping shall be wrapped or coated and cathodically protected. Carbon steel piping shall be jeepped prior to cover. Cathodic protection will be provided by the passive method which utilizes protective anodes and provides inspection coupons at strategic locations to monitor for potential corrosion.

Piping insulation will be provided for all steam piping to meet the requirements of the hot piping insulation specifications located in the Appendix under Section 12.

- 3.1.11 Cathodic Protection System – The cathodic protection system will be installed to control the electrochemical corrosion on the exterior surfaces of underground carbon steel, stainless steel. The bottoms of soil or sand pad mounted steel tanks, the exterior surfaces of underground ductile or cast iron pipe will be installed with Cathodic protection will be CP protected as well.

### **3.2 Electrical      Equipment**

- 3.2.1 Generator Step-up Transformer – The GSU Transformer is per the following information:

- **Gas Turbine GSU – Owner Supplied (\*)**  
13.8KV delta primary voltage and 230 KV wye secondary voltage
- Standard high voltage, full capacity de-energized taps at  $\pm 2 \times 2.5\%$  with switch provisions for padlocking.
- Overhead outdoor type bushings for high and low voltage and neutral connections with spade type connectors for cable connections.
- Cooling fans at 400 V 3-phase auto controlled from winding temperature
- Standard ANSI accessories for alarms and control and sudden pressure trip.
- One (1) bushing current transformers on each HV bushing for relay accuracy.
- One (1) bushing current transformer on neutral bushing.
- Station type lightning arrestors on HV side.

- 3.2.2 **230 KV SF6 Circuit Breaker & Disconnect – Owner Supplied (\*)**

- 3.2.3 **13.8 KV GTG Circuit Breakers – Owner Supplied (\*) - Each GTG will be 5000 amp, 3-phase, 60 HZ, 3-pole.**

3.2.4 **Auxiliary Transformers – Owner Supplied (\*)** - The auxiliary transformers are as follows:

- One (1) Pad mounted 13.8 KV / 480 V, 3000 KVA, 3-phase, 60 Hz, oil filled, 65°C rise OA.
- One (1) Pad mounted 13.8 KV / 4160 KV, 3380 KVA, 3-phase, 60 Hz, oil filled, 65°C rise OA.

3.2.5 Power Distribution Center “PDC” – Owner Supplied (\*). The “PDC” is equipped with 480V Distribution Panels and BOP MCC’s. It is a Climatized Modular Building

3.2.6 480 Volt Distribution Switchboard – Owner Supplied (\*). This equipment is indoor, metal enclosed, floor mounted cabinets containing distribution breakers, mounted in “PDC”.

3.2.7 480 Volt BOP MCC - Owner Supplied (\*) – NEMA 1, indoor, with combination starters and breakers with NEMA class 1 type B wiring mounted in “PDC”.

3.2.8 PEEC Building – Owner Supplied (\*) - Each Gas Turbine is equipped with a PEEC Building which houses the Turbine control Panel, Generator Control Panel, GTG MCC Batteries and Chargers.

3.2.9 480/220-120 V Auxiliary Transformers –The low voltage transformers shall be indoor floor mounted, single and three phase as required for low voltage power.

3.2.10 Grounding and Lightning Protection – The plant and substation will be equipped with grounding system which is solidly tied into all plant equipment.

Ground conductors shall be sized in accordance with the NEC, below grade ground grid shall be a minimum of #4/0 AWG bare copper. Grounded neutral conductors shall be protected by a non-metallic conduit, where conductors run exposed above grade.

Ground rods shall be copper-clad steel, and shall not be less than ¾ inch in diameter by 10 feet in length. Each ground rod shall be driven into the ground. If the specified ground resistance cannot be met, longer ground rods or additional rods shall be installed and interconnected until the specified resistance is obtained. Connect ground rods 30 inches below grade.

Connections above grade shall be made with exothermic welds or compression connectors bolted to skidded equipment or structural steel. Connections below grade shall be made via an exothermic-welding process.

A ground loop inside, and a ground rod for manholes will be provided.

3.2.11 Lightning protection will be in accordance with NFPA 780 guidelines and provided where required for plant structures and well pumps. The structures requiring lightning protection shall be determined during detailed design by a lightning protection study conducted by the Contractor

- 3.2.12 Cable Tray - The cable tray shall provide support to electrical cable which is routed throughout the plant either directly to Equipment or to areas of concentrated electrical loads. All cable trays shall be of ladder type construction with a maximum rung spacing of 9 inches, nominal depths of 4 to 6 inches, and various widths as required. The cable tray shall be aluminum. There shall be a maximum spacing of 10 feet between cable tray supports, except fittings (elbows, tees, etc.) which shall be supported in accordance with NEMA standards.

Cable tray fittings shall have a radius equal to or greater than the minimum bending radius of the cables they contain.

Individual tray systems shall be established for the following services:

- 13.8 kV
- 480 volt power cables.
- Control cables.
- Special noise-sensitive circuits and instrumentation cables.

Further division shall be provided where required by individual Equipment manufacturers, particularly the GTG.

- 3.2.13 Conduit shall be used to extend circuits from cable tray, cable trenches, manholes, or wireways to equipment or cabinets, and for circuits between equipment and cabinets.

Conduit shall be used to protect conductors to individual devices, in hazardous areas, and where the quantity of cable does not economically justify the use of cable tray. All conduits shall be non-metallic or PVC covered rigid steel.

Raceway for communications, lighting, and receptacles, and installed in finished indoor non-hazardous locations may be PVC covered EMT.

PVC conduit shall be used for roadway lighting, duct banks, and for some below grade runs. Type EB PVC conduit shall be concrete encased. Schedule 40 PVC conduit shall be concrete encased or direct buried.

Rigid galvanized steel (RGS) with PVC cover shall be utilized for underground service, duct bank risers and bends, and elsewhere as specified.

- 3.2.14 Duct Bank - Duct bank shall be utilized when other types of raceway are not practical due to interferences with equipment or maintenance access and to route cables to remote areas.

All underground duct banks shall consist of PVC or RGS conduit encased in concrete. Reinforcing shall be furnished under all roadways, driveways, and as determined by the Contractor during detailed design. The nominal diameter of the ducts shall be no less than 2 inches and no greater than 5 inches. Galvanized steel conduit shall be installed

where required for digital and analog low-level circuits requiring noise immunity from adjacent power circuits.

### 3.2.15 230 KV Substation Inter Tie, Revenue Metering and Interface Relaying

- 230 KV line protective relaying and metering to be supplied by others.
- Contractor will install 230 KV GSU Transformer, SF6 Breaker, 230 KV Disconnect. Contractor will connect the 13.8 KV to low side bushings, Owner will perform all work from 230 KV high voltage bushings on GSU.

### 3.2.16 Power Cable

#### (1) 13.8 KV Power Cable

13.8 KV power cable shall be single-conductor, class B, stranded-copper, with extruded semi-conducting stranded shield, high-temperature extruded EPR insulation, extruded semi-conducting insulation shield, uncoated copper tape shield, and overall flame retardant CPE or Hypalon jacket. The cables shall have 133% insulation level. The uncoated copper tape shield maximum continuous operating temperature and short-circuit temperature of conductors shall be 105° and 250°C, respectively.

#### (2) 600 V Power Cable

The 600 V power cable shall be single conductor, class B, stranded annealed copper, with XHHW type insulation. The maximum continuous operating temperature of the conductors shall be 90°C in wet or dry locations. The minimum conductor size shall be #12 AWG routed in trays, conduits, or electrical ducts.

### 3.2.17 600 V Control Cable

The 600 V control cable shall be multi-conductor, class B, stranded annealed copper, with XHHW type insulation. The maximum continuous operating temperature of the conductors shall be 90°C. Each cable shall have at least 10% spare conductors (at least one spare for cables with fewer than 10 conductors). The minimum conductor size shall be #14 AWG, unless connecting a current transformer the minimum conductor size shall be #10 AWG. Color coding shall be NEC approved color scheme K-2.

#### (1) 300 V Instrumentation Cable

Instrument cable shall be 300 V, single twisted pair, or triad structured copper conductors, XHHW insulated, overall shield, XHHW jacketed, approved for cable tray use. The maximum continuous operating temperature shall be 90°C. Color coding shall be black & white for pairs and black, white, red for triads.

#### (2) Thermocouple Extension Cable

Thermocouple extension cable shall be used for extension leads from thermocouples to junction boxes and to instruments for measurements of temperature. Thermocouple cable shall be single pair or multi-pair shielded thermocouple extension solid conductor cable with a shield over each pair, an overall shield, flame retardant crosslinked insulation, rated for 105°C, CPE overall jacket, and shall be UL listed Type PLTC. The cable shall meet the flame test requirements of IEEE 383.

### 3.2.18 Plant 120 amp 480 V Welding Receptacles

#### (1) 120 Volt Convenience Receptacles

The Contractor will provide 220 volt, 15 amp convenience receptacles located around the facility and in all buildings. Location in buildings shall be in accordance with the local building codes and NEC requirements. It is understood maintenance workers will have 50-foot extension cords.

The control room shall have two (2) receptacles connected to the UPS system for each CRT, printer, and workstation installed.

The Contractor will provide welding receptacles as required through out the plant.

## 3.3 Instrumentation and Control

3.3.1 Gas Turbine Control Panel (GTGCP) – The GTG Control Panel is included as part of the GE Gas Turbine Package and is installed in the PEEC Climatized Control Building.

3.3.2 Plant Distributed Control System (DCS) – A Plant control system based on DCS technology is provided. The system interconnects the Balance of plant systems, and gas turbine to a central PLC computer based control system. Specifications and a detailed description of the DCS system are included in the appendix under section 12. The DCS System is housed in the Modular Climatized Control Building.

### 3.3.3 Plant Instrumentation

#### (1) General Installation

All instruments will be located where they will be accessible from ladders, platforms, or grade. All locally mounted indicating instruments shall face forward toward the normal operating area and shall be within reading distance and in the line of sight. Instruments shall be mounted such to make accessible for maintenance.

Signals for analog control system inputs shall be provided from process transmitters at 4-20 mA signal level, or direct wired RTDs and thermocouples. Pneumatic signals shall be 3-15 psi.



(2) Thermocouples and Resistance Temperature Detectors

Thermocouples and extension wire will comply with the standard limits of error according to ANSI MC96.1-1975 and shall be Type K or Type J.

Thermocouples and RTDs shall have stainless steel sheathed elements, spring-loaded to provide good thermal contact with the thermowell.

(3) Thermowells

Temperature sensors shall be equipped with thermowells and of one piece, solid bored Type 316 stainless steel (or higher alloy if required for the application) of step-less tapered design. Maximum bore internal diameter shall be 0.385 inches.

(4) Flow Elements and Flow Meters

Flow elements shall be provided in accordance with appropriate applications.

All flow measurements shall be taken using orifice plates, vortex shedding meters, magnetic flow meters, or other Owner approved equals.

Magnetic flow meter suitable for well water applications shall be rated for continuous submergence.

(5) Transmitters

Transmitters shall be of the smart electronic two-wire type, HART compatible and capable of driving a load of at least 500 ohms with non-interacting zero and span adjustments and remote recalibration features. Transmitters shall provide a 4-20 mA signal for signals to the BOP control system. The accuracy of all transmitters shall be 0.5 percent of the calibrated range or better. Repeatability shall be 0.1 percent or better. Transmitters utilized for measuring differential pressure, flow, and level shall be furnished with a preassembled valve manifold suitable for mounting directly on the transmitter. All parts of the transmitters in contact with the process medium shall be constructed of Materials suitable for the application and pressure-temperature conditions encountered. Transmitters are to be Fisher Rosemount.

(6) Gas Meters

Fuel gas certified fuel flow metering will be provided by the GTG Vendor. Fuel flow information will be available through the gas turbine to BOP control system communications interface. The plant fuel gas meter was described in an earlier section.

(7) Temperature, Pressure, Level, and Flow Switches

Temperature, pressure, level, and flow switches shall generally have two Form C contacts for each actuation point. Switch set point shall be adjustable with a calibrated scale. Contacts shall be snap acting type. Switch enclosures shall be NEMA 4 for non-hazardous locations, and NEMA 7 or 9 for hazardous locations. All switches shall be voltage sensed from the BOP control system. All switches shall be electrically isolated from ground and from one another.

(8) Local Indicators

a) Thermometers

Thermometers shall be the bimetallic, adjustable, “every-angle” types with minimum 4 ½ inch dials.

b) Pressure Gauges

Pressure gauges shall be of the bourdon tube type with solid front cases, 4 ½ inch dials, stainless steel movements and nylon bearings. Gauges shall have ½ inch NPT bottom connections.

c) Local Level Indicators (Gauge Glasses)

Tubular gauge glasses shall be used for low-pressure applications. All gauge glasses shall be equipped with gauge valves, including a safety ball check.

(9) Control Valves

Control valves shall be used in on-off and modulating service. Globe valves shall be used extensively in water, gas, and oil service with butterfly and ball valves used in limited applications, typically low pressure and temperature water service.

Pressure retaining component and valve trim Materials shall be selected based on process conditions such as type of fluid, static and differential pressures, and temperature.

In general, control valves designed to fail closed shall have ANSI class IV leakage ratings.

Each control valve shall be provided with accessories such as handwheels, filter regulators, solenoid pilot valves, and limit switches as applicable.

(10) Tubing Systems

Instrument, control, and sampling tubing systems shall be designed, fabricated, and tested in accordance with ASME B31.1.



Primary process instrument and sampling tubing shall be ASTM A213 Type 316 SS, 3/8 .049 standard wall or 1/2 inch .065 standard wall, respectively.

Pressure type instruments shall have associated isolation and test valves or combination two-valve isolation/test manifolds. Differential pressure type instruments shall have associated pairs of isolation and test valves plus an equalizing valve or combination five-valve isolation/test/equalizing manifolds. Blowdown valves shall be provided for each remote device as required.

### **3.4 Civil / Structural**

- 3.4.1 Site Preparation – The Owner will perform removal as required of any existing buildings, structures, and underground piping systems on the project site.
- 3.4.2 Site Grading – The Owner will provide all rough and final grading. Grades will be established to minimize the amount of earthwork required to construct the facilities. All areas disturbed during construction shall be graded to a smooth surface and covered with appropriate material as conditions require. Finish grading shall be performed to conform to the finished design elevations for surface drainage and to prepare the areas to receive the specified surface finishes.
- 3.4.3 Storm Water Drainage – The Contractor will design and Owner will provide storm water drainage for rainwater from the site. Storm water will be managed through use of swales, ditches, culverts and site grading to drainage locations within the facility. All rain water collected from active areas that can potentially be contaminated by oil shall be routed through an oil/water separator.
- 3.4.4 Process Waste Water – The Contractor shall route all process waste water to the oily water separator. The process waste water shall include:
- GSU and Aux Transformer Containments
  - Frame 7EA Water Wash
  - Oily Water Separator Waste Water
  - Liquid Fuel Storage

Discharge of waste water shall be routed to a waste water tank for disposal by Interconnect Piping to Pipeline Header System Adjacent to Plant.

- 3.4.5 Plant Gravel, Roads, Paving and Parking – The Contractor will provide for plant gravel, roads and parking as shown on the Plot Plan.

3.4.6 Concrete – Contractor to provide concrete foundations in accordance with the following section:

Contractor to provide design of foundations and anchor bolts.

(1) Codes

Design of structural concrete will be in accordance with the American Concrete Institute (ACI) – “Building Code Requirements for Structural Concrete,” ACI 318, latest edition, and the UBC Code.

(2) Materials

Minimum concrete strength classes for various structures will be as stated.  
Reinforcing bars will conform to ASTM A615, Grade C.

Welded wire fabric will conform to ASTM A185, using bright basic wire conforming to ASTM A82. Wires gauge No. 11 or smaller shall be galvanized.

Spiral reinforcement will conform to ASTM A82.

(3) Placing of Concrete

Contractor will adhere to good and accepted practices in placing concrete generally as outlined:

Placing Concrete:

- Conform to ACI
- Place within 60 minutes after mixing, except site weather conditions may extend the period to 90 minutes (maximum).
- Place in horizontal layers not exceeding 20 inches.
- Vibrate to produce solid mass without honeycomb or surface air bubbles.

Curing Concrete:

- Unless specified to be moist cured, cure with liquid membrane-forming compound conforming to ASTM C309, Type I. Apply according to manufacturers recommendations.
- Apply curing compound to all exposed surfaces immediately after removing form or after finishing concrete.
- Keep formwork wet until stripped.
- Moist curing shall be used for surfaces that will receive a separate finish or coating.

(4) Testing

Owner will test concrete and make test cylinders conforming to ASTM C31, C143, and C172. Owner will make a minimum of four test cylinders for each 150 cubic yards of concrete or fraction thereof, or every 5000 square feet of surface area for slabs and walls, for each day concrete is placed.

(5) Equipment Foundations

The types of foundations and piling, if required and allowable bearing values for soil and rock, will be as recommended by Contractor's Geotechnical Engineer in accordance with the Contractor-provided final geotechnical report.

Design of foundations will be in accordance with ACI 318 and the UBC.

(6) Containment Basins

Containment basins will be provided around transformers and other equipment, which contain oil in case of rupture, spill, or leak. The basins shall be designed in accordance with the NFPA 850 and Factory Manual recommendations.

### 3.4.7 Structural Steel

Contractor will furnish and install necessary structural steel including:

- 1) Piping racks and supports
- 2) Cable Tray supports
- 3) Walkways and platforms
- 4) Grating and supports

Pipe racks and cable tray supports may be a combination of concrete and structural steel. Structural design will be in accordance with the applicable codes and standards.

(1) Wind and Seismic Loads

All structures, tanks, equipment anchorage, and piping and cable tray supports will be designed and installed to resist code-specified wind and seismic loads. Pipe supports shall also be designed for reactions due to pipe stress analyses and support degree of fixity.

(2) Codes

Design of structural and miscellaneous steel shall be in accordance with the 1997 Uniform Building Code (UBC), the American Institute of Steel Construction (AISC) "Specification for Structural Steel Buildings," latest edition and other applicable Codes and Standards in accordance with Section 2.4 of the TSD.

---

**3.5 Plant Buildings**

A Climatized Modular Control Building is to be furnished by Contractor for the DCS System.

**3.6 Plant Lighting****3.6.1 Area Lighting – Owner to Provide****3.6.2 Building Lighting**

Types of building interior lighting fixtures are outlined as follows:

- Control Room – Fluorescent

**3.7 Telephone and Paging**

Furnish and install a complete key type telephone system including but not limited to the following: incoming Owner lines, and incoming trunk line from the local phone company suitable for the service but not less than eight (8) pairs. Surge arrestors, punch-down blocks for all circuits, and speakers for paging are included. Analog key phones in each electrical equipment room, office, control room, and the GTG control building. Provide two (2) phone lines, one (1) fax line, a phone jack for computer internet connection, and network connections for three (3) computers in the control room. Surge arrestor equipment will be installed in out-lying buildings. Furnish and install all grounding. Furnish and install all telephone equipment including wall jacks, key type desk phones and wall phones, (total not to exceed 32) racks, panels, raceway, terminal blocks, cable, plugs, labels, and patch cords.

The system will allow paging from any telephone. The system will be designed so that paging can be heard from anywhere in the plant. Loud speakers to be installed on area lighting poles or other elevated structures per detail design.

## **Section 4.0 Design Basis and Interconnect Points**

### **4.1 Design Basis**

#### **Design Conditions**

Site Elevation	50 ft.
Air Temperature, High	104°F
Air Temperature, Low	60°F
Design Temperature	85°F
Relative Humidity	60%
Wind Speed	8 mph
Gas Turbine Power	75 MW net each Gas Turbine
High Voltage Interconnect	230 KV
Natural Gas Usage	21.2mm SCFD per Turbine 42.4mm SCFD Total
Liquid Fuel Usage	126 GPM per Turbine – 252 Total
Liquid Fuel Storage	120,000 Gal – 8 hr Supply – By Owner
Treated Water Injection	111 GPM per Turbine – 222 Total when on Diesel Fuel
Inlet Air Fogging	25 GPM per Turbine – 50 Total
Treated Water Usage	272 GPM Total
Treated Water Storage	125,000 Fiberglass Tanks by Contractor, 8 hr supply
Firewater System	Fire Water Supply by Owner
Waste Oil Storage	10,000 Gallons by Contractor
Waste Water Storage	10,000 Gallons by Contractor
Instrument/Service Air System	85 SCFM by Contractor

### **4.2 Interconnect Points**

Natural Gas at min. 450 psig	Pipeline Header System Adjacent to Plant
Liquid Fuel Storage	Owner Furnished 120,000 Gal Tank Located Adjacent to Plant
Instrument / Service Air	85 SCFM Supply by Owner to Header System Adjacent to Plant
Treated Water Supply	Pipeline Header System Adjacent to Plant
Plant Waste Water	Pipeline Header System Adjacent to Plant
Plant Waste Oil	Plant Waste Oil Tank.
Fire Water Supply	Pipeline Header System Adjacent to Plant
230 KV	Connection to Utility via dead end structure at Substation battery limits.



## **5.0 Plant Performance**

**See attached GE Frame 7EA Performance Summary**

# General Electric Model PG7121EA Gas Turbine

## Estimated Performance - Configuration: DLN Combustor

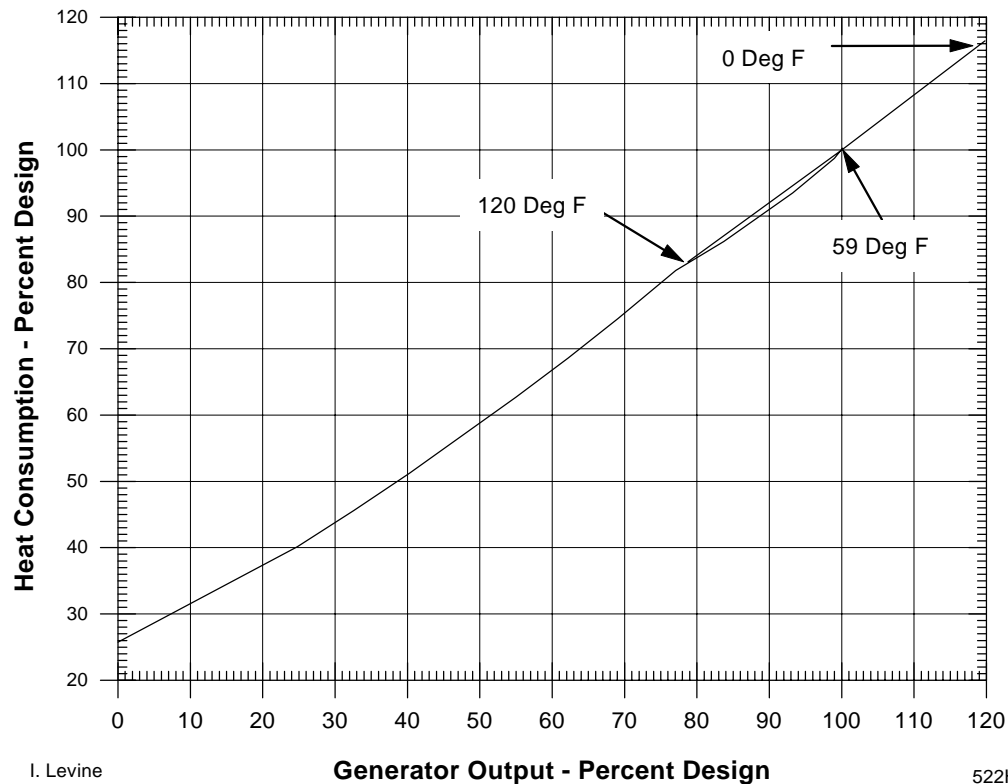
Compressor Inlet Conditions 59 F (15 C), 60% Relative Humidity  
Atmospheric Pressure 14.7 psia (1.013 bar)

Fuel:			Natural Gas	Distillate
Design Output	kW		84360	82890
Design Heat Rate (LHV)	Btu/kWh (kJ/kWh)		10480 (11050)	10570 (11150)
Design Heat Cons (LHV)	Btu/h (kJ/h)x10 <sup>6</sup>		884.1 (932.5)	876.1 (924.2)
Design Exhaust Flow	lb/h (kg/h)x10 <sup>3</sup>		2361 (1071)	2368 (1074)
Exhaust Temperature	deg. F (deg. C)		998 (536.7)	999 (537.2)
Load			Base	Base

### Notes:

- Altitude correction on curve 416HA662 Rev A.
- Ambient temperature correction on curve 522HA283 Rev 2.
- Effect of modulating IGV's on exhaust temperature and flow on curve 522HA284 Rev 2.
- Humidity effects on curve 498HA697 Rev. B - all performance calculated with a constant specific humidity of .0064 or less as not to exceed 100% relative humidity.
- Plant Performance is measured at the generator terminals and includes allowances for the effects of inlet bleed heating, exitation power, shaft driven auxiliaries, and 3.5 in H<sub>2</sub>O (7.29 mbar) inlet and 5.5 in H<sub>2</sub>O (13.70 mbar) exhaust pressure drops and a DLN Combustor.
- Additional inlet and exhaust pressure loss effects:

	% Effect on		Effect on
	Output	Heat Rate	Exhaust Temp.
4 in Water (10.0 mbar) inlet	-1.40	0.42	1.9F (1.0C)
4 in Water (10.0 mbar) exhaust	-0.42	0.40	1.8F (1.0C)



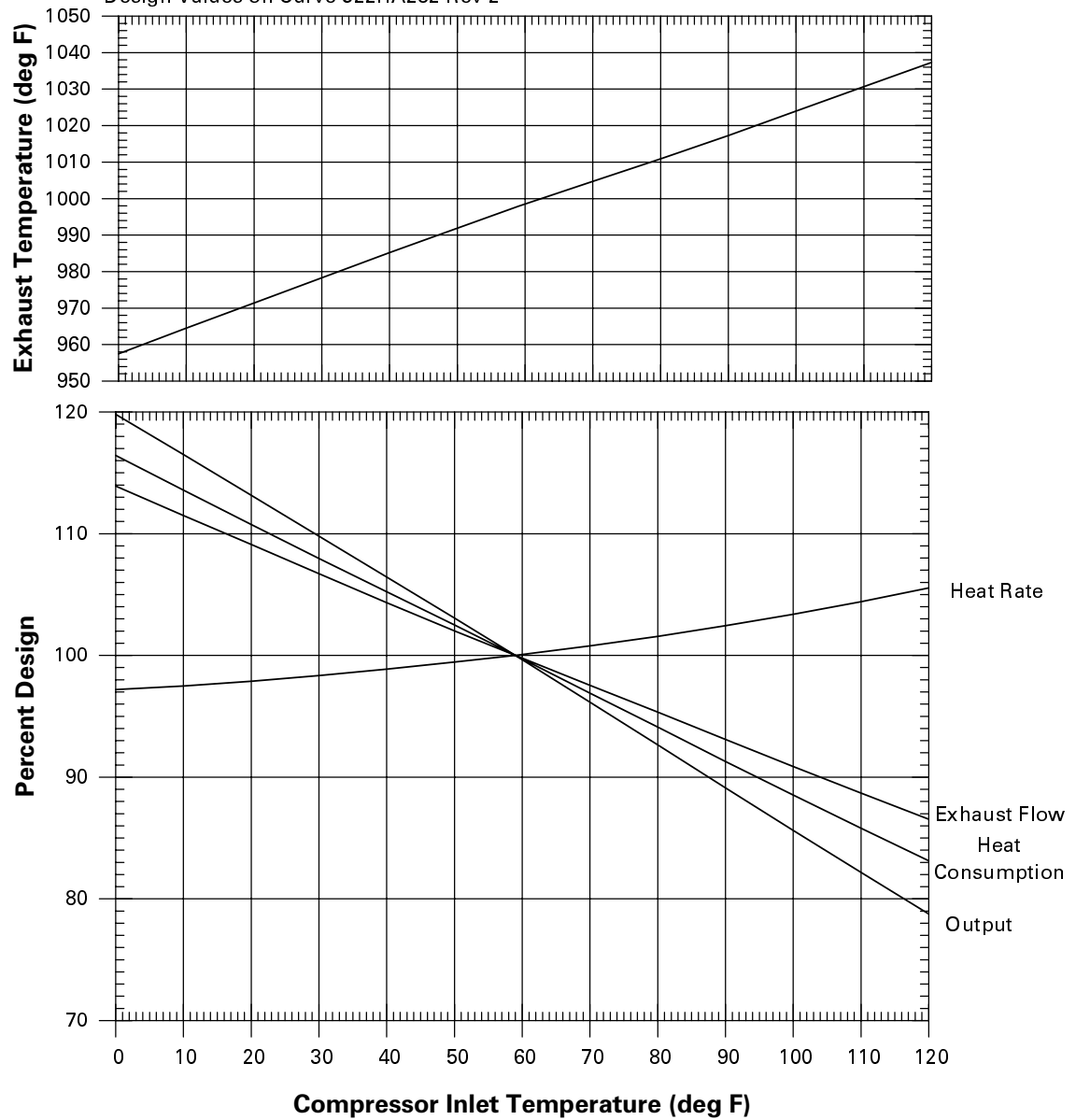
# GENERAL ELECTRIC MODEL PG7121EA GAS TURBINE

Effect of Compressor Inlet Temperature on  
Output, Heat Rate, Heat Consumption, Exhaust Flow  
And Exhaust Temperature at Base Load and 100% speed.

Configuration: DLN Combustor

Fuel: Natural Gas

Design Values on Curve 522HA282 Rev 2

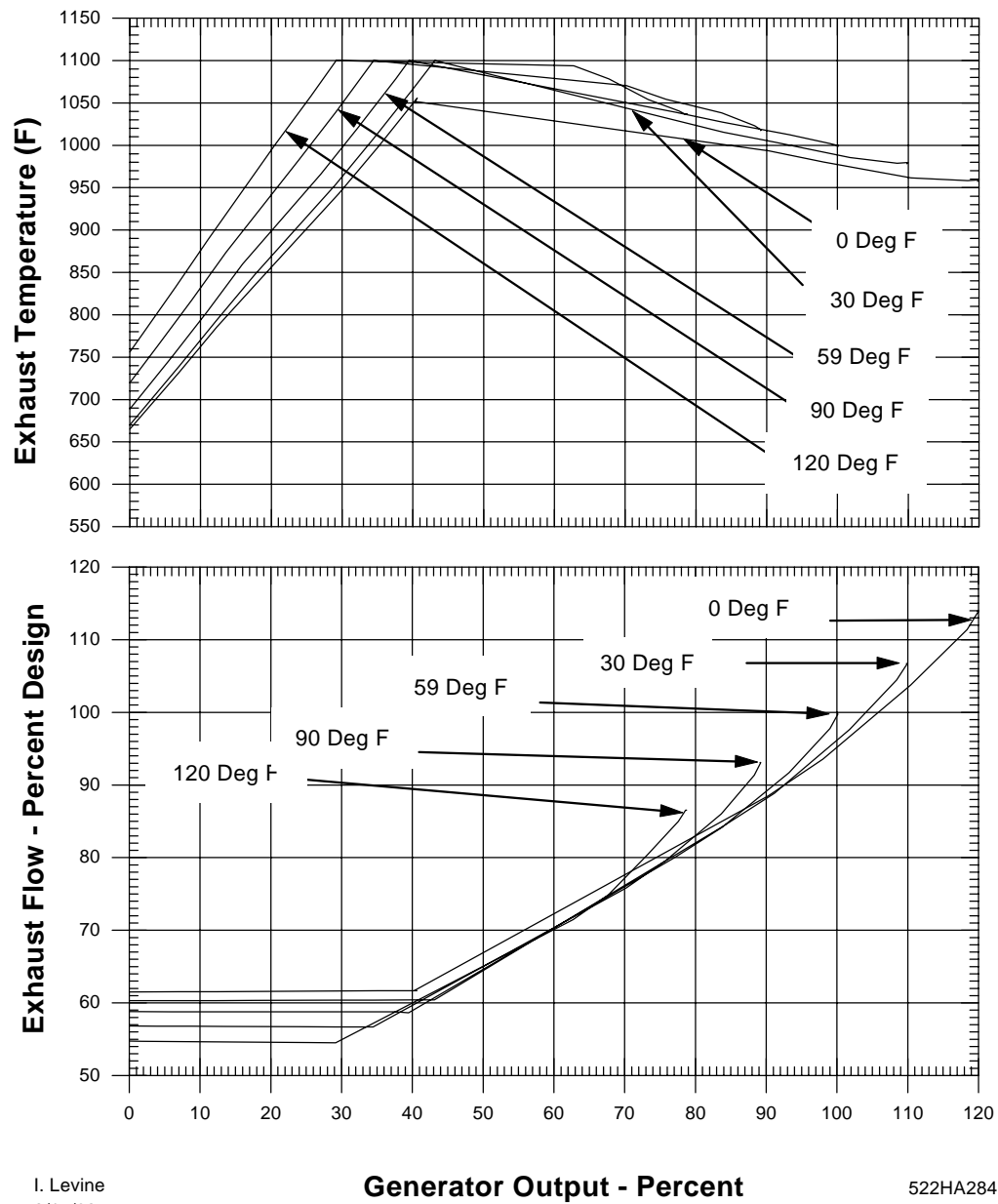




# GENERAL ELECTRIC MODEL PG7121EA GAS TURBINE

## Effect of Inlet Guide Vane on Exhaust Flow and Temperature As a Function of Output and Compressor Inlet Temperature

Fuel: Natural Gas  
Design Values on Curve 522HA282 Rev 2

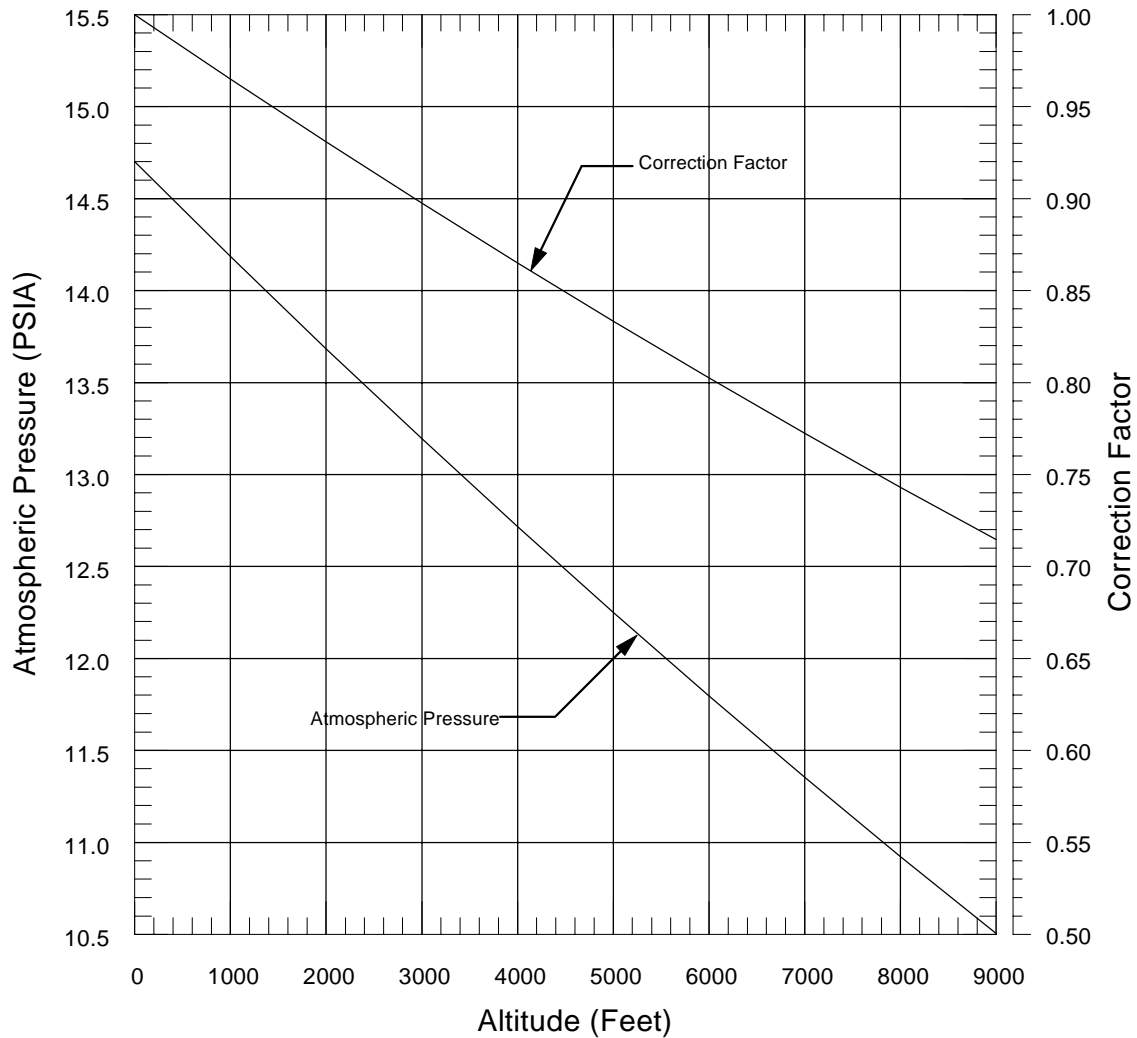


# GENERAL ELECTRIC GAS TURBINE ALTITUDE CORRECTION CURVE

ALTITUDE VS ATMOSPHERIC PRESSURE  
AND  
ALTITUDE VS CORRECTION FACTOR  
FOR GASTURBINE OUTPUT, FUEL CONSUMPTION, AND EXHAUST FLOW

NOTES:

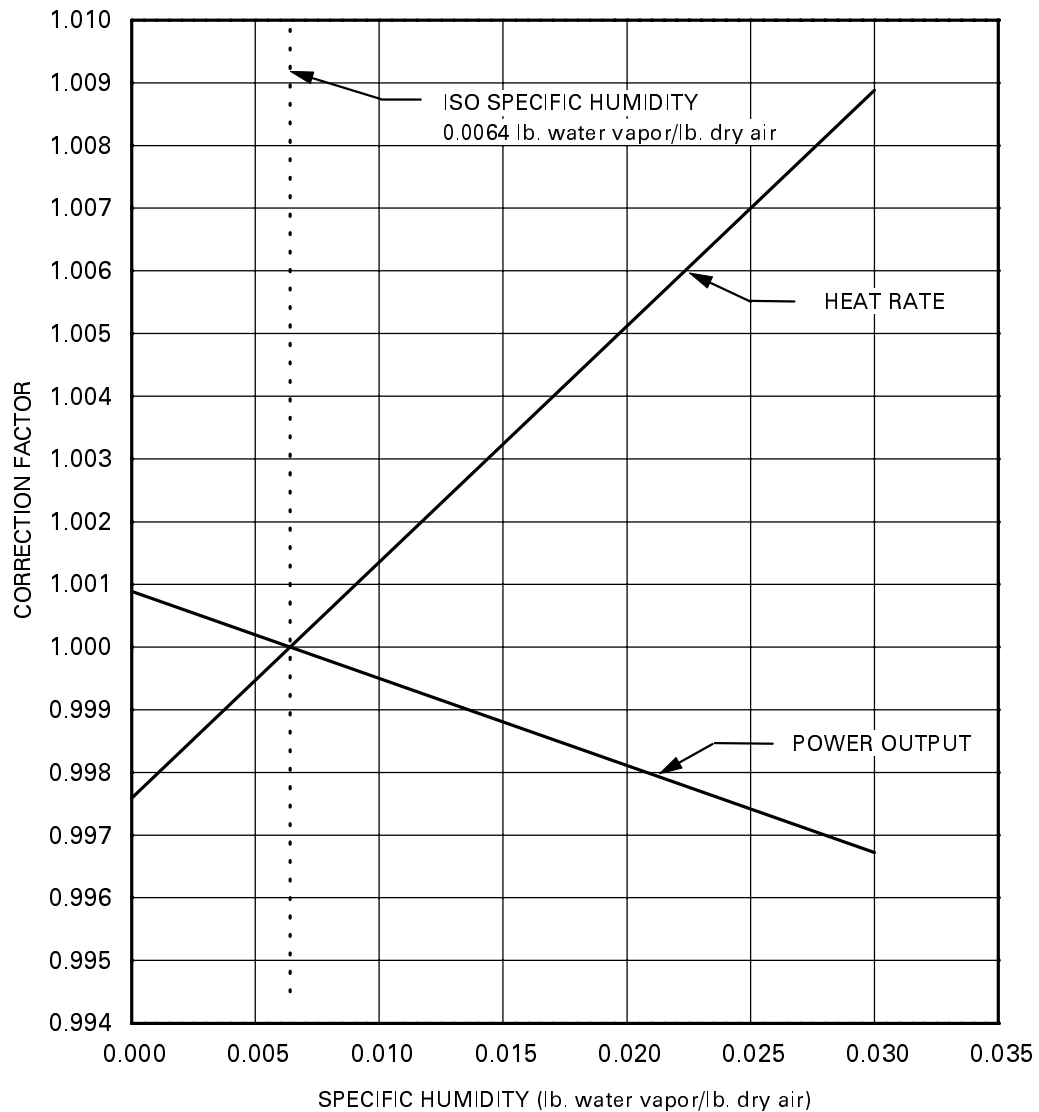
1. Exhaust Temperature, Heat Rate, and Thermal Efficiency are not affected by altitude.
2. Correction Factor =  $P(\text{atm})/14.7$



## General Electric MS6001, MS7001 And MS9001 Gas Turbines

Corrections To Output And Heat Rate  
For Non-Iso Specific Humidity Conditions

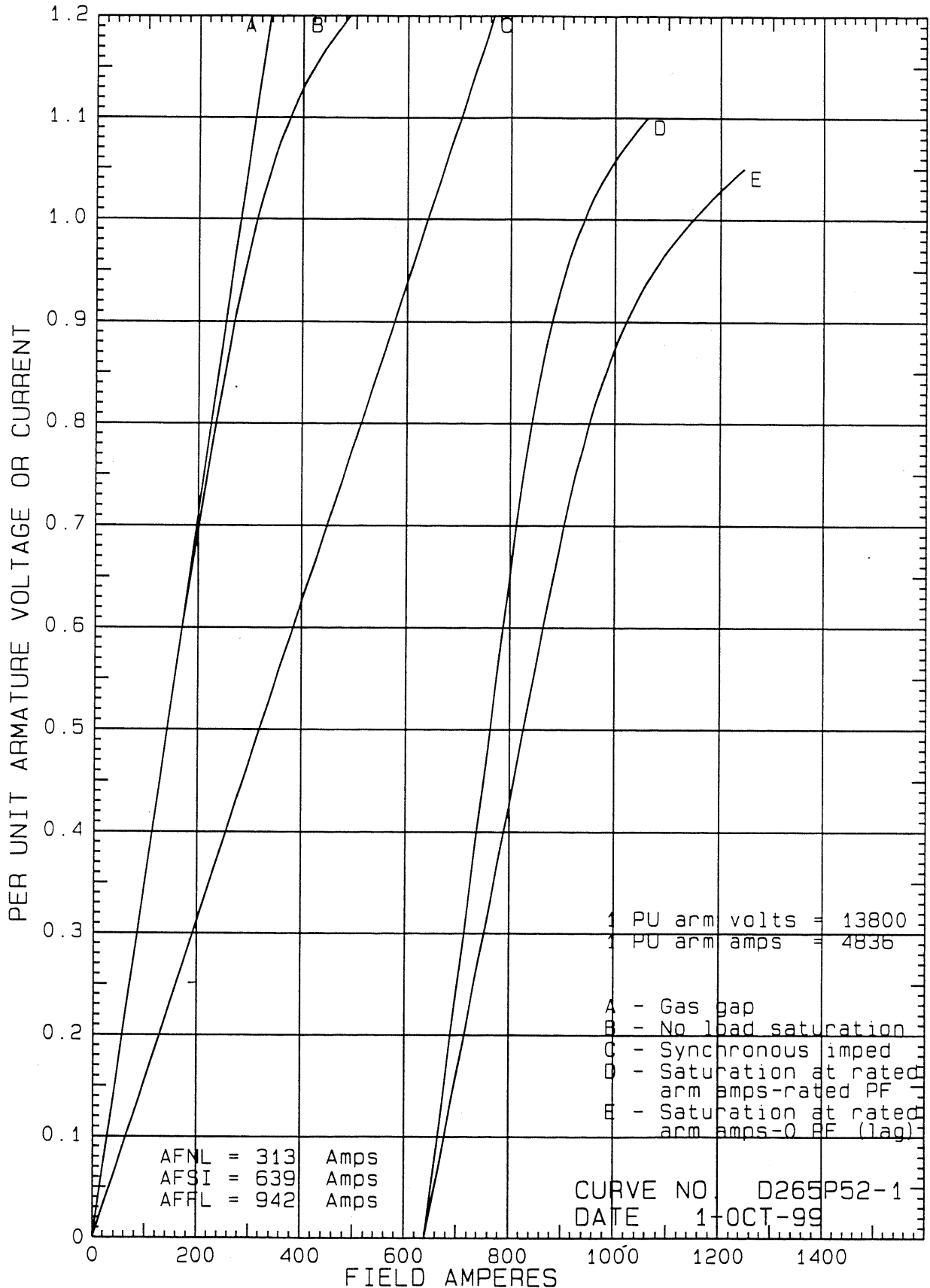
For Operation At Base Load On Exhaust  
Temperature Control Curve



# ESTIMATED SATURATION AND SYNCHRONOUS IMPEDANCE CURVES

115600 KVA - 3600 RPM - 13800 VOLTS - 0.85 PF

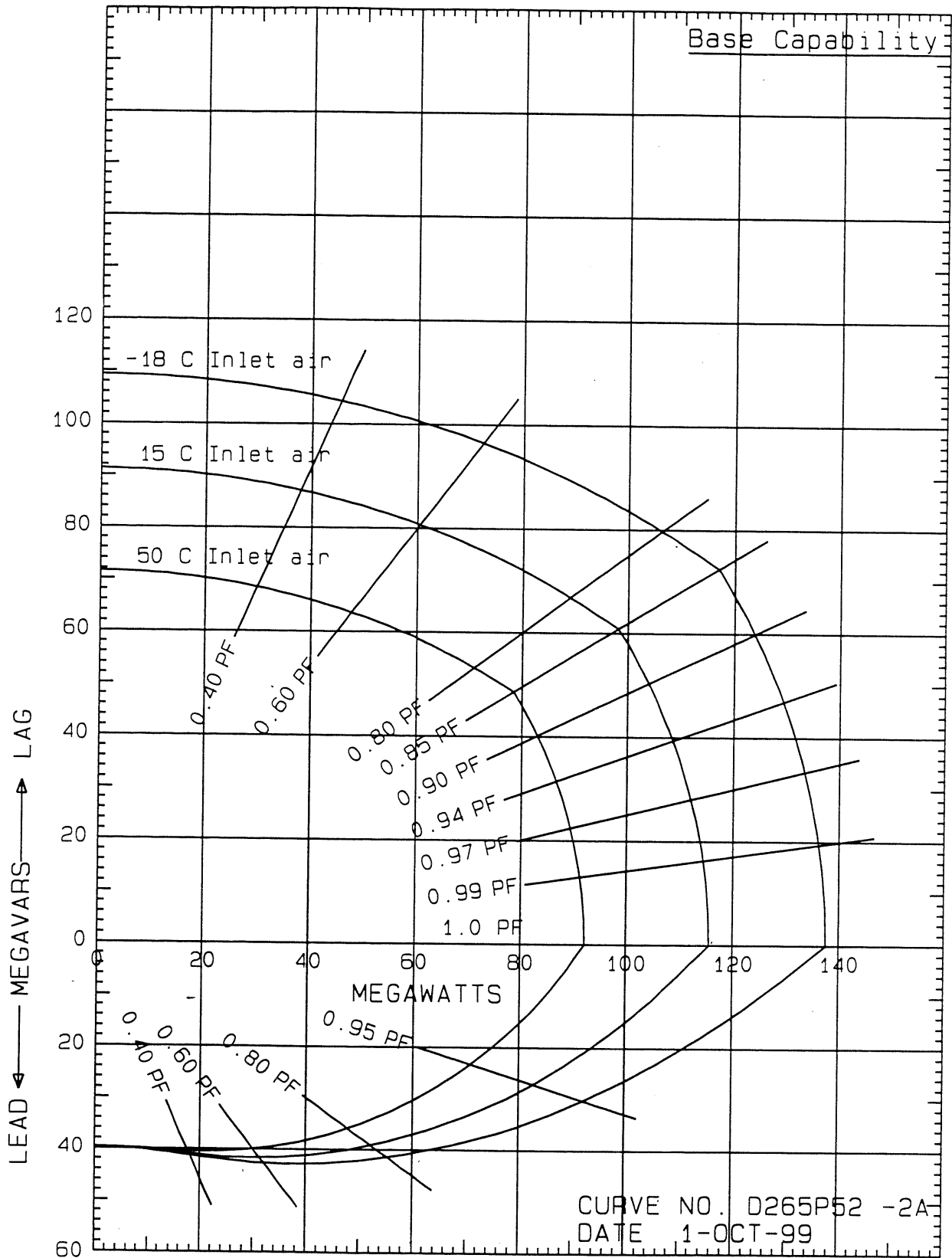
300 FLD VOLTS - 15 C INLET AIR - 0 FT ALT



# ESTIMATED REACTIVE CAPABILITY CURVES

115600 KVA - 3600 RPM - 13800 VOLTS - 0.85 PF

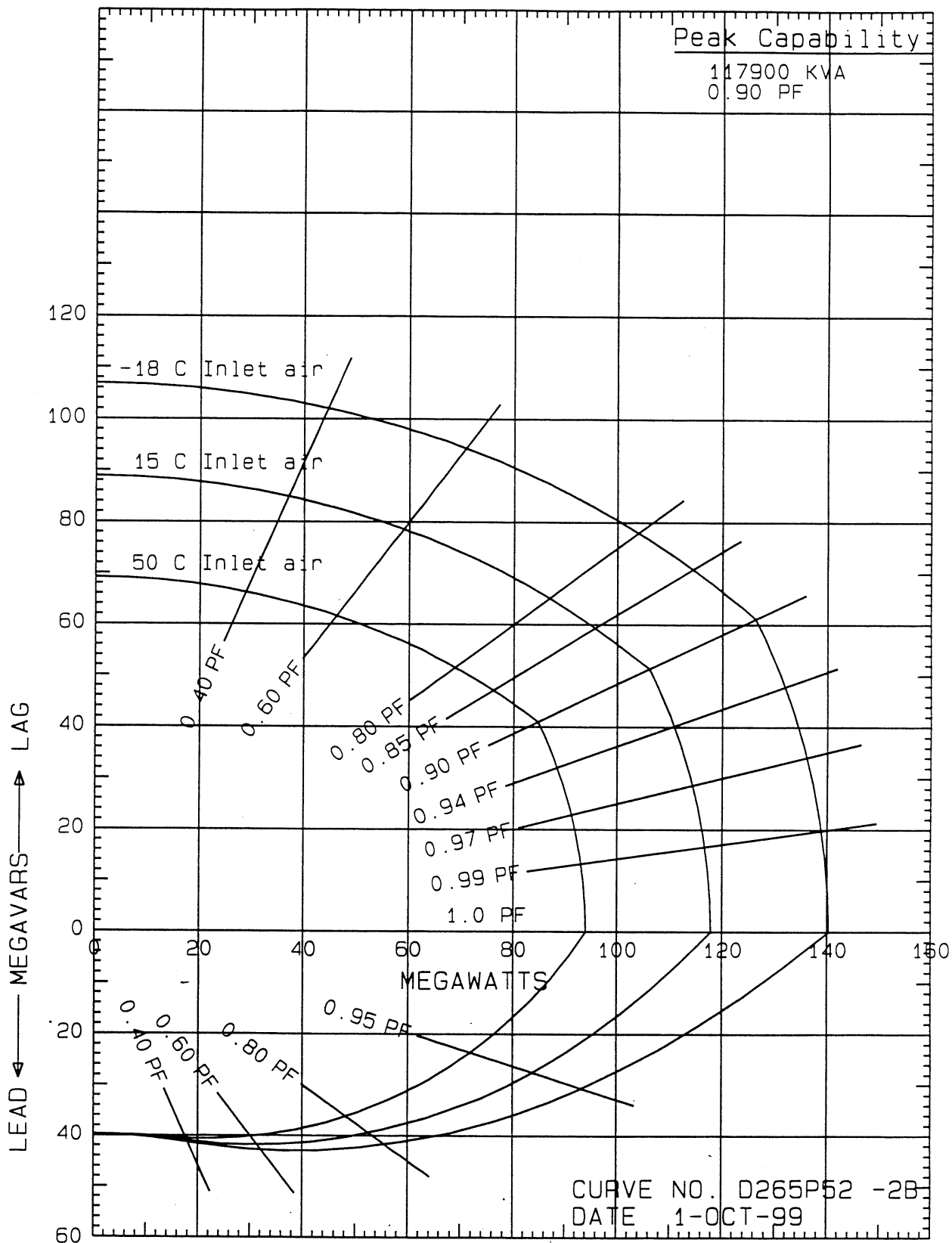
300 FLD VOLTS - 15 C INLET AIR - 0 FT ALT



# ESTIMATED REACTIVE CAPABILITY CURVES

115600 KVA - 3600 RPM - 13800 VOLTS - 0.85 PF

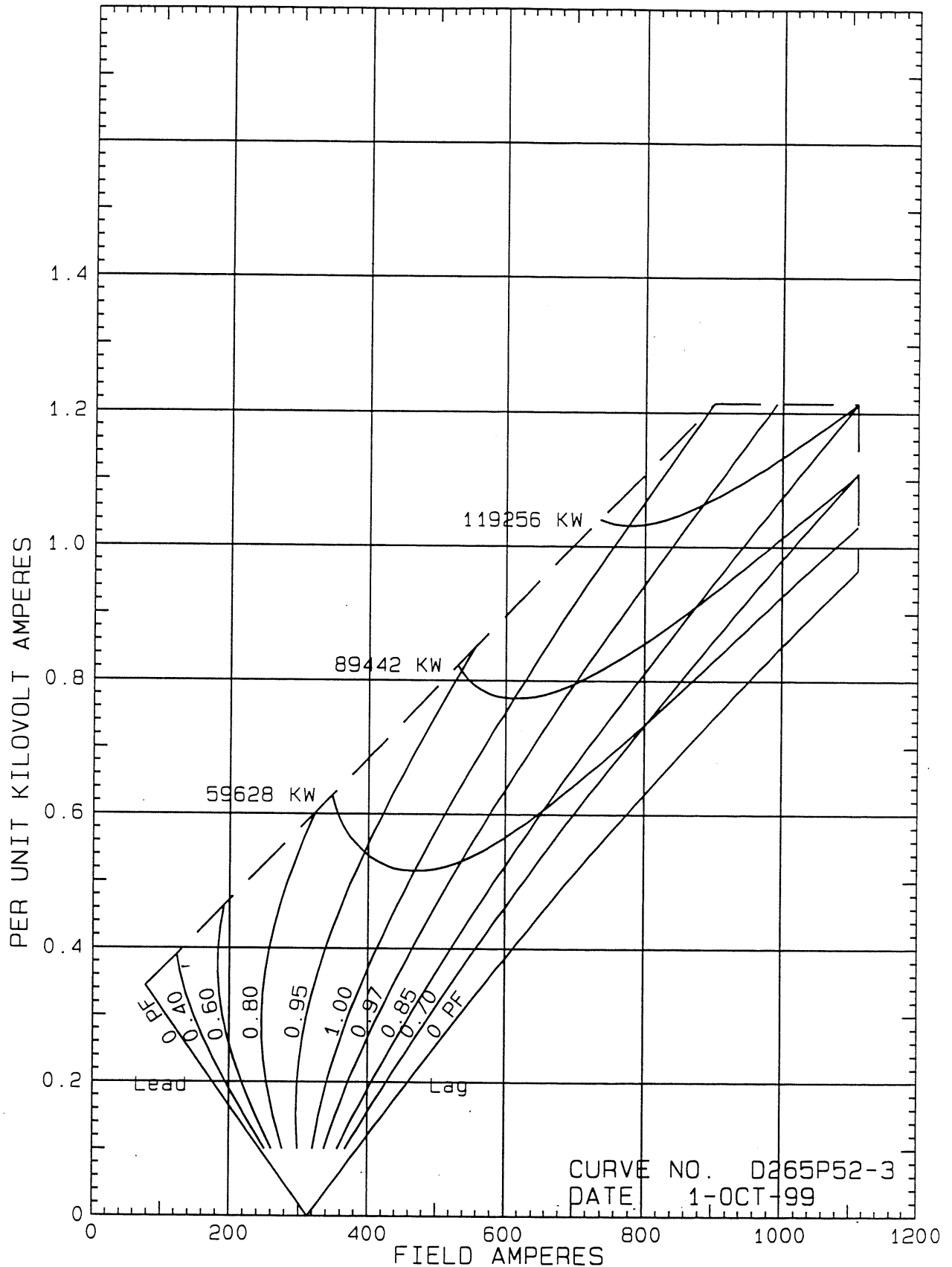
300 FLD VOLTS - 15 C INLET AIR - 0 FT ALT



# ESTIMATED EXCITATION V CURVES

115600 KVA - 3600 RPM - 13800 VOLTS - 0.85 PF

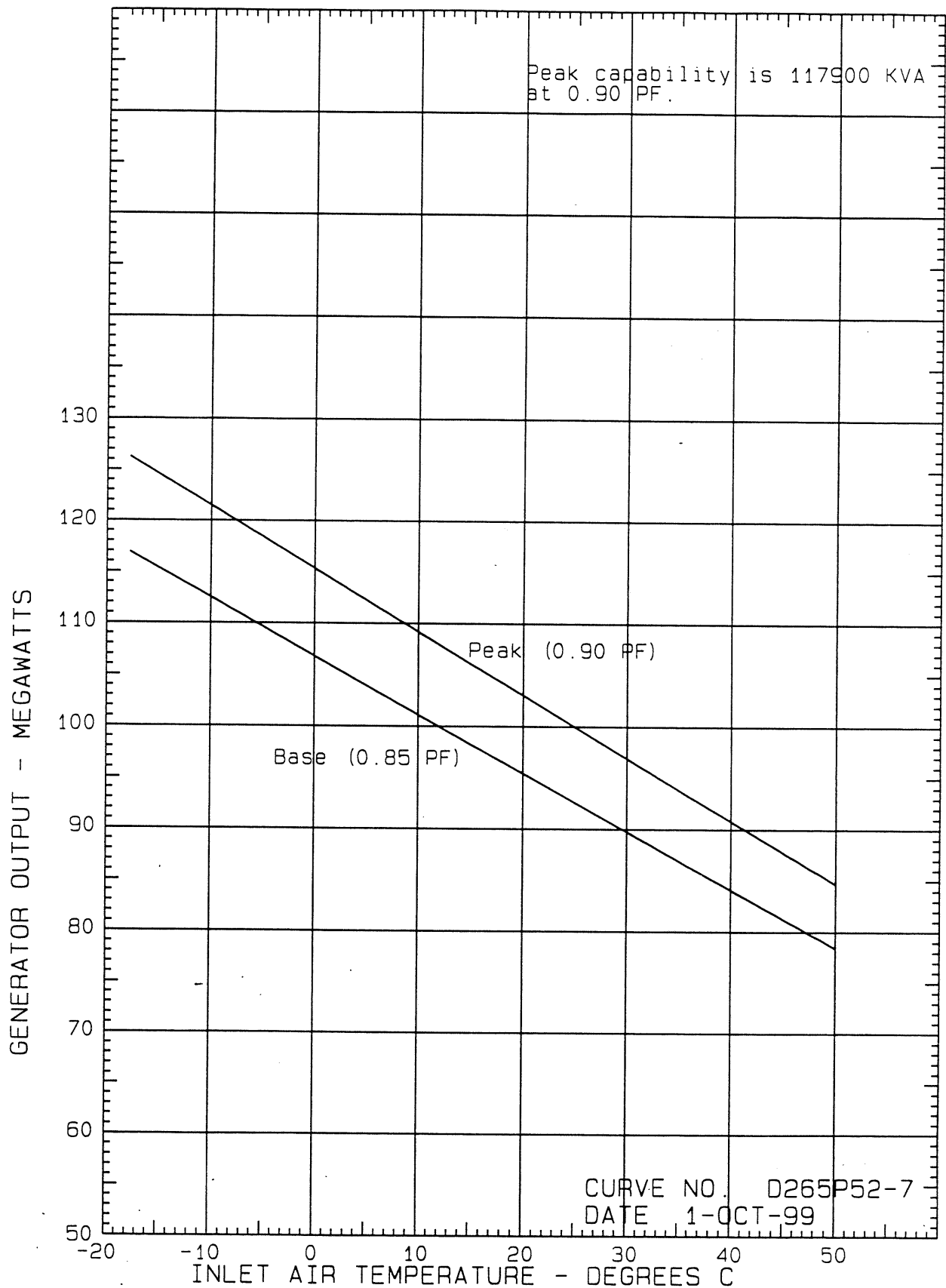
300 FLD VOLTS - 15 C INLET AIR - 0 FT ALT



# GENERATOR OUTPUT AS A FUNCTION OF INLET AIR TEMPERATURE

115600 KVA - 3600 RPM - 13800 VOLTS - 0.85 PF

300 FLD VOLTS - 15 C INLET AIR - 0 FT ALT





## **6.0 Plant and Equipment Warranties**

### **6.1 Equipment Warranties**

Contractor will obtain from all new equipment vendors their warranty on the material and equipment provided. ProEnergy warranties will be for a term of 12 months following the commercial operation date. The warranty for each component will include replacement of the item as well as the Contract labor cost to replace and install for those items not considered a normal maintenance replacement.

This vendor warranty information will be assembled and packaged into a Warranty Manual. The information will be indexed and cross referenced by vendor, component description, model and/or SN, and supply contact (telephone, email and address). A Warranty Manual will be provided to the Owners for use by the operator.

### **6.2 Plant Warranty**

As part of this warranty, Contractor agrees to provide for a period of six months following the commercial operation of the facility, a person responsible for administrating the plant and equipment warranties. This person will be an employee of ProEnergy. He will be available, on call, to manage the warranty items.

---

## **Section 7.0 Project Management and Organization**

### **7.1 Project Management Execution**

#### **7.1.1 Project Management Team (Typical)**

The Contractor will assemble a well qualified and experienced team of individuals who have worked together on many previous projects.

The team will be comprised of:

- Project Manager
- Administration Manager
- Project Technical Consultants
- Construction Manager
- Purchasing / Expediter
- Scheduling
- QA/QC
- Project Engineering Manager
- Site Erection
- Commissioning / Start up Managers
  - Mechanical
  - Electrical
- Mechanical Construction Superintendent
- Electrical Construction Superintendent
- Training

The team as outlined above has worked together on many gas turbine generator power plants within the US as well as internationally. They have successfully completed a number of “Fast Track” projects internationally.

#### **7.1.2 Project Manuals**

One of the first tasks to be initiated is the preparation of the project specific project manuals. These manuals are listed:

- Project Procedures
- Project Implementation
- Project Engineering Calculations
- Project Warranties
- QA/QC
- Safety

- Training
- Operation and Maintenance
- Commissioning, Start Up, and Turnover
- Project Performance Tests

### **7.1.3 Project Schedule**

Along with the commencement of preparation of the project manuals, the detailed project schedule will be started. This detailed schedule will be developed utilizing Microsoft Project. The project schedule will be a living document which will be continually updated by a full time assigned scheduler for the life of the project. The proposed project schedule is included in Section 8.0.

### **7.1.4 Project Engineering**

Preliminary conceptual engineering has been developed during the proposal phase which consists of:

- General Arrangement Plot Plan
- Process Flow Diagram
- One Line Diagrams

The conceptual drawings listed above are immediately completed after project Notice to Proceed. This entails updating the various drawings based on final agreed upon items with the Owner and/or Owner's Engineer. The Process Flow Diagram is completed with the latest heat and material balance. The One Line Diagrams are further developed to reflect loads, breaker / fuse sizing, DL power, etc. The Control System Drawing is likewise further completed reflecting agreed upon HMI's, printers, Balance of Plant Equipment PLC's, etc.

The conceptual engineering is completed utilizing the project technical consultants (responsible for proposal preparation) and the detailed engineering team to guarantee a smooth hand over to the detailed engineering phase.

During the conceptual engineering phase, specifications are finalized for all engineered equipment to be purchased. On a "Fast Track" project most of the engineered equipment has been preliminarily specified with only final checks and agreed upon modifications made.

Detailed engineering will be completed utilizing the conceptual drawings previously described and with Owner approval. This detailed engineering will include: engineering protocol for drawings and specification.

As-built drawings will be completed upon completion of the installation phase of the project.

#### **7.1.5 Owner Approval**

It is proposed that three approval steps be in place for the engineering phase of the project. These steps would be 30%, 60%, and 90%. The Owner or Owner's Representative could travel to the Contractor or vice versa at the Owner's request.

#### **7.1.6 Project Procurement**

Major engineered equipment which has been specified during the proposal and configuration phases of the project are submitted on the agreed upon approval process and when approved will be purchased.

The Balance of Plant Equipment and materials (normally short delivery) will be itemized and listed during detailed engineering. A decision will be made as to who will furnish (Contractor or Subcontractor) based on job conditions, locations, etc.

#### **7.1.7 Construction Phase On Site**

The project management team will move to the site for the construction phase of the project. This phase is further described as follows:

##### **1. Mobilization**

A mobilization and construction lay down plan will have been prepared as part of the Project Implementation Manual. This would include setting up the normal required items.

- Construction offices
- Site utilities
- Secure and non-secure lay down areas
- Communications
- Project management housing, transportation, food, etc.
- Arrangements for major equipment rental
- Surveys, soil tests, etc.

2. Project Construction

Project construction will be carried out utilizing local subcontractors and materials where feasible. Contractor will furnish construction management and detailed supervision of all disciplines.

3. Commissioning and Turnover

Commissioning and Turnover Manuals will be prepared for each discrete system making up the power plant. An experienced and knowledgeable commissioning and turnover team will be assigned under the supervision of a well qualified start-up manager. This team will commission on a “priority system” basis the various systems to provide for plant start up. It is desired that plant operation and maintenance personnel be involved to provide valuable hands on experience.

4. Training

Operation and maintenance training will be conducted in two phases:

- General Electric LM 6000 GTG equipment classroom at the site subject to plant operator preference.
- On site balance of plant operation and maintenance.

Formal training manuals will be prepared with formal on site training to be conducted.

5. Plant and Performance Testing

Plant and performance test documents will be prepared and submitted for approval. The formal tests will be conducted on an agreed time with the necessary Owner’s Representatives attending.

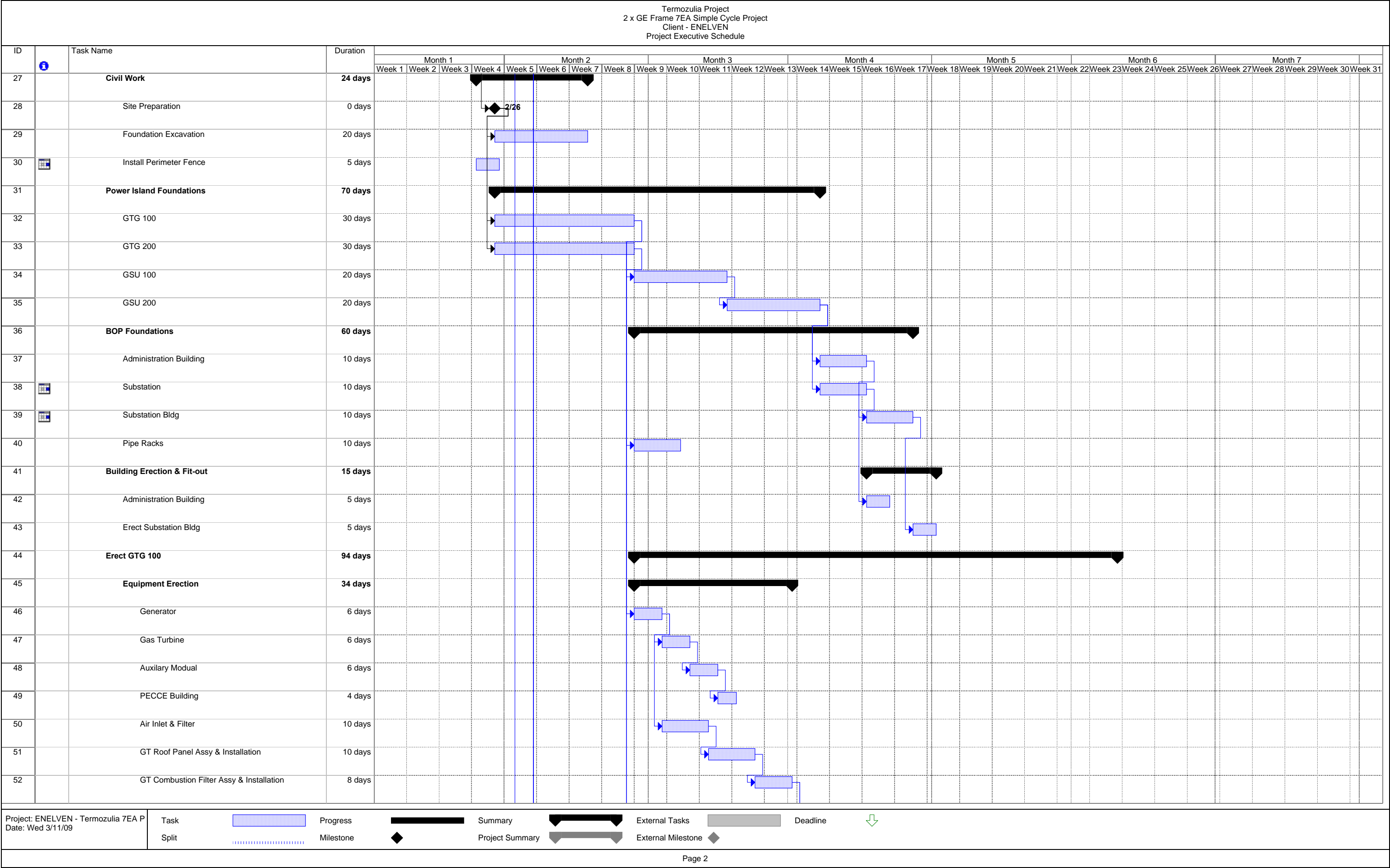


## **Section 8.0      Executive Project Schedule**

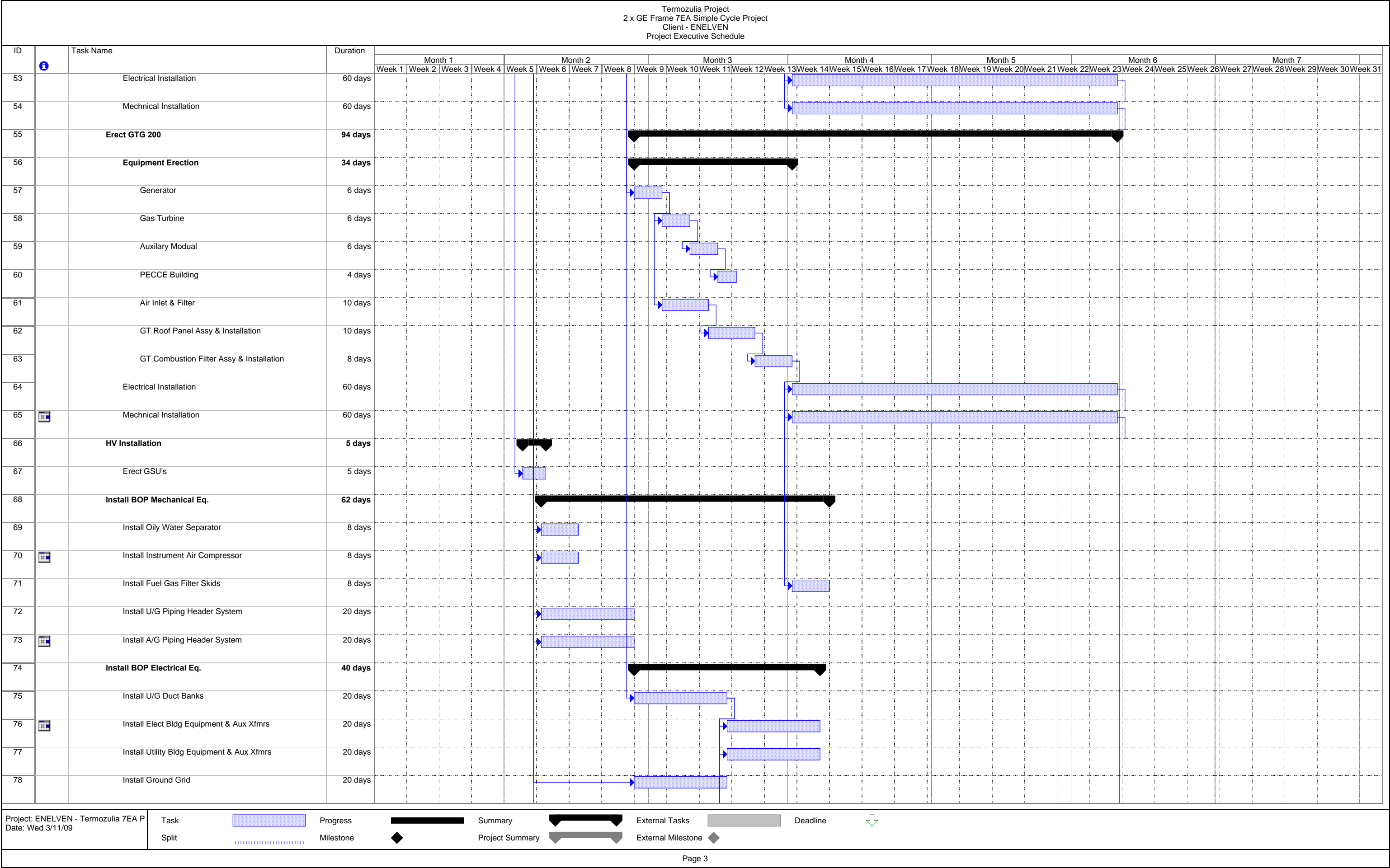
Please find on the following pages ProEnergy EPC Services' project schedule for the Frame 7EA Power Projects.

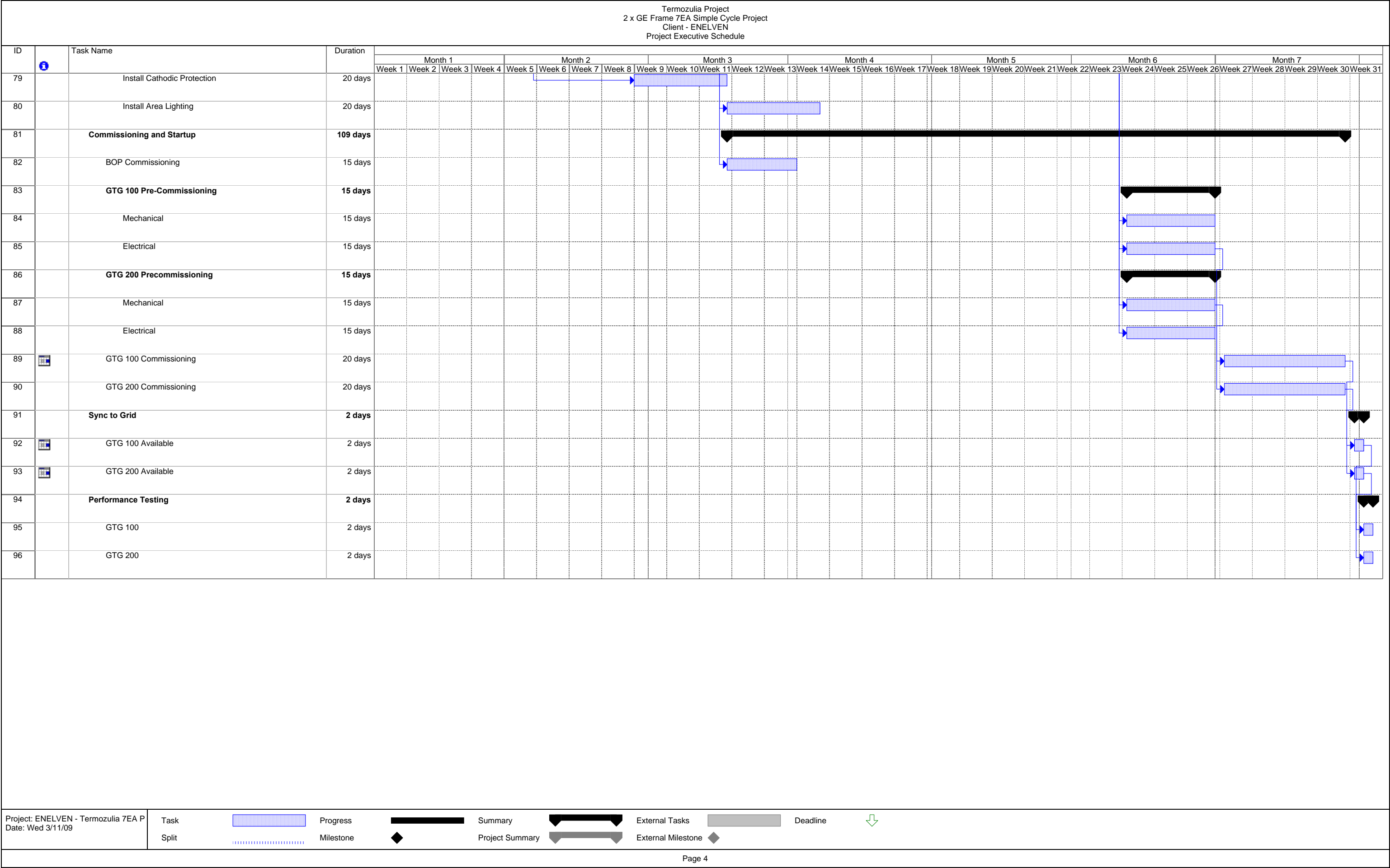
Termozulia Project  
2 x GE Frame 7EA Simple Cycle Project  
Client - ENELVEN  
Project Executive Schedule

ID	Task Name	Duration	Timeline																														
			Month 1			Month 2			Month 3			Month 4			Month 5			Month 6			Month 7												
			Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15	Week 16	Week 17	Week 18	Week 19	Week 20	Week 21	Week 22	Week 23	Week 24	Week 25	Week 26	Week 27	Week 28	Week 29	Week 30	Week 31
1	<div><div></div>Termozulia Project - 2 Unit 7EA site</div>	188 days																															
2	<div><div></div>Initial Date</div>	1 day																															
3	<div><div></div>Milestone Dates (Key Dates)</div>	31 days																															
4	<div><div></div>Initial Date</div>	1 day																															
5	<div><div></div>Backfeed Power Available</div>	1 day																															
6	<div><div></div>Natural Gas Available</div>	1 day																															
7	<div><div></div>Raw Water Available</div>	1 day																															
8	<div><div></div>Telephone &amp; Internet Service Available</div>	1 day																															
9	<div><div></div>Construction Power Connection Available</div>	1 day																															
10	<div><div></div>Construction Permit</div>	1 day																															
11	<div><div></div>Engineering</div>	25 days																															
12	<div><div></div>Conceptual &amp; Major Equipment Specs</div>	5 days																															
13	<div><div></div>Site Survey</div>	5 days																															
14	<div><div></div>Bulk Material Specs and PO's</div>	10 days																															
15	<div><div></div>Issue for Construction Drawings</div>	20 days																															
16	<div><div></div>Procurement</div>	25 days																															
17	<div><div></div>Buildings</div>	4 wks																															
18	<div><div></div>BOP Mechanical</div>	1 mon																															
19	<div><div></div>BOP Electrical</div>	1 mon																															
20	<div><div></div>Transportation</div>	34 days																															
21	<div><div></div>GTG Package 100/200 - Houston to Venezuela</div>	10 days																															
22	<div><div></div>GTG Package 100/200 - Port Venezela to site</div>	20 days																															
23	<div><div></div>BOP material from Houston to Site</div>	14 days																															
24	<div><div></div>Transport GSU / Substation equipment</div>	30 days																															
25	<div><div></div>Construction</div>	135 days																															
26	<div><div></div>Mobilize to Site</div>	11 days																															









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## **Section 9.0                      PROJECT QA/QC PLAN**

### **TABLE OF CONTENTS**

- I.     INTRODUCTION**
- II.    ORGANIZATION**
- III.   PLAN TASKS AND PROCEDURES**
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    - 2.    Design Documentation Review-Specifications
    - 3.    Drawing Control
  - B.    Subcontracted Design**
  - C.    Material Procurement**
    - 1.    Procurement Procedures
    - 2.    Equipment / Material Specification Preparation
  - D.    Test Plans**
    - 1.    Measurement and Test Equipment
    - 2.    Documentation
    - 3.    Definition of Test Types
  - E.    Corrective Action**
- IV.   INSPECTION REQUIREMENTS**
  - A.    Responsibilities**
  - B.    Classification of Test**
    - 1.    Factory Testing
    - 2.    Operational System Test (OST)
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  - D.    Electrical**
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  - F.    Piping and Welding**
  - G.    Instrumentation**
  - H.    Documentation**
- VI.   SHIPPING AND HANDLING**

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**PART 1 PROJECT QA/QC PLAN****I. INTRODUCTION**

Our employees have over 40 years of history with EPC projects for the Power Generation industry. As a turnkey engineering and construction contractor, we have followed stringent quality guidelines throughout its history. The QA/QC Controls in place have been developed and fine tuned over these multiple and varied project experiences. The QA/QC plan that exists today is based upon experience in interpretation and application of codes and standards as well as practical knowledge learned in expeditiously bringing a project to successful completion.

The following sections will provide a detailed description of the Corporate Policy regarding Quality Assurance/Quality Control and a Project Specific Plan for the Quality Assurance/Quality Control management of the Power Project.

**II. ORGANIZATION**

The Quality Assurance Manager acts as the point-of-contact for any non-conformance reports and initiates corrective action as required. He/she ensures that required inspections, tests, evaluations, reviews, audits and all other quality control measures are performed as necessary to strictly adhere to the corporate-approved Quality Control and Assurance program plan. The Quality Assurance Manager is assisted by a team of inspectors who conduct all manners of inspections and tests required, ensuring that the installed system conforms to the approved drawings and specifications.

An organization chart is furnished which shows the organization of the Quality Control and Assurance Team by position, title and name. All quality control team personnel will be assigned based upon individual and collective expertise as related to the specific areas of quality control necessary to support the contract work effort.

**III. PLAN TASKS AND PROCEDURES****A. Construction Design****1. Design Documentation Review - Drawings**

Project Engineers are responsible for conceptualizing and engineering the project. To ensure that the design meets all requirements, inspections will be conducted throughout the design process. Prior to issuance of "Issue For Construction" package, all drawings will have the following signatures and dates.

---

Draftsman	Signature and Date in Drawn By Block
Checker	Signature and Date in Check Block
Project Engineer	Signature and Date in Design Block
Project Manager	Signature and Date in Project Manager Block
QA Manager	Signature and Date in QA Block

The Project Engineer responsible for the drawing design will initial his approval on all completed drawings. Fundamental configuration drawings (i.e., PFD, P&ID, Electrical One-lines, and Control Configuration drawings) will undergo peer review. Selection of the peer reviewer will be made jointly by the Senior Engineering Manager and the QA/QC Manager. The Quality Assurance Manager will check the drawing for all necessary signatures and initials and will then sign his name and date. The Drawing Review Sheet will be filed by the Quality Assurance Manager as a permanent project record.

Changes to approved drawings require the same review process. Changed drawings will be issued as revisions and will be labeled as such.

## **2. Design Documentation Review - Specifications**

A specification will be generated for each major piece of equipment to be purchased for this project. The Project Engineer responsible for the generation of each specification will initial the completed specification. Prior to each specification's attachment to a Request for Bid or a Purchase Requisition, this specification will undergo peer review by the Project Manager and the Engineering Manager. The Specification will then be passed to the QA/QC Manager for his review and will become a permanent part of the project record.

## **3. Drawing Control**

A Master Drawing Index of all drawings will be maintained. The index will be updated as drawing changes occur and will reflect the current status of each drawing. Only the latest applicable drawings, specifications, instructions and authorized changes thereto, will be issued for manufacturing, construction, inspection and testing. Reproducible copies or computer disk files of final revision levels of a drawing will be maintained for record.

### **B. Subcontracted Design**

The same approval and quality assurance procedures to which own design work is subjected will also be applied to all design work subcontracted to an outside source. Drawings and other design documents will be reviewed and examined for compliance with both the technical and format requirements of the contract specifications.

## **C. Material Procurement**

Responsibility for procurement of various equipment and supplies will be clearly defined prior to the initiation of any procurement. Purchasing Manager and staff will directly monitor all procurement efforts of major equipment under their immediate control.

Balance of Plant purchasing, i.e., Buildings, Mechanical, Electrical (conduit, fittings and wire), and Area Lighting will be the primary responsibility of the various subcontractors. Some of the project tasks will be purchased as a sub-system or system from different vendors or subcontractors. In order to ensure adherence to the project schedule, will direct scheduling and expediting of materials and equipment purchased by subcontractors.

### **1. Procurement Procedures**

Procurement Procedures are published in the Corporate Project Procedures Manual. The following sections detail Procurement Procedures for this project. We implements these controls for every large project to ensure that the client receives the best value in materials and equipment as well as a quality installation effort.

#### **1.1 Prequalification of Manufacturers / Vendors / Construction Contractors**

Select Manufacturers / Vendors / Construction Contractors based on our own Qualified Vendors List (QVL). The stated purpose of the QVL is to ensure the best value and the highest quality in workmanship, materials and equipment for and our clients. Each manufacturer / vendor / contractor listed on the QVL has been evaluated based on past performance using the following criteria:

- Proper documentation of and compliance with inspection/test requirements
- Quality of workmanship
- Efficient handling of Purchase Orders
- Adherence to shipping schedules
- Prompt resolution of non-conforming material problems
- Compliance in manufacture and supply with specifications
- Warranty Work
- Product or Product Lines
- QA/QC audit (if necessary)
- Price

New vendors / contractors with no previous history are evaluated based upon the following:

- Product Lines

- Project Histories for similar projects
- Discussion with former Client Contacts
- Financial Stability
- Staff Qualifications
- Capability to complete the project
- Financial Stability
- QA/QC Audit (Manufacturers / fabricators if necessary)
- Client List

## **1.2 Material / Equipment / Parts / Services Selection**

This section provides an overview of methodology in selecting materials, equipment, parts and services. Expediting procedures are included to ensure that the project schedule is not impacted by shipping delays.

The established twelve main stages in the procurement of materials, equipment, parts and services:

- Preparation of the Specifications for equipment and materials
- Identification of each item and preparation of purchase requisitions
- Issuing the Request for Quotation
- Quotation Review, Negotiations and selection of vendor or contractor
- Preparation and Placement of the Purchase Order
- Scheduling delivery of the Purchase Order
- Expediting the Purchase Order
- Receipt of Materials/Equipment/Parts and Inspection of same
- Inspection of Contracted Services and Approval of Same
- Resolution of any Non Conforming Material problems as well as any Corrective Action Items
- Field Purchase Orders

## **2. Equipment / Material Specification Preparation**

Procurement specifications originate in the Engineering Department. The Engineering Manager will task staff engineers with the generation of specifications. The Engineering Manager and the Project Manager will review the equipment specification for compliance with applicable codes/standards and contract specifications. If Client approval is required, the Project Manager will forward specification to Client, obtain approval signatures, and then return the approved specifications to the Engineering Manager.

Standard Specifications are divided into two (2) classes, "short form" and "book type." Short form specifications are used whenever good engineering practice and contractual arrangements permit. They are simple and flexible. "Book type" specifications are more formal, more expensive, and may be used on major engineered items of equipment, usually at the request of the Client.

## **2.1 Purchase Requisitions**

Purchase Requisitions will originate with engineering. The Purchase Requisition will be approved by the Project Manager or Engineering Manager prior to submittal to the Purchasing Department. The Requisition will be checked by either the Engineering Manager or the QA/QC Manager for compliance to specifications. The Purchase Requisition will then be forwarded to the Purchasing Manager. The Purchasing Manager will direct that the Request for Quotation (RFQ) be developed and sent to approved suppliers on QVL. The specifications developed by Engineering will be attached to the RFQ.

The vendor or subcontractor shall be given sufficient time to prepare their bid for equipment or services. The time frame for bidder response shall be so stated on the RFQ.

## **2.2 Quotation Reviews**

Each quotation will be reviewed prior to the issue of a Purchase Order. Major Equipment, Material, and Contracted Services purchases will be reviewed by a representative from the applicable engineering discipline and project management.

## **2.3 Purchase Order**

Following evaluation of quotations and completion of negotiations, an award will be made. The Purchasing Manager will generate the Purchase Order.

Purchase Orders include the following:

- Detailed description of products and services
- Required delivery date
- Test and Inspection requirements, if applicable
- Terms of payment
- Shipping information and point of contact
- Required documentation

A Purchase Order Log will be maintained at all times. Purchase Progress Reports will be updated weekly.

### **2.3.1 Expediting the Purchase Order**

Purchasing Manager will delegate an expeditor to track delivery of major equipment and materials for the project. The expeditor will closely monitor the progress in fabricating or gathering of materials from each vendor of equipment and materials which could impact the project schedule.





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### **2.3.2 Closing out of Purchase Orders**

Documented receipt of equipment / materials in good order will be forwarded to the Administrative Manager and the Purchasing Manager. Contracted services will be inspected and signed off upon satisfactory completion. At this time, the Administrative Manager will sign these documents and direct the Purchasing Manager to forward same to Accounting for payment. Payment will be by terms agreed to on Purchase Order.

### **2.3.3 Field Purchase Orders**

Field Purchase Orders will require approval from Purchasing Manager. Field Purchase Orders will be documented, and a written Field Purchase Order Log will be maintained.

## **2.4 Material / Equipment Receiving Inspection**

Receiving Inspections will be performed on all major equipment / material for the project. QA/QC project staff will perform the inspection. Methodology is discussed in detail in the project QA/QC Section of this document.

All materials requiring Material Certifications and/or Material Test Reports (MTRs) will be checked for compliance to project specifications. Materials received without the proper certifications will be tagged and segregated until such required documentation is received.

### **2.4.1 Hazardous Materials Storage**

All coating materials, lubricants, flammable solvents, and other items identified by the Project Manager or the Owner as falling under Hazardous Material designation will be segregated from other project materials and equipment. These items will be stored in a secure location. All MSDS sheets will be posted in this area concerning each type Hazardous Material. An inventory will be maintained detailing receipt and issuance of any said material to installation staff and/or subcontractor.

If a subcontractor will directly receive or bring upon jobsite any materials in this category, they will be directed to comply with the established HAZMAT storage materials plan. This plan will be issued as a separate document and will be available at site for all personnel to review.

## **2.5 Corrective Action / Non-Conforming Equipment / Materials**

All equipment / materials which do not reflect compliance to project specifications, shipped without MTRs, damaged in shipment, etc. will be tagged and segregated until such time as vendors resolve the problem. Methodology for these processes is discussed in detail in the QA/QC section of this document.

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**D. Test Plans**

Test plans will be developed for testing each segment of the project both independently and collectively. Test plans will explain the purpose of the tests, define inputs, specify procedures, and acceptance criteria.

**1. Measurement and Test Equipment**

Measurement and test equipment used for inspection and acceptance testing shall be calibrated at established intervals against certified standards. All subcontractor and vendor test equipment used for vendor acceptance testing in connection with this contract shall meet the same calibration requirements.

**2. Documentation**

Inspection and testing documentation will be prepared in clear language. Test procedures will define all conditions and materials required for the test, specify test equipment and provide pass/fail criteria.

Reports will be prepared to document the results of each inspection and test performed. The records will identify the test equipment used, the observations made, the deficiencies found and the corrective actions taken.

**3. Definition of Test Types**

- a. Factory Tests are defined as tests performed at the location where the item is produced, fabricated, manufactured or assembled prior to shipment to the site.
- b. Field Verification Tests or Pre-Operational Tests are tests performed after installation. These tests verify that components and subsystems are installed and perform correctly.
- c. The Operational Systems Test is a comprehensive test of the installed system. The results of this test determine acceptance or rejection of the system.
- d. Performance tests are a series of tests to verify project-mandated performance guarantees.

**E. Corrective Action**

When problems or deficiencies are discovered in workmanship and/or materials during the inspection process, they will be documented. The inspector will prepare a Corrective Action Request (CAR) detailing the problem and submit it for resolution. The QA Inspector will forward the CAR to the QA Manager and the Project Manager. Corporate

Project Management will investigate the problem and direct the proper course of action. All Corrective Action Requests shall be maintained for future reference or analysis as may be required.

#### **IV. INSPECTION REQUIREMENTS**

##### **A. Responsibilities**

Perform the inspections and/or tests required to substantiate that the materials and services conform to requirements. The Client may witness any of the inspections or tests. All errors and/or defects discovered during inspections and/or tests shall be documented.

##### **B. Classification of Test**

Test Classifications include factory testing of components and major subsystems, field testing, and on-site final acceptance testing of the complete system. Some of the individual component and subsystem testing may be performed concurrently with the Operational Test. Construction Inspections will be performed during the installation work.

##### **1. Factory Testing**

Factory testing will be accomplished as required to ensure compliance with the contract specifications. Prior to shipment from the factory, some components and/or subsystems may be tested to demonstrate their compliance with the specifications. These items shall be identified and noted on the purchase order.

##### **2. Operational System Test (OST)**

A test of the entire System in full operational mode will be conducted to verify correct operation of all subsystems and system components. All functional capabilities of the system will be demonstrated. Following completion of the test, we will prepare and submit a test report.

These test procedures will be developed during the project construction phase and will be delivered to the client for approval prior to Operational Testing efforts being undertaken.

##### **4. Performance Tests**

A series of tests will be conducted to verify project performance guarantees. These tests will include

- Gross power output in kW
- Parasitic Load
- Net Power Output in kW
- Gross and Net Heat Rate

**C. Test Documentation**

The Quality Assurance Manager will ensure that test procedures and test reports are prepared as outlined herein. Test documentation will be issued to the client. Test procedures will be developed for testing components, subsystems and the overall system. Testing shall demonstrate that the system design meets the requirements and that materials and workmanship are as specified. Test results shall be recorded and bound with the test procedures to form a permanent record.

**V. PROJECT SPECIFIC INSPECTIONS AND TESTS**

The project warrants a wide variety of inspections and tests. The following sections briefly describe the project inspection and test requirements by function and/or discipline.

**A. Site Preparation**

- Confirmation of site dimensions.
- Confirmation of topographical elevations on completion of final grading. assumes existing elevation is within two (2) feet of final grading level.
- Confirmation of Water Run Off Control after Final Grading is achieved
- Review of complete soil compaction and associated tests.

**B. Ground Grid**

- Confirm grid installed at correct depth and dimension with correct materials.
- Observe and confirm that junctions, splices, and taps are made with the correct Thermic weld type molds or pressure connectors and tools.
- Observe and confirm that correct wire and size are used with regard to ground rods.
- Perform ground grid resistance test.

**C. Concrete Foundations, Walls and Slabs**

- Confirmation of correct locations and dimensions of concrete foundation and wall forms.
- Confirmation of correct size and spacing of rebar in concrete foundations.
- Confirmation of proper anchor bolt sizes and location.
- Verify procurement of correct concrete strength.
- Witness the taking of necessary concrete samples for "slump" and "strength tests."
- Obtain qualified testing lab for concrete strength tests.
- Confirm proper correct elevations and slope of all slabs, walls, etc.
- Document above items on concrete pour card.

**D. Electrical**

- Witness factory tests for correct power and control on all motor control centers (if applicable).
- Confirm the receipt of each major item of electrical equipment. Verify specification compliance and inspect for transit damage.
- Confirm that receipt of all equipment and miscellaneous materials - conduits, cabling, etc., adhere to procurement requirements.
- After wiring is pulled and prior to connection, the wire will be Megger tested and all test results will be recorded on a Megger / Hi-Pot Test Record Form.
- Observe all conduits routing to ensure adequate turning radius for cable pulling.
- Perform detailed point-to-point wiring checks to verify power, control, and instrument wiring.
- Perform pre-operational tests on all electrical equipment and systems.
- Confirm tagging and labeling, verify and document as-built drawings.

**E. Structural      Steel**

- Confirm correct size and type of structural steel.
- Confirm proper installation of anchor bolts, washers, and nuts installed, as required.
- Verify that qualified welders perform welding in accordance with applicable codes.
- Visually inspect all field welds to confirm they are complete and adequate.
- Verify paint and corrosion protection.

**F.      Piping and Welding**

- Confirm correct size, rating, etc., of each piping system as applicable.
- Verify that qualified welders are utilized. Inspect piping fit up to ensure proper workmanship is utilized.
- Obtain qualified testing lab for welding radiography.
- Set up welding inspection and test procedures in accordance with applicable codes and standards.
- Set up a detailed welding documentation system to address individual pipe code, each weld, x-ray, welder, welding map, date, and inspector review.
- Establish a pipe cleaning procedure.
- Witness hydrostatic testing and test procedures, as required by various codes for each piping system.

**G. Instrumentation**

- Confirm all instrumentation and control equipment adheres to procurement requirements.
- Confirm instrumentation specification compliance, and inspect for transit damage.
- Observe individual calibration of each instrument, confirming range, accuracy, etc. in accordance with specifications and applicable codes.
- Perform functional loop checks and document same.

**H. Documentation**

Test and Inspection Documentation will be maintained on site throughout the project construction, commissioning and startup phase. The client will be allowed access to this data at any time.

Following Completion of Startup and Commissioning, the full battery of project Testing and Inspection Documentation will be delivered to the Client.

**VI. SHIPPING AND HANDLING**

Procedures for shipping and handling of materials will ensure that all shipments meet the requirements for identification, packing, packaging and data submittal. Contractor will be responsible for packing, shipping, receiving and installing the component parts and subsystems that comprise the complete system. The degree of protection and method of handling will be consistent with the anticipated hazards.

Contractor will ensure that the appropriate shipping and handling procedures will be followed. Should damage occur in transit, it will be repaired or replaced as appropriate.

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## **PART 2      PROJECT SPECIFIC TEST AND INSPECTION PROCEDURES**

### **I. SCOPE**

The following civil, mechanical and electrical test and inspection requirements have been developed for the project.

The civil, mechanical and electrical tasks on this project shall comply with the standards set forth in this document to ensure both the safety and quality of the installation. This document stipulates the inspections and tests that will be performed on the project.

### **II.      STANDARDS AND CODES**

The following organization's standards and codes are applicable to design and construction practices for the project.

ANSI B31.3	Plant Piping
ASME IX	Welder Qualifications
AWS A3/0	Definitions of Welding Terminology
AWS B2.1-84	Standard for Welding Procedure and Performance Qualification
AWS D1.1	AWS Code for Structural Welding
AISC	American Institute of Steel Construction – Various sections
ASTM	American Society for Testing Materials – Various Sections
ASME	American Society for Mechanical Engineers – Various Sections
ISA S5.1	Instrumentation Symbols and Identification
NACE RP018890	Standard Recommended Practice: Discontinuity (Holiday) Testing of Protective Coatings
NEMA AB1	Molded Case Circuit Breakers
NEMA ICS1	General Standards for Industrial Control and Systems
NEMA ICS2	Industrial Control Devices, Control and Systems
NEMA ICS4	Terminal Blocks for Industrial Use
NEMA ICS6	Enclosures for Industrial Controls and Systems
MG1	Motors and Generators
PE5	Constant-Potential-Type Electric Utility (Semi-Conductor Static Converter) Battery Chargers
SG2	High Voltage Fuses
WC2	Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NFPA70	National Electric Code
NFPA No. 1	Carbon Dioxide Extinguishing Systems
NFPA No. 37	Stationary Combustion Engines and Gas Turbines
OSHA CFR Title 29	Occupational Safety and Health Administration
(Note: Codes and Standards may also include Codes and Standards issued by other organizations as directed by Owner.)	

### **III. TESTS / INSPECTIONS - CIVIL**

Inspections will be undertaken throughout the civil portion of the project. The site dimensions will be confirmed. Topographical elevations will be confirmed following grading. All concrete slab and wall dimensions will be confirmed prior to concrete pouring. All concrete will be confirmed to be compliant with design specifications. A qualified third party inspection agency will be retained to conduct slump tests prior to and during concrete pours. All concrete will be strength-tested intervals per ASTM standards. Grouting of mechanical equipment skids will be performed per the developed specifications.

### **IV. TESTS / INSPECTIONS - GROUND GRID**

The ground grid will be inspected throughout installation to ensure that materials used are per design specifications and that installation splices, junctions, and taps are made properly. Depth and dimensional boundaries will be measured and recorded. At the conclusion of installation, the grounding grid will be tested using a test instrument specifically for the task to confirm acceptable impedance levels.

### **V. TESTS / INSPECTIONS - MECHANICAL**

Several elements of the project will require welding during fabrication and installation. These elements include:

- Structural Steel
- Fuel System - Natural Gas Fuel System Piping
- Fuel System - Liquid Fuel System Storage Tank and Piping
- Process Water Systems
  - Raw Water System Storage Tank and Piping
  - Waste Water System Piping
  - Firewater System Piping (HDPE piping Thermal Welding Inspections)
- Oily Waste System
- Lube Oil System

The welding inspection criteria for each of these tasks will be based upon the applicable codes and standards. The following paragraphs briefly describe each task and stipulate the specific code and/or standard(s) that apply.

#### **A. Structural Steel**

The structural steel aspects of the project will consist of the building related structural steel and various supports of racks. Design and erection of these assemblies shall be in accordance with the latest edition of the AISC. All welding will be visually inspected per AWS applicable codes and standards.

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**B. Welding      Inspections/Tests**

All welders are required to have current certification of their qualifications. Current certifications should indicate the welder has been tested to the project welding procedures within one year prior to welding on project piping.

All visual-welding inspections will be performed by persons who have current certification from AWS or ASNT-TC-1A. All NDE will be performed and approved by persons holding current ASNT-TC-1A Level II certification for the specific test processes implemented. All visual welding inspections will be performed based on the criteria established in ANSI B31.1 and AWS D1.1.

Radiographic Testing (RT) where necessary will be performed in accordance with standards established by ASME Boiler and Pressure Vessel Code, Article 2, Section V, except as stipulated in the applicable code, ANSI B31.3 (Pipe welding inside Plant Battery Limits).

Welded Steel Storage Tank welding and erection inspections/tests will be performed per API 650 (Welded Steel Tanks for Petroleum Storage).

All radiographs of full penetration welds must be accepted by a certified Level II inspector with current certification under ASNT-TC-1A. Accept/Reject criteria for all welds shall be in accordance with criteria established as well as applicable codes. Any rejections will require two (2) weld penalty shots on that welder. If in the judgment of the Site QA/QC Manager that a welder or welders have excessive rejections; may demand the welder be removed from the project or certified to weld on only non critical piping.

If the Client wishes, all radiograph films will become the property of Client and will be submitted with the accompanying reader sheets within two (2) weeks after completion of the project. The client may review the films and accompanying interpretations at any time at the project site. If the client does not desire the films, they will be destroyed at the completion of the project.

**C.      Natural Gas Piping**

The Natural Gas Fuel System piping shall consist of piping installed from Client's source of supply to the Fuel Gas Compressors and on to Fuel Filter/Separators and finally to the Gas Turbine Generators. Piping from the supply source to the Fuel Gas Compressors and subsequently to the Fuel Filter/Separators will be Carbon Steel. The piping on the

downstream side of the filter/separators to the will change to Stainless Steel piping. All

Natural Gas piping will be designed and constructed to ANSI B31.3.

A total of 100% of the pipeline welds (100% of each weld) will be subjected to Radiographic Testing (RT).

All radiographs of full penetration welds must be approved and accepted per criteria established in Section B above.

#### **D. Liquid Fuel System**

The liquid fuel system consists of a double walled piping system from the storage tank underground to the filter skid. From the fuel filter skid, the piping changes to stainless steel between the skids and the gas turbine.

The double wall piping system will consist of 8" carbon steel piping with a Schedule 40 Polyethylene (PE) or Reinforced Thermal Resin (RTR) flexible 4" liner within. All carbon steel piping will be performed under ANSI B31.3. The bonding of the PE shall be performed under ASTM D-2104. If the piping system will be RTR ASTM 2996.

All piping systems will be visually inspected by Craft Inspectors qualified to visually inspect these systems. 10% carbon steel piping welds will undergo RT, 100% of the weld. RTs will be examined and approved by a Level II or III ANSTC-1A qualified technician.

PE or RTR lines will undergo hydro or pneumatic testing. If Hydrotest is used, water as the test medium hydro will be 1.5 times design pressure up to a maximum of 150 PSI. If a pneumatic test is decided upon, the test pressure will be 1.2 times design pressure.

#### **E. Lube Oil System**

The Lube Oil system consists of a skid and interconnecting stainless steel piping to the Gas Turbine Package. All interconnecting pipe welds shall be in accordance with ANSI B31.1. All Lube Oil system welds will undergo visual inspection or testing in accordance with ANSI B31.1. Ten percent (10%) of these welds will undergo RT testing (100% of the weld)

#### **F. Hydraulic System**

The Hydraulic System consists of a skid and interconnecting stainless steel piping to the Gas Turbine Package. All interconnecting pipe welds shall be in accordance with ANSI B31.1. All Hydraulic system welds will undergo visual inspection or testing in accordance with ANSI B31.1. Ten percent (10%) of these welds will undergo RT testing (100% of the weld)



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All radiographs of full penetration welds must be approved and accepted per criteria established in Section B above.

#### **F. Raw Water System**

The Raw Water System consists of Carbon Steel Piping from the city water supply Water Day Tank. The Raw Water System Raw Water Pump then supply the Water Treatment and Demineralized Water Treatment systems via Carbon Steel Piping Systems.

Raw Water System piping welds will be visually inspected.

#### **G. Process Water Systems**

The process water systems consist of:

- The Lube Oil Cooling Water system shall consist of pumps and Carbon Steel Piping to and from Fin Fan Coolers to the Gas Turbine Lube Oil Skids
- The Oily Waste System consists of PVC Piping from Oil Containment areas located at various sites within the BOP to the new Oily/Water Separator

All welded steel piping will be visually inspected as welds are completed. All PVC piping joints will be inspected as they are made up. The Process water systems will be inspected prior to startup. All pumps will be balanced. Remaining components will be inspected and confirmed that they are supplied and installed per specifications.

#### **H. Fire Water System**

The Fire Water System consists of HDPE Piping from the City Water Supply to the Fire Water distribution system.

#### **I. Pump Testing**

All pumps supplied will be balanced and confirmed as fully operational prior to startup.

### **VI. WELDER QUALIFICATIONS**

Welders qualified according to the appropriate codes shall make all welds on the project:

- |                                   |               |
|-----------------------------------|---------------|
| • Structural Steel                | AWS CODE D1.1 |
| • Fuel System Piping              | ANSI B31.3    |
| • Lube Oil System Piping          | ANSI B31.3    |
| • Hydraulic Startup System Piping | ANSI B31.3    |

All welders will be required to provide certification of their qualification to the appropriate standard. Each welder's certified qualifications will be reviewed and approved by the welding inspector prior to the welder's beginning work on the project. Applicable welding procedure specifications (WPS) and Procedure Qualification Reports (PQRs) will be required. All reports and certifications will be in accordance with ASME Section IX Article II.

## **VII. AREA DESIGNATION**

Areas where combustible fluids, gases or vapors might be present shall be classified as hazardous areas or hot areas. Guidelines for welding in these areas will be drawn from ANSI Z49.1. Areas designated as safe areas will be those areas on site remote from hazardous areas and where no contact with combustible fluids, gases and vapors are present. Welding in these safe areas, as well as on-site welding fabrication, will be subject to the same standards and codes listed in the previous paragraphs. The welding inspector shall designate an area classification for the project.

## **VIII. MATERIAL TEST REPORTS**

All carbon steel piping and flanges will be supplied with traceable material test reports (MTRs) as well as documentation certifying that the material is per specification.

All piping and flanges connected to the GE 7EA skid will be 304 or 304L seamless stainless steel. Traceable material test reports (MTRs) will be required on all stainless steel piping and flanges.

## **IX. SUB-SYSTEMS MECHANICAL TESTS**

The test requirements for the various tasks on the project are defined in the following paragraphs. Tests are defined in this case to be "system" centered, i.e., hydrostatic tests, vacuum tests, etc., versus inspections which are "component" centered. All tests shall be performed in the presence of a QA/QC inspector or his designate. All tests shall be documented with a written test report. The test report shall include a description of the test, the item or items tested, the procedure used, the date and time of the test and the test results. All test documentation shall be signed by the inspector.

### **A. Fuel System Tests**

All fuel system piping shall be subjected to hydrostatic leak testing to 1.5 times the design pressure. Non-pipe components of the system shall be isolated from the test. The hydrostatic leak test pressure shall be held for a minimum of 1 Hour and then reduced in accordance with ANSI B31.3 to conduct examination for leakage. Pneumatic tests on the PE or RTR may be substituted at 1.2 times design pressure.

### **B. Lube Oil System Tests**

All Lube Oil System piping shall be subjected to hydrostatic leak testing to 1.5 times the design pressure. Non-pipe components of the system shall be isolated from the test. The hydrostatic leak test pressure shall be held for a minimum of 1 Hour and then reduced in accordance with ANSI B31.3.



**C. Hydraulic Starter System Tests**

All Hydraulic Starter System piping will be subjected to hydrostatic leak testing to 1.5 times the design pressure. Non-Pipe components of the system shall be isolated from the test. The hydrostatic leak test pressure shall be held for a minimum of 1 Hour and then reduced in accordance with ANSI B31.3.

**D. Process Water System Tests**

All metallic process water system piping will be leak service tested prior to commissioning. The piping systems under test will be brought up to Normal Operating Pressure and this pressure will be held for 10 minutes or as long as it takes to check each joint or fitting on the line under test. Test shall be conducted in accordance with ANSI B31.3 to conduct examination for leakage. Piping Systems which will be tested in this manner are the following:

- Cooling Water Systems (New Piping)
- Oily Water Piping

**E. Instrument Air System Leak Tests**

Instrument air piping systems will be subjected to a Pneumatic leak test following installation. Pressures will be raised to Normal Operating Pressures levels for each system and held for a minimum of 10 minutes.

**X. SPECIFIC TESTS – ELECTRICAL****A. Ground Grid Integrity Test**

The new installed grounding cables/rods will be attached to the existing system. Installed Ground Grid will be tested using a suitable multimeter to measure integrity prior to startup. Continuity and resistance will be confirmed for the new installed cables/rods. The readings will be recorded for record.

**B. Cable Insulation Testing - Megger**

All 600 Volt and above wire and cable to be used on this project will undergo an insulation test or tests to ensure cable is suitable for intended usage and has structural integrity for installation. All low voltage cables, below 600 volts, will be tested for continuity prior to being energized.

All medium and high voltage cable and wire will undergo Megger testing. Cables will be tested to levels established not to exceed the rated voltage of the cables. Megger testing will be performed with a calibrated test instrument certified to national standards.



The results will be recorded and maintained for record. A cable failing a Megger test will be tagged, segregated and removed from the job site.

**C. Cable Insulation Testing - Hi Potential Test**

Medium and high voltage cables will undergo Hi-Potential testing to detect any insulation breakdown in these cables.

Testing will be accomplished with a calibrated instrument certified to national standards. Results will be recorded and maintained for record.

**D. Cable and Conduit Installation - Inspections**

All cable, conduit and associated fittings will be checked to ensure compliance to specifications developed for this project. Conduit, fittings and cable installation will be monitored during construction to ensure compliance to NEC codes.

**E. Point to Point Testing**

All installed cables shall be point-to-point tested prior to being energized. The point-to-point test shall confirm cables are installed as designed and phased properly.

**F. Switchgear, Motor Control Centers, Breakers, and other Electrical Components, Instrumentation**

All switchgear, motor control centers, breakers and other electrical components, will be inspected and tested prior to and following installation. Specific test procedures will be developed for each major piece of equipment to be installed. Electrical components will be inspected prior to installation and, in most cases, will be tested as part of a larger sub-system. Instrumentation will be inspected prior to installation and calibrated following installation. Instrumentation will be tested as part of a larger sub-system.

**XI. FACTORY ACCEPTANCE TESTS / INSPECTIONS**

The Client has the right to request the contractor an inspection of the equipment and witness all factory tests prior to shipment to the Project site. Tests will be undertaken at the manufacturer or fabricator's facility prior to being shipped to site.

Records of tests / inspections will be recorded and maintained for record. No sub-system or component will be installed until the successful completion of tests / inspections is achieved, or unless written release by the Manager is obtained.

**XII. STARTUP TESTING AND COMMISSIONING**

Startup testing and commissioning will involve integration of all sub-systems into a complete system-wide test of operation. Testing will involve operation of all sub-systems listed below:



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- Process Water Systems – Raw Water Supply System and Firewater System
- Fuel Gas Delivery System
- Gas Turbine Startup
- Gas Turbine Electrical Transmission
- Breaker Operation
- Protective Relays, Breaker Testing

### **XIII. REPORTS**

A copy of all inspection and test reports shall be maintained in a file at the project site. These reports shall be made available for review and reference as may be required throughout the project. The original copies of all inspection and test reports shall be forwarded periodically to the Quality Assurance Manager for review and safekeeping. Quality related problems that cannot be readily corrected at the project site will be immediately referred to the Quality Assurance Manager for resolution.

## **Section 10.0 Exceptions and Clarifications**

For clarification of the project the following exceptions and assumptions are stated:

### **10.1 The Scope of Supply of this document does not include the following outlined items:**

- Real estate property on which the Power Project is to be sited.
- Local, state, and/or government taxes associated with the Owner's corporations.
- Local, state, and/or government taxes associated with the Contractor furnished equipment.
- Any site environmental cleanup or modifications to site.
- Environmental permits. (Note: Contractor will assist in obtaining all permits where applicable.)
- Local county or state construction permit. (Contractor will assist in obtaining.)
- Fuel gas for blow down, flushing, commissioning, start-up, and operation.
- Supply of Owner furnished items as outlined in Section 2.0 of this proposal
- Operating spares. (Contractor will submit a list of recommended spare parts.)

### **10.2 This proposal is also based on the following assumptions:**

- Owner to supply to Contractor or receive the items outlined in Section 2.16
- Owner will provide all authority required to make the proposed utility interconnects.
- Owner will provide complete site for use as described in the TSD and associated drawings.
- Contractor to furnish and install "first fill" lubricants and chemicals for the plant.
- Contractor will provide soil borings to be utilized for site design..

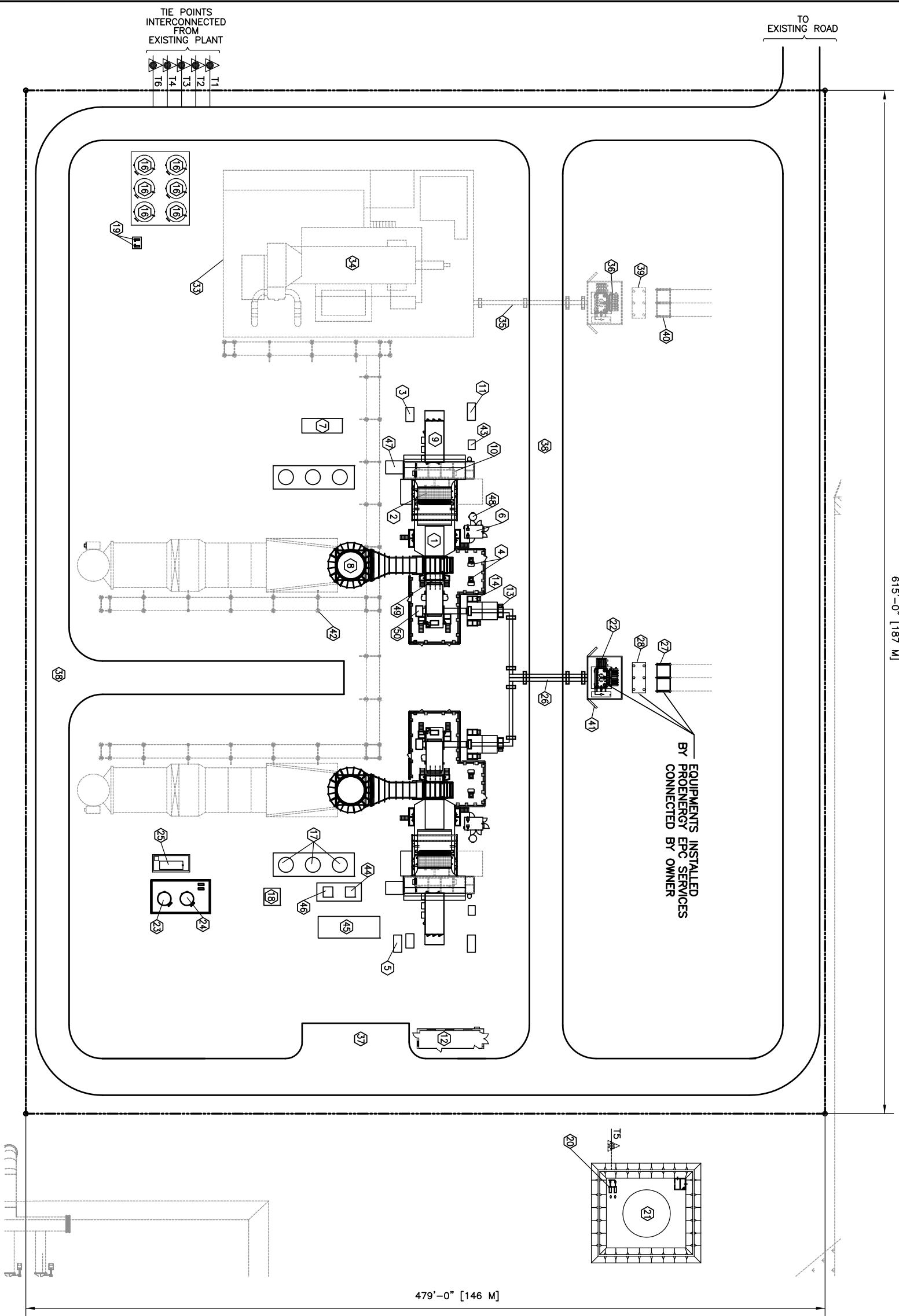
- Owner to provide site survey as necessary
- Owner to provide custody transfer fuel gas metering and interconnect point at sit boundary as shown on drawings.
- Owner to provide natural gas fuel for plant commissioning and start-up.
- Owner to provide rights-of-way for roadways, entrances, pipeline, and transmission line to the Power Project.
- Performance guarantees, administration of warranty conditions will be discussed and agreed upon and inserted into the appropriate sections of this document at contract signing.
- Contractor will transfer software licenses to the Owner at the completion of the project. This will include the license documentation passwords and keys. It will be the responsibility of the owner to maintain these licensing articles for the time when the software needs to be reinstalled.
- The Contractor supplied DCS shall allow for system expansion through the addition of controllers, operator stations in the control panels, process I/O systems and / or process controllers while the equipment associated with the controller/computer are in manual mode. Modifications can be preformed while the Power Plant is operational and the equipment in question is in manual mode. Proper safety precautions must be adhered to. "Tag out" procedures may be required.
- Operator stations in the control room can be expanded while in remote mode and the Power Plant is operational.
- Various vendor supplied PLCs for the major equipment will use either function block or ladder logic programming. The Balance of Plant PLC will use ladder logic programming. The Gas Turbines will utilize a GE designed control system.

## **Section 11.0     Drawings**

Please find on the following pages the following preliminary project drawings.

General Arrangement Plot Plan	10-001 Sh 1
Process Flow Diagram	50-001 Sh 1, 2 & 3
High Voltage One Line Diagram	60-001 Sh 1
Typical LM6000 Protection	60-001 Sh 2
GTG MCC-100 480V One Line Diagram	60-003 Sh 1
One Line Diagram 480V BOP-MCC	60-004 Sh 1

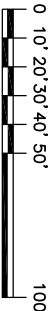





- <sup>1</sup> GE FRAME 7EA GAS TURBINE.
- <sup>2</sup> ACCESSORY MODULE.
- <sup>3</sup> AIR PROCESSING UNIT.
- <sup>4</sup> EXHAUST FRAME BLOWERS.
- <sup>5</sup> CO2 FIRE PROTECT SYSTEM.
- <sup>6</sup> GAS FUEL MODULE.
- <sup>7</sup> WATER WASH SYSTEM.
- <sup>8</sup> EXHAUST STACK.
- <sup>9</sup> PECC AREA.
- <sup>10</sup> TURBINE INLET FILTER HOUSE.
- <sup>11</sup> FUEL GAS ELECTRIC HEATER MODULE.
- <sup>12</sup> MODULAR CONTROL BUILDING.
- <sup>13</sup> GENERATOR BREAKER.
- <sup>14</sup> GENERATOR AIR FILTER HOUSE.
- <sup>15</sup> NOT USED.
- <sup>16</sup> DEMIN STORAGE TANK (6-21,000 GALS EACH).
- <sup>17</sup> COOLING WATER MODULE.
- <sup>18</sup> COOLING WATER SUMP.
- <sup>19</sup> DEMIN WATER FORWARDING PUMPS.
- <sup>20</sup> RAW FUEL FORWARDING PUMPS.
- <sup>21</sup> RAW FUEL TANK (125,000 GALS).
- <sup>22</sup> GSU TRANSFORMER.
- <sup>23</sup> WASTE OIL TANK.
- <sup>24</sup> WASTE WATER TANK.
- <sup>25</sup> OILY WATER SEPARATOR.
- <sup>26</sup> OVERHEAD CABLE TRAY.
- <sup>27</sup> DISCONNECT SWITCH.
- <sup>28</sup> SFB BREAKER.
- <sup>29</sup> NOT USED.
- <sup>30</sup> NOT USED.
- <sup>31</sup> NOT USED.
- <sup>32</sup> HRSG (FUTURE).
- <sup>33</sup> STG BUILDING (FUTURE).
- <sup>34</sup> STEAM TURBINE GENERATOR (FUTURE).
- <sup>35</sup> OVERHEAD CABLE TRAY (FUTURE).
- <sup>36</sup> STG GSU TRANSFORMER (FUTURE).
- <sup>37</sup> PARKING AREA.
- <sup>38</sup> ROAD.
- <sup>39</sup> SFB BREAKER (FUTURE).
- <sup>40</sup> DISCONNECT SWITCH (FUTURE).
- <sup>41</sup> BLAST WALL.
- <sup>42</sup> PIPE RACK.
- <sup>43</sup> FUEL GAS SCRUBBER.
- <sup>44</sup> AUXILIARY TRANSFORMER (4160 V).
- <sup>45</sup> ELECTRICAL PDC.
- <sup>46</sup> AUXILIARY TRANSFORMER (480 V).
- <sup>47</sup> FOGGING SYSTEMS.
- <sup>48</sup> LUBE OIL DEMISTER.
- <sup>49</sup> GENERATOR COMPARTMENT.

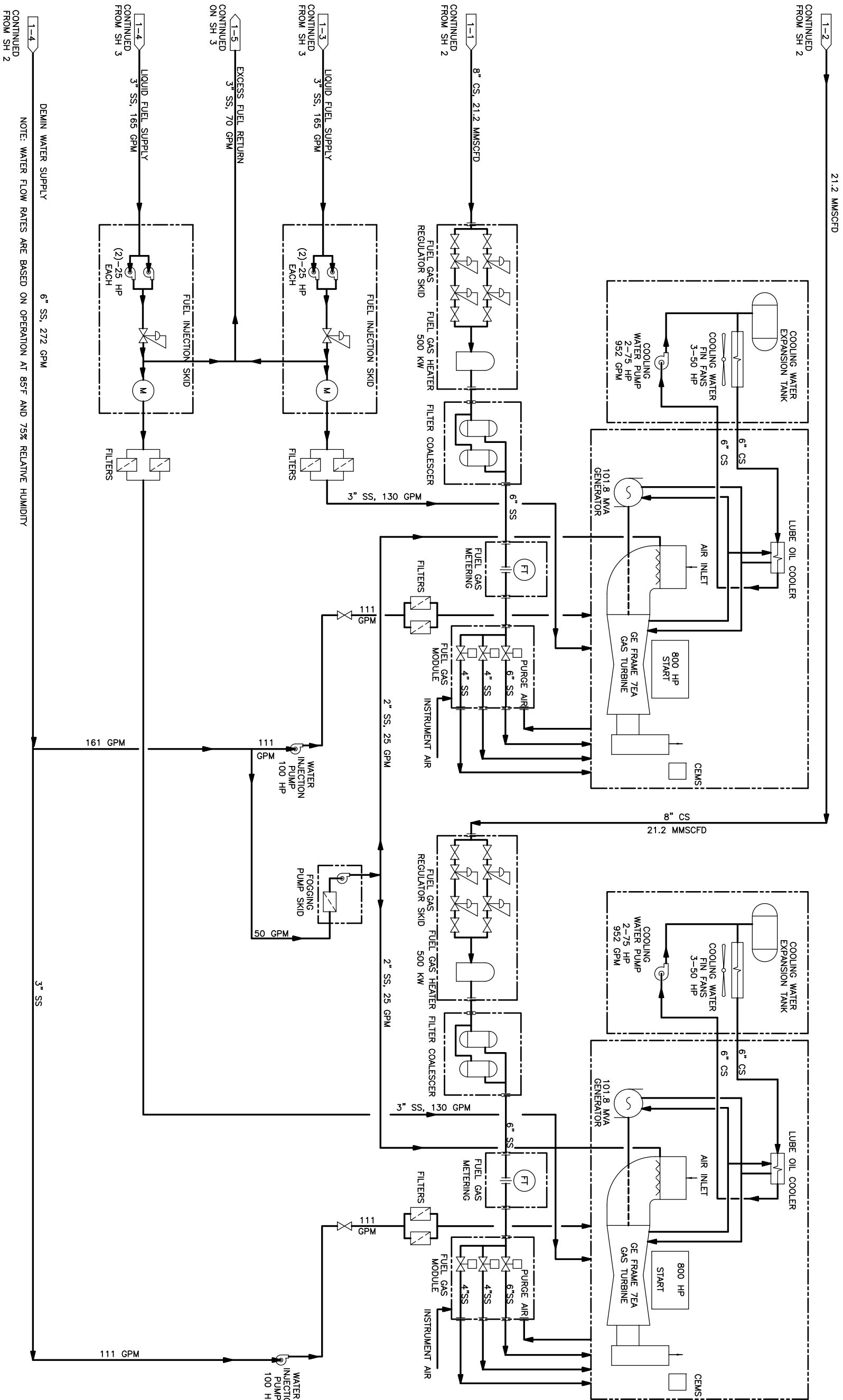
## THE POINTS LEGEND

- |    |                     |
|----|---------------------|
| 11 | FROM NATURAL GAS.   |
| 12 | FROM TREATED WATER. |
| 13 | FROM FIRE WATER.    |
| 14 | TO WASTE WATER.     |
| 15 | FROM LIQUID FUEL.   |
| 16 | FROM INSTRUMENT AIR |



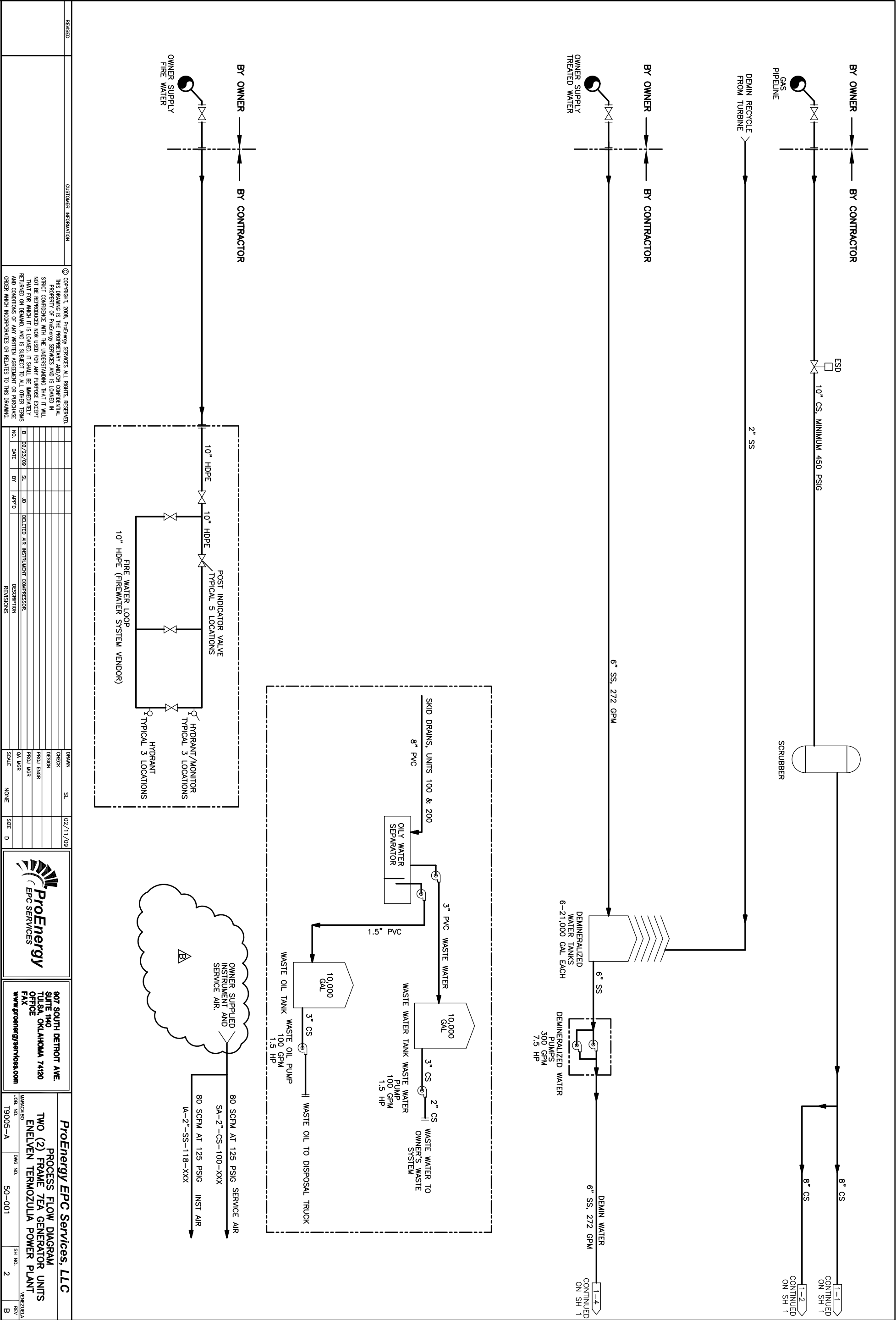
**GRAPHIC SCALE**

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<div><b>ProEnergy EPC Services, LLC</b></div> <div>GENERAL ARRANGEMENT PLOT PLAN TWO (2) FRAME 7EA GENERATOR UNITS ENELIVEN TERMOZUULA POWER PLANT</div>																		
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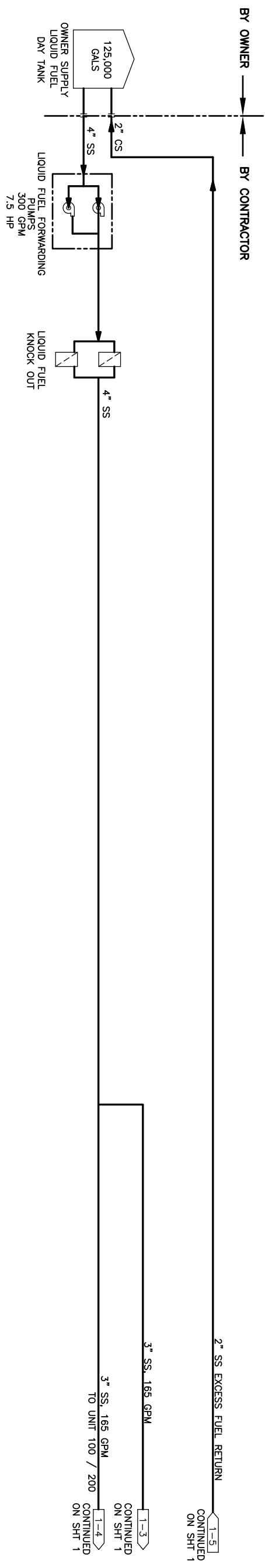
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PROCESS FLOW DIAGRAM  
TWO (2) FRAME 7EA GENERATOR UNITS  
ENELVEN TERMOZULIA POWER PLANT  
VENEZUELA  
JOB NO. 19005-A  
DWG NO. 50-001  
SHEET NO. 2  
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