

# Preliminary Work Scope

Presented To:

**PDVSA**

**Barinas, Venezuela**

4 ea. Rolls Royce Trent 60 Power  
“Barinas 4 Power Plant”

*By*

**DERWICK**

DERWICK ASSOCIATES CORP.



Proposal No. T-1004 Preliminary

February 5, 2010

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PDVSA**

## **Section 1.0 Introduction**

PDVSA desires to build a liquid fuel generating facility installed and operational within the schedule agreed upon. Contractor proposes to install (4) Owner Finished Rolls Royce Trent 60 Gas Turbine Generators including the supply of the following major equipment items:

This turnkey proposal includes installing (4) Owner Furnished Rolls Royce Trent 60 gas turbine generators as well as the supply and installation of the following major items of equipment in the combined cycle power plant.

- Four (4) Rolls Royce Trent 60 gas turbine generator packages
- One (1) Liquid Fuel Treating Plant
- One (1) Water Treatment Plant
- Four (4) Generator Step-up Transformers

This proposal also provides for the furnishing, on a turnkey basis, all engineering, balance of plant equipment, construction, construction tools, equipment rental, project management, commissioning, start-up, and performance testing as described in the following sections.

## Section 2.0 Preliminary Scope of Work and Supply

The Scope of Work and Supply is comprised of the following outlined items:

### Major Generation Equipment

Installation of four (4) Owner Supplied Rolls Royce Trent 60 gas turbine generator packages complete with auxiliary skids, inlet filters and exhaust stacks.

GE interface points are as follows:

<b>Equipment System</b>	<b>Limits of Rolls Royce Scope</b>
<ul style="list-style-type: none"> <li>All supply piping, including Fuel Gas, Steam, Cooling Water, Heating Water, Demineralized Water, Lube Oil, Compressed Air, Instrument Air, Hydraulic Start Oil</li> </ul>	<ul style="list-style-type: none"> <li>Flanged or threaded connection on SwiftPac base plates.</li> </ul>
<ul style="list-style-type: none"> <li>Inlet Air-to-Filter</li> </ul>	<ul style="list-style-type: none"> <li>Atmosphere (non-standard duct by others)</li> </ul>
<ul style="list-style-type: none"> <li>Turbine/Generator Ventilation Air</li> </ul>	<ul style="list-style-type: none"> <li>Atmosphere (non-standard duct by others)</li> </ul>
<ul style="list-style-type: none"> <li>Turbine Exhaust</li> </ul>	<ul style="list-style-type: none"> <li>Flange &amp; Expansion Joint for connection to Exhaust Stack or SCR</li> </ul>
<ul style="list-style-type: none"> <li>Instruments on SwiftPac Base plate</li> </ul>	<ul style="list-style-type: none"> <li>Terminal box on base plate</li> </ul>
<ul style="list-style-type: none"> <li>Instrument wiring in Turbine Control Panel</li> </ul>	<ul style="list-style-type: none"> <li>Terminal in Turbine Control Panel</li> </ul>
<ul style="list-style-type: none"> <li>High Voltage Connections</li> </ul>	<ul style="list-style-type: none"> <li>Bus bar in SwiftPac generator line side cubicle</li> </ul>
<ul style="list-style-type: none"> <li>Generator Ground Connections</li> </ul>	<ul style="list-style-type: none"> <li>SwiftPac Neutral cubicle</li> </ul>
<ul style="list-style-type: none"> <li>Electric Motors</li> </ul>	<ul style="list-style-type: none"> <li>Terminal box on individual motors</li> </ul>
<ul style="list-style-type: none"> <li>Ladders and Platforms for Air Filter</li> </ul>	<ul style="list-style-type: none"> <li>Ladders and Platforms for Inlet Air Filter and Vent Fans</li> </ul>

## **2.0 Balance of Plant**

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

The Balance of Plant scope of supply will be comprised of the following:

- Contractor will provide complete design of the facility including civil, structural, buildings, mechanical, electrical, instrumentation and control.
- Contractor will provide concrete foundations, plant gravel, fencing and security gate.
- Owner will provide a reasonably level graded site.
- Owner will provide access roads to the site.
- Contractor will provide Installation of the complete Power Plant with the inter-ties as described later in this document and including:
  - Mechanical installation of the various items of equipment with the associated inter-ties of raw water, liquid fuel, sanitary sewer, and waste water.
  - Electrical installation of the plant including a new 230 KV high voltage switchyard with one (1) utility tie-in interface to the existing substation adjacent to the plant, area lighting, grounding, lightning protection, and cathodic protection.
  - Installation of Instrumentation and Control System including plant instrumentation, metering, and Plant DCS.

### **2.1 BOP Major Mechanical Systems**

#### **2.1.1 Simple Cycle Exhaust Stack**

The Contractor will install a 60 ft. exhaust stack for each unit in accordance with the standards set out by Rolls Royce for each Trent 60 machine.

#### **2.1.2 Plant Fuel Gas System (NOT INCLUDED)**

The Contractor will install the plant fuel gas system outlined as follows:

- Interconnect to Owner gas metering station above ground at the Power Plant boundary.
- Install two (2) redundant coalescing filter separators on a common skid including redundant pressure regulators.
- Install a fuel gas compression plant to raise the available supply pressure to the required 500 psi. supply pressure to the gas turbines.
- Install all plant fuel gas carbon steel piping, valves and fittings from plant inlet fuel gas interconnect to the fuel gas regulator filter.
- Install stainless steel piping from the fuel gas filter to the gas turbine generator.

### **2.1.3 Plant Liquid Fuel System**

The Contractor will design and install the plant liquid fuel system outlined as follows:

- Off load station for fuel supply trucks with measurement facilities to Contractor's liquid fuel storage at the Power Plant boundary.
- Install three (3) 50% capacity liquid fuel treatment systems.
- Install three (3) 50% capacity liquid fuel forwarding pumps.
- Install two 100% capacity liquid fuel filter/regulator skids.
- Install two 100% capacity liquid fuel injections pump skids.
- Provide and install all plant liquid fuel carbon steel piping, valves and fittings from the plant liquid fuel storage tank to liquid fuel treatment.
- Provide and install all plant liquid fuel stainless steel piping, valves and fittings from the plant liquid fuel treatment to the gas turbines.
- Provide and install treated liquid fuel day storage tank.
- Install liquid fuel injection pump skids.

### **2.1.4 Water and Demineralized Water System**

Contractor will install a complete demineralized water plant to treat raw water from an Owner furnished potable water supply. The specifications for this system are attached in Section 12.

### **2.1.5 Oily Water Drain System**

The Contractor will furnish and install the oily water drain system as follows:

- Furnish and install below ground one (1) oily water separator with associated pumps and ancillaries.
- Furnish and install PVC or HDPE below ground piping and fittings from concrete oil containment units located at:

- 1) All Transformers
- 2) Gas Turbine Generator Auxiliary Skids

Piping is to be routed to the oily water separator and then to the waste oil storage tank. Provisions are to be made to pump out the waste oil to a truck for disposal, which will be provided by the Owner.

### **2.1.6 Plant Fire Water System**

The Contractor will furnish and install the Firewater System that includes:

- Headers routed throughout the plant in accordance with NFPA Codes sized as 10" HDPE pipe.
- Monitors and Hydrants installed in accordance with NFPA Codes
- Portable fire extinguishers
- Building Fire Protection in accordance with Local Codes

- Firewater Pumps and associated controls

### **2.1.7 Instrument and Service Air Systems**

The instrument and service air systems will be as follows:

- Furnish and install one (1) set of two (2) instrument and service air screw compressors with associated dryer and air storage tanks.
- Furnish and install carbon steel piping, valves, fittings and instruments for instrument and service air systems from the air compressors to various required areas throughout plant for instrument air and service air. Furnish the appropriate quick connect connectors.

## **2.2 BOP Electrical Systems**

### **2.2.1 13.8 KV System**

The Contractor will perform the following work on the 13.8 KV system:

- Install two (4) 13.8 KV 3,000 amp generator circuit breakers, two (2) 1,200 amp feeder breaker and with PTs and CTs.
- Furnish and install all 13.8 KV cabling, bus work, cable tray etc. from the generators to the generator circuit breakers.

### **2.2.2 13.8/4.16 KV System (NOT REQUIRED)**

The Contractor to provide the following:

- Furnish and install one (1) 13.8 KV fused switchboard with three (3) 600 amp fused disconnects.
- Furnish and install one (1) 13.8KV / 4160V auxiliary power transformer.
- Furnish and install two (2) 13.8KV / 480 volt auxiliary power transformer.

### **2.2.3 480V System**

The Contractor will provide the 480V system as follows:

- Furnish and install one (1) 480 V distribution switchboard
- Furnish and install two (2) gas turbine generator MCC's.
- Furnish and install one (1) BOP 480V MCC
- Furnish and install cable tray / conduit with cabling from transformers to MCCs and from MCCs to plant 480V equipment and motors.
- Furnish and install underground conduit, duct banks, or overhead cable tray mounted on the pipe racks.

#### **2.2.4 120/208 System**

The Contractor will provide the 120/208 system as follows:

- Furnish and install 480V/120/208V transformers, distribution panels and lighting panels as required with associated conduits, fittings and wire.

#### **2.2.5 Plant Area Lighting**

The Contractor will provide the plant area lighting as follows:

- Furnish and install area lighting consisting of four (6) 45 ft galvanized metal poles with two (2) 400 watt metal halide floodlights on each pole sufficient to illuminate both GTG's and common areas.

#### **2.2.6 Ground Grid**

The Contractor will provide the ground grid for the plant as follows:

- Furnish and install plant ground grid with associated ground rods and connections to plant equipment, buildings and fence.

#### **2.2.7 Plant Electrical Cable Tray**

The Contractor will provide the plant electrical cable tray work as follows:

- Furnish and install aluminum cable trays throughout plant. Cable trays to be mounted on pipe racks, cable trenches or within buildings for routing plant cabling. A separate cable tray will be installed for each of the 15/5KV systems, 480V system, and instrumentation system cables.

#### **2.2.8 Underground Conduit and Cable Systems**

The Contractor will provide the plant underground conduit and cable system as follows:

- Furnish and install rigid galvanized conduit or PVC encased in concrete for all underground power, control and instrumentation systems.

#### **2.2.9 Lightning Protection**

The Contractor will provide lightning protection as follows:

- Furnish and install lightning protection on each gas turbine exhaust stack.

### **2.2.10 Batteries / Chargers / UPS Systems**

The Contractor will perform the following work on the batteries / chargers / UPS systems:

- Furnish and install BOP UPS system for DCS and associated equipment.
- Furnish and install one (1) 125V DC battery and charger for 13.8KV plant switchgear.

Note: 24 VDC and 125VDC batteries and chargers are to be supplied as part of the GE packaged control house.

## **2.3 Plant Instrument and Control Systems**

### **2.3.1 BOP Control System**

The Contractor will furnish and install a BOP control system consisting of:

- One (1) PLC DCS system.
- Three (3) PCs for human-machine interface (HMI).
- Two (2) printers.
- One (1) software package for plant DCS.

### **2.3.2 Plant Instrumentation Devices**

- Gas Turbine Control Panel is supplied with each LM2500 gas turbine. The two Control Panels will be mounted in a new modular pre- Control Room.
- Contractor to furnish and install instrument devices, both pneumatic and electric, consisting of meters, pressure, flow, temperature and level where required.

### **2.3.3 Electronic Wiring and Pneumatic Piping**

- Contractor to furnish and install necessary instrument wiring and pneumatic piping with associated Swagelok fittings, etc.

## **2.4 230 KV Substation**

### **2.4.1 Generator Step-up Transformers (GSU's)**

- Contractor to supply and install two (2) generator step-up three winding transformers with 13.8KV to 230 KV. Contractor to furnish oil. Contractor to provide dressing, oil fill and testing of transformer



#### **2.4.2 230 KV SF6 Circuit Breaker**

- Contractor to supply and install (3) new SF6 Circuit Breaker rated 230 KV, 1200A, dead tank with CT's on each bushing

#### **2.4.3 230 KV Air Switches**

- Contractor to supply and install (4) 230 KV, 1200A, 3 phase Air Switches

#### **2.4.4 Aluminum Bus Work**

- Contractor to supply and install all necessary aluminum bus work in the high voltage substation.
- Contractor to supply and install all necessary support insulators for the substation bus work

#### **2.4.5 Structural Steel**

- Contractor to supply and install all structural steel to support the following:
  - Air Switches
  - Bus Work and Insulators
  - Lightning Protection
  - Dead End Tower for Outgoing Transmission Line

#### **2.4.6 Lightning Protection**

#### **2.4.7 Protective Relaying**

- Contractor to supply and install protective relaying for the GSU transformers and the other substation equipment

#### **2.4.8 Hi Voltage Metering**

- Contractor to supply and install metering for both the 13.8 KV and the outgoing 230 KV feeder.

#### **2.4.9 Site Work**

- Contractor to prepare the site and provide the following:
  - Foundations for the GSU transformers, SF6 Breakers, Air Switches and other Structural Supports.
  - Perimeter Fence
  - Driveways
  - Gravel Paving

## **2.5 Plant Communication System**

- Contractor to provide communication and public address system for the new plant.
- Contractor to furnish temporary telephones and email capability for construction communication purposes.
- Permanent telephone lines for operation of the plant will be provided by Owner.

## **2.6 Plant Civil and Structural**

- Site preparation, rough grading, and finished grading to be furnished by Contractor based on an existing site requiring minimal cut and fill.
- Contractor to furnish and install all plant reinforced concrete foundations designed to IBC 2003. GSU foundation shall have 9" freeboard.
- Contractor to furnish and install concrete containment curbs and equipment foundations, including ammonia truck filling area.
- Contractor to furnish and install plant gravel and asphalt paving as shown on the Plot Plans.
- Contractor to provide structural steel pipe racks to support overhead piping and cable trays. Pipe racks to be located as shown on Plot Plan drawings.

## **2.7 Plant Buildings**

- Furnish and install a (40ft. x 60ft.) prefabricated metal insulated building for the Control / DCS/PLC room and also auxiliary mechanical equipment. The Control / DCS/PLC room will be air conditioned and finished out as office space.
- Furnish and install a (50ft. x 75ft.) prefabricated metal insulated building for Maintenance & Warehouse
- Furnish and install a (20ft x 30ft.) prefabricated metal Shed for the demin water forwarding pumps.
- Furnish (2) 45ft. x 50ft. prefabricated metal power block utility buildings

## **2.8 Plant Equipment Erection**

- Contractor to unload all Plant equipment delivered to site.
- Contractor will provide all cranes and support equipment and manpower as required to erect the gas turbine generators.
- Contractor to provide for erection of all BOP equipment.

## **2.9 Cranes, Equipment and Tools**

Contractor to furnish or provide for all plant construction required cranes, fork lifts, back hoes, hydraulic lifts, welding machines, air compressors, generators, temporary lights, trucks, pick-ups, etc.

## **2.10 Transportation Owner will furnish transportation to site of all furnished equipment.**

### **2.11 Lubricants and Chemicals**

- Contractor will supply and install all lubricants, lube oils and chemicals for furnished equipment.
- Contractor to supply and install non-PCB oil for GSU transformers.

### **2.12 Spares**

- Contractor will make provision to supply, receive and store all commissioning spare parts furnished for equipment during start-up and commissioning.
- Contractor to provide Owner with recommended list of spare parts for Gas Turbine Generator and BOP equipment.

### **2.13 Construction Offices and Storage Facilities**

- Contractor to provide construction offices for Contractor, Technical Representatives (3), and Owner.
- Owner to provide 3 acre lay down area and site for construction offices and construction utilities (electrical and potable water)
- Contractor to provide fenced storage and a lay down area and around the construction site during construction.
- Contractor to provide sanitation facilities for Contractor, & Owner personnel during construction.
- Contractor to provide communication facilities for construction.

### **2.14 Engineering and Project Management**

- Contractor to provide detailed engineering and specifications for all disciplines involved for the power plant including civil and concrete foundations.
- Contractor to provide project management complete with construction management, quality control / quality assurance, scheduling, administration, warehousing, and expediting including regular monthly reporting of all disciplines.
- Contractor to arrange for and provide fully qualified technical representatives during erection, testing, start-up, commissioning for the gas turbine generator units and Chillers.
- Contractor to provide startup, commissioning and testing of BOP associated systems.
- Contractor to provide operator and maintenance training for Power Plant on the Gas Turbine Generator Packages, DCS, and Balance of Plant.
- Contractor to provide one (1) electronic and two (2) hard copies of the O&M manuals, training manuals, engineering calculations, commissioning and start-up

manuals, test manuals, as-built drawings, design specifications and warranty manuals for plant equipment.

## **2.15 Cathodic Protection**

Cathodic Protection will be provided for all steel underground piping.

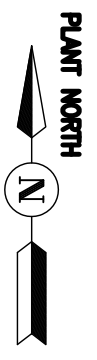
**2.16 Project Equipment List and Supplier**

Qty	Description	Responsibility	
		Owner	Contractor
1	Power Plant Site with survey	xxx	
1	Soil test report		xxx
None	Fuel gas pipeline to site	xxx	
None	Fuel gas	xxx	
1 lot	Site permits if required (Environmental, etc.)	xxx	
1	Construction permit (if required)	xxx	
1 lot	Import duties, sales taxes, VAT, etc. (if required)	xxx	
1 lot	Water supply to site for construction and operations	xxx	
1 lot	Construction Power	xxx	
1 lot	Oil disposal	xxx	
1 lot	Site Preparation and grading		xxx
1 lot	Concrete Foundations		xxx
1 lot	Site Gravel and Paving		xxx
1 lot	Plant construction and lay down area temporary fencing and gates		xxx
1 lot	Plant security during construction		xxx
4	RR Trent 60 Gas Turbine Generator Packages	xxx	
4	GTG Turbine Control Panels	xxx	
4	Sets of GTG batteries and chargers each set consisting of 3ea 24 volt batteries and 2ea chargers to be located in the Battery Room	xxx	
4	Exhaust Stacks		xxx
1 Lot	Prefabricated insulated metal building with air conditioned Control and Electrical Rooms, and Pump Room.		xxx
4	Lube oil cooling water pump skids consisting of 2 each 100% pumps.		xxx
None	Gas ESD Block Valve		xxx
None	Duplex Fuel Gas Regulator Coalescing Filter Skids (Note: The addition of a fuel gas heater on each skid is quoted as an alternate)		xxx
1	Underground 2,000 Gallon Oily Water Separator with Pumps		xxx
1 Lot	Demineralized water storage 21,000 gallon FRP tanks		xxx
2	100% Demineralized water forwarding pumps		xxx
1	Waste Oil 5,000 gallon Storage Tank		xxx
2	100% Waste Oil Transfer Pumps		xxx
1	Duplex Instrument / service air compressor with dryer and dual storage tanks		xxx

Qty	Description	Responsibility	
		Owner	Contractor
4	13.8KV Generator Circuit Breakers 3000 Amp NEMA 3R		xxx
4	13.8 KV aux feeder breaker NEMA 3R		xxx
4	13.8KV to 480V Transformers		xxx
None	13.8KV to 4160V Transformer		xxx
4	480V MCCs for Gas Turbine Generators		xxx
3	480V MCC for Balance of Plant		xxx
2	480V Switchboard		xxx
1 lot	Balance of plant (BOP) 480V/120/208V Transformer, Distribution Panels, Lighting Panels		xxx
12	Pole mounted 400 watt Metal Halide Lights		xxx
6	45ft Metal Poles		xxx
1	Plant Ground Grid		xxx
1 Lot	Plant Instrumentation		xxx
1	Power Plant PLC based DCS System		xxx
1	Lot fencing for construction and storage		xxx
1 lot	Start up and commissioning spare parts		xxx
1 lot	Plant Cathodic Protection of Buried Piping		xxx
1 lot	BOP Equipment Erection		xxx
1 lot	Transportation of all Contractor Furnished Equipment		xxx
1 lot	Lubricants and Chemicals for gas turbine generator		xxx
1 lot	Lubricants and Chemical for BOP		xxx
1 lot	Construction Offices, Storage, Temporary Facilities and Utilities		xxx
1 lot	Construction Tools and Equipment		xxx
1 lot	Temporary Power Supply (500KVA)	xxx	
1 lot	Temporary Power Distribution		xxx
1 lot	Engineering and Project Management, Safety, QA/QC, subcontracting for civil, mechanical, electrical, instrumentation & DCS system.		xxx

## 2.17 Substation Equipment & Supply

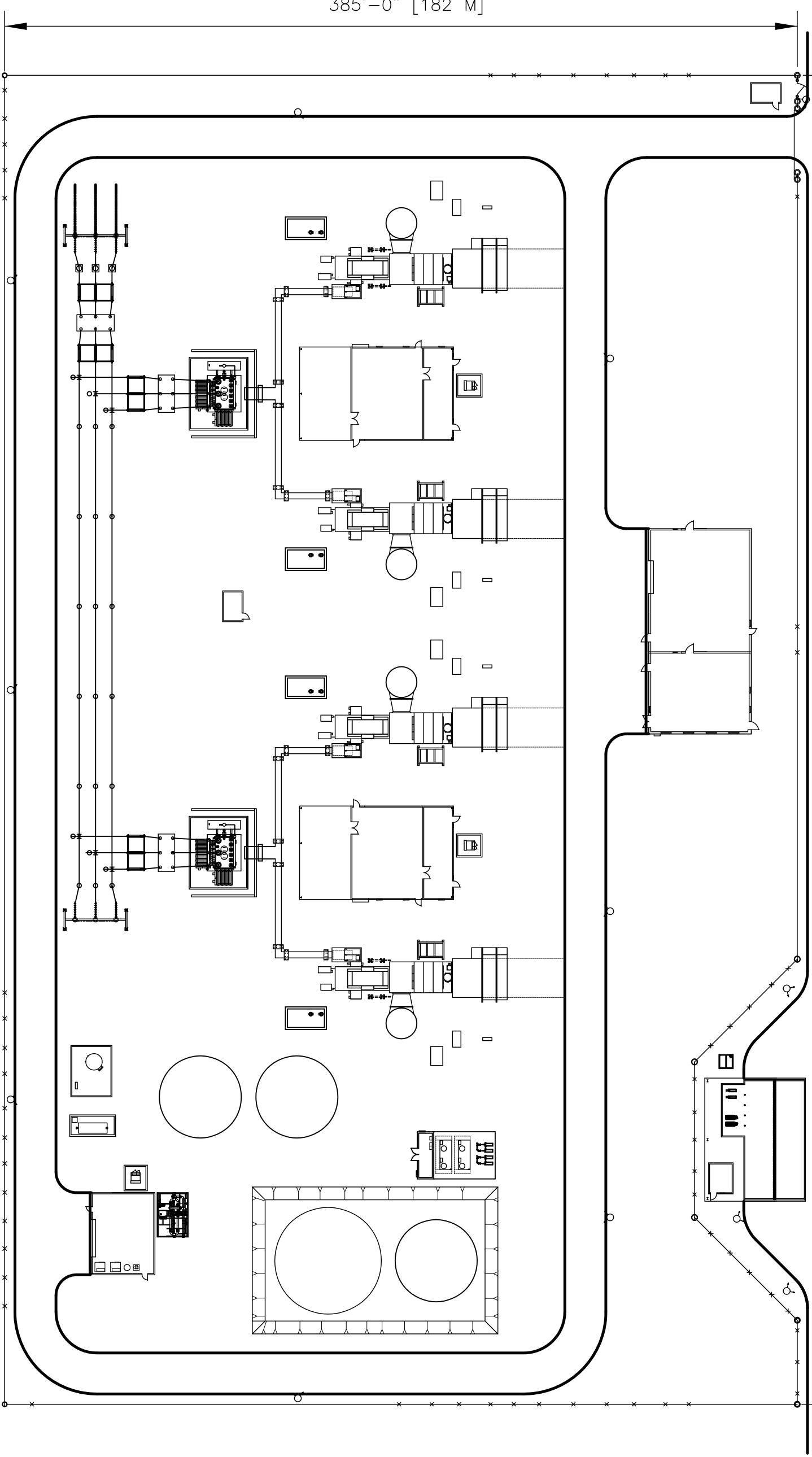
Qty	Description	Responsibility	
		Owner	Contractor
1	Power Plant Site with survey	xxx	
1	Soil test report		xxx
2	GSU Transformers (See Section 3 for Detail Description)		xxx
3	SF6 Circuit Breakers (230 KV)		xxx
4	115 KV Air Switches		xxx
1 lot	High Voltage Metering & Relaying		xxx
1 lot	Transformer Oil and Dress-out		xxx
1 lot	Aluminum Bus Work		xxx
1 lot	Structural Steel		xxx
1 lot	Perimeter Fence		xxx
1 lot	Site Preparation and grading		xxx
1 lot	Concrete Foundations		xxx
1 lot	Site Gravel and Paving		xxx



647'-0" [197,20 M]

PUBLIC ROAD

385'-0" [182 M]



GRAPHIC SCALE