

Summary
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New Document:

[Barinas I - TSD 1003 Rev3 con puntos agregados por DWK](#)

18 pages (627 KB)

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Old Document:

[Barinas I - TSD 1003 Rev2 from Lugo](#)

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Technical Scope Document

Presented To:

PDVSA

Barinas, Venezuela

**2 ea. P& W FT4 TwinPac
“Barinas I Plant”**

By

DERWICK

DERWICK ASSOCIATES CORP.



Proposal No. T-1003 Rev. 3

September 25, 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 (2) Owner Finished Pratt & Whitney FT4 TwinPac Gas Turbine Generators including the supply of the following major equipment items:

This turnkey proposal includes installing (2) Owner Furnished FT4 TwinPac gas turbine generators as well as the supply and installation of the following major items of equipment in the combined cycle power plant.

- One (1) Liquid Fuel Offload, Storage & Treating Plant
- Two (2) Owner Furnished 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.

THIS DOCUMENT IS CONFIDENTIAL. IT IS DESIGNED AND INTENDED FOR PDVSA USE. THIS DOCUMENT IS FOR THE SOLE PURPOSE OF EVALUATING PROENERGY EPC SERVICES' PROPOSAL FOR THE 2 x P&W FT4 Twin Paks.

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 two (2) Owner Supplied Pratt & Whitney FT4 TwinPac gas turbine generator packages complete with auxiliary skids, modular control rooms, inlet filters and exhaust stacks.

Pratt & Whitney interface points are as follows:

Equipment System	Limits of P&W FT4 Scope
<ul style="list-style-type: none"> All supply piping, including Liquid Fuel, Cooling Water, Demineralized Water, Lube Oil, Instrument Air, Hydraulic Start 	<ul style="list-style-type: none"> Flanged or threaded connection on TwinPac base plates.
<ul style="list-style-type: none"> Inlet Air-to-Filter 	<ul style="list-style-type: none"> Atmosphere (non-standard duct by others)
<ul style="list-style-type: none"> Turbine/Generator Ventilation Air 	<ul style="list-style-type: none"> Atmosphere (non-standard duct by others)
<ul style="list-style-type: none"> Turbine Exhaust 	<ul style="list-style-type: none"> Flange & Expansion Joint for connection to Exhaust Stack
<ul style="list-style-type: none"> Instruments on TwinPac Base plate 	<ul style="list-style-type: none"> Terminal box on base plate
<ul style="list-style-type: none"> Instrument wiring in Turbine Control Panel 	<ul style="list-style-type: none"> Terminal in Turbine Control Panel
<ul style="list-style-type: none"> High Voltage Connections 	<ul style="list-style-type: none"> Bus bar in TwinPac generator line side cubicle
<ul style="list-style-type: none"> Generator Ground Connections 	<ul style="list-style-type: none"> TwinPac Neutral cubicle
<ul style="list-style-type: none"> Electric Motors 	<ul style="list-style-type: none"> Terminal box on individual motors
<ul style="list-style-type: none"> Ladders and Platforms for Air Filter 	<ul style="list-style-type: none"> Ladders and Platforms for Inlet Air Filter and Vent Fans

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 remove existing foundations 2 x GE Frame 5 and existing base under 16 Engine Gensets, Storage tank foundation, etc. as described in drawings attached.
- Contractor will transport removed concrete foundations and Genset base material (up to 1132.6 cubic meters) for a distance up to 30 kilometers away from present plant location. Owner to provide permits to transport and dispose of waste concrete and Genset base material.
- Contractor will remove and replace contaminated soil (up to 5,348.48 cubic meters) as described in drawings attached.
- Contractor will transport contaminated soil (up to 5,348.48 cubic meters) for a distance to an owner provided dumping site up to 30 kilometers away from present plant location. Owner to provide permits to transport and dispose of contaminated soil.
- Contractor will transport the 16 Engine Gensets up to 20 kilometers from present plant location to Owner provided remote Storage.
- Contractor will provide complete design of the facility including civil, structural, buildings, mechanical, electrical, and instrumentation.
- Contractor will provide concrete foundations and plant gravel.
- Owner will provide a reasonably level graded site and additional 2 hectares adjacent to plant as shown on drawings attached. Contractor will grade, fence and gravel this area.
- 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 supply-storage-treatment, liquid fuel delivery-treatment-storage, and waste oil and water.
 - Electrical installation of the plant including installation of two (2) owner provided 11.5KV/115 KV Generator Step up Transformers, and Contractor provided two (2) new 115 KV SF6 Breakers and two (2) new 115 KV Disconnect Switches. Owner to provide connection to the existing substation.
 - Installation of Plant metering, Instrumentation and Control System

2.1 BOP Major Mechanical Systems

2.1.1 Simple Cycle Exhaust Stack

The Contractor will install the four (4) exhaust stacks provided by Owner with their purchase of the Pratt & Whitney FT4 gas turbines.

2.1.2 Plant Liquid Fuel System

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

- Provide and install a Three -Truck Off- loading station for accepting truck delivery of Raw Diesel with measurement facilities located adjacent to Owner's existing liquid fuel storage area.
- Provide and install three (3) DFO unloading pump skids each 1 x 100% pumps with 1 common spare, (4) block valves and (2) check valves.
- Repair existing Tank Dike and install a new liner or asphalt liner.
- Re-use of Owner's 660,000 gallon liquid fuel storage tank as raw fuel storage
- Provide and Install one (1) new 660,000 gallon raw fuel tank
- Provide and install two (2) 100% capacity liquid fuel forwarding pumps with (4) block valves and (2) check valves.
- Provide and install three (3) new 100% centrifuges for liquid fuel treatment.
- Provide and install one (1) new 550,000 gallon clean liquid fuel storage tank.
- Provide and install two (2) 100% capacity liquid fuel forwarding pumps.
- Install two (2) Owner provided Liquid Fuel injection Skids each with 1 x100% capacity liquid fuel pumps.
- Install two (2) Owner provided Liquid Fuel filters.
- Provide and install all plant liquid fuel carbon steel piping, valves and fittings from the plant liquid fuel Truck Off-Loading facility to each Gas Turbine liquid fuel filters
- Provide and install all plant liquid fuel stainless steel piping, valves and fittings from the plant liquid filters to each gas turbine.

2.1.3 Water System

Owner has limited raw water supply at site.

- Contractor will drill a water well on or near the plant site to satisfy the plant water requirements.
- Contractor will design and install a water plant to treat raw water as required to meet Pratt & Whitneys' specifications for the water wash system as well as the liquid fuel centrifuge water requirements.

2.1.4 Oily Water Drain System

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

- One oily water separator system.
- Furnish and install PVC or HDPE below ground piping and fittings from concrete oil containment units located at:

- 1) All Transformers
 - 2) Liquid Fuel Treatment
 - 3) Gas Turbine Generator Auxiliary Skids
 - 4) Liquid fuel Truck Off-Loading area
- Waste water will be disposed of by owner into a ditch
 - Waste Oily water will be stored in a 10,000 tank for truck disposal by Owner
 - Waste Sludge from Centrifuge will be stored for truck disposal by Owner

2.1.5 Plant Fire Water System

The Contractor will furnish and install a firewater system that includes:

- A combination Raw Water / Firewater Storage tank
- A firewater pump designed system with one (1) each diesel, electric and jockey pumps
- An 8" diameter HDPE below ground and carbon steel above ground pipeline from the Fire Water pump shed and routed throughout the plant in accordance with NFPA Codes. Monitors and Hydrants to be installed in accordance with NFPA Codes. Include tank rings and sprinkles
- Portable fire extinguishers
- Contractor to supply and install the Foam System with foam tank in the plant and truck offloading areas, includes rings and sprinkles.

2.1.6 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.

Furnish and install needed vibration and velocity instruments (pneumatic and electric) .

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 (2) 13.8 KV fused disconnect switches with key interlock for BOP Aux. Transformers.

- Furnish and Install one (1) 13.8KV/480V 750 KVA BOP Aux. Transformer, including associated control, protection and communication scope.
- Furnish and install all 13.8 KV cabling, bus work, cable tray etc. from the generators to the generator circuit breakers.
- Furnish and install all 13.8 KV cable via underground conduit from each Generator Breaker to the 13.8 KV terminals of the respective Gas Turbine GSU.

2.2.2 480V System

The Contractor will provide the 480V system as follows:

- Furnish and install one (1) 480 V distribution switchboard
- 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.
- Furnish and install a Black Start generator with fuel tank, including lines, services and associated utilities.

2.2.3 120/208 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.

2.2.4 Plant Area Lighting

The Contractor will provide the plant area lighting as follows:

- Furnish and install area lighting consisting of eight (8) 45 ft galvanized metal poles with Three (3) 400 watt metal halide floodlights on each pole sufficient to illuminate both GTG's, liquid fuel truck supply road, off-loading facility and plant common areas.

2.2.5 Ground Grid

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

- Furnish and install plant ground loops in areas of new construction with associated ground rods and connections to plant equipment, buildings and fence. It will interconnect with existing plant ground grid.

2.2.6 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 cable.

2.2.7 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.

2.2.8 Lightning Protection

The Contractor will provide lightning protection as follows:

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

Note: Owner to provide lightning protection on the 115 KV Substation.

2.2.9 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) 125 VDC battery and charger for 115 KV substation breakers.

Note: The Gas Turbine 24 VDC and 125VDC batteries and chargers are to be supplied as part of the P&W packaged control houses.

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 BOP Control system.
- Three (3) PCs - (1 PC for BOP HMI, 2 PC's for the two (2) FT4 GTG's.(HMI).
- Two (2) printers.
- One (1) software package for plant PLC Control System.

2.3.2 Plant Instrumentation Devices

- Gas Turbine Control Panel is supplied with each FT4 gas turbine. The two (2) sets of Gas Turbine-Generator Control Panels will be mounted in a modular 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.

2.4 115 KV Substation

2.4.1 Generator Step-up Transformers (GSU's)

- Contractor to install two (2) Owner furnished generator step-up transformers with 13.8KV delta to 115 KV wye windings. Owner to furnish oil. Contractor to provide dressing, oil fill and testing of transformer, including associated control, protection and communication scope.

2.4.2 115 KV SF6 Circuit Breaker

- Contractor to supply and install (2) new SF6 Circuit breakers rated 115KV, 1200A.

2.4.3 115 KV Air Switches

- Contractor to supply and install (2) new 115 KV, 1200A, 3 phase Air Switches

2.4.4 115 KV Bus Work

- Contractor to supply and install all necessary aluminum bus work between the GSU to the disconnect switch in the high voltage substation.

2.4.5 115 KV Bus Insulators

- Contractor to supply and install all necessary support insulators for the substation bus work

2.4.6 115KV Support Steel

- Contractor to supply and install all structural steel to support the followings:
 - SF6 Breakers
 - Disconnect Switches
 - Bus Work and insulators

2.4.7 Protective Relaying

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

2.4.8 High Voltage Metering

- Contractor to supply and install metering for the 115 KV outgoing system, including protection, maneuver and communication.

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.
 - New Substation Gravel in immediate area of substation equipment provided.

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

- 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 fuel truck offloading 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 Building

It is planned to utilize the Owners' existing Office, Control Room and maintenance building for these purposes. In addition, contractor will provide:

- Furnish and install a prefabricated metal insulated building for the water treatment and Instrument Air Compressor equipment. An attached shed will be provided for the firewater pumps and controls.
- A shed will be provided for the liquid fuel treatment

- Guard House

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 and storage tanks

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

- Contractor will furnish transportation to site of all Contractor furnished equipment.

2.11 Lubricants and Chemicals

- Contractor will supply and install all lubricants, lube oils and chemicals for furnished equipment.

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.
- Contractor guarantees the supply of spare parts up to 5 years.

2.13 Construction Offices and Storage Facilities

- Contractor to provide six (6) construction offices for Contractor, Technical Representatives (3), and Owner.
- Owner to provide 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.
- 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 and Balance of Plant Equipment.
- 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 including 2 hectares area	xxx	
1 lot	Temporary construction power	xxx	
1 lot	Site permits if required (Environmental, etc.)	xxx	
1	Construction permit (if required)	xxx	
1	Black Start Generator with tank	xxx	
1 lot	Import duties, sales taxes, VAT, etc. (if required)	xxx	
1 lot	Water supply at site for construction and operations – (contractor will drill a water well per owner's direction)	xxx	
1 lot	Construction Power	xxx	
1 lot	Plant construction and lay down area approx. 3 acres	xxx	
1 lot	Plant security during construction	xxx	
2	P&W FT4 TwinPac Gas Turbine Generator Packages equipped with a prepackaged, modular control house.	xxx	
2	Exhaust Stacks per FT4 package	xxx	
2	GTG Turbine Control Panels to be located in the FT4 prepackaged control houses	xxx	

Qty	Description	Responsibility	
		Owner	Contractor
2	Sets of GTG batteries and chargers each set consisting of 2 xxx ea. 24 volt batteries and 2 ea. chargers		
2	13.8KV Generator Circuit Breakers 3000 Amp NEMA 3R	xxx	
1 lot	Contaminated Soil removal p to 5,328.48 cubic meters	xxx	
1 lot	Foundation and Genset pad removal up to 1132.63 cubic meters	xxx	
1	Water Treatment, Instrument Air Building with Firewater Pump shed.	xxx	
1 lot	Liquid Fuel Treatment with shed	xxx	
1	Duplex Instrument / service air compressor with dryer and dual storage tanks	xxx	
1 lot	Site Preparation and grading as needed	Xxx	
1 lot	Fencing on 3 sides of 2 Hectares area	xxx	
1 lot	Concrete Foundations	xxx	
1 lot	Site Gravel and Paving	xxx	
1	480V Switchboard	xxx	
1 lot	Balance of plant (BOP) 480V/120/208V Transformer, Distribution Panels, Lighting Panels	xxx	
24	Pole mounted 400 watt Metal Halide Lights	xxx	
8	45ft Metal Poles	xxx	
1	Plant Ground Grid	xxx	
1 Lot	Plant Instrumentation	xxx	
1	Power Plant PLC based BOP Control System	xxx	
1	Lot temporary 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 Distribution	xxx	
1 lot	Engineering and Project Management, Safety, QA/QC, subcontracting for civil, mechanical, electrical, instrumentation & DCS system.	xxx	



2.17 115 KV Substation Equipment & Supply

Qty	Description	Responsibility	
		Owner	Contractor
1	Substation with survey	xxx	
1	Perimeter Fence	xxx	
2	GSU Transformers 13.8 KV to 115 KV	xxx	
1 Lot	Transformer Oil	xxx	
2	115 KV SF6 Breakers		xxx
2	115 KV Disconnect Switches		xxx
1 lot	Aluminum Bus between GSU's to Disconnect Switches		xxx
1 lot	Transformer Dress-out		xxx
1 lot	Site Preparation and grading		xxx
1 lot	Concrete Foundations (GSU's, SF6, & Disconnects)		xxx
1 lot	Site Gravel and Paving (GSU's, SF6 & Disconnects area only)		xxx
1	Soil Test		xxx

Section 3.0 Design Basis

3.1 Design Conditions:

Design Conditions (Assumed)

Site Elevation	926.2 feet
Air Temperature, Design	81° F
Maximum Wind Velocity	80 mph
Relative Humidity	70%
Seismic Zone	4
Liquid fuel supply	180 gpm Raw
Water Supply	15 gpm
Raw/Fire Water Storage	350,000 gallons
Raw Liquid Fuel tank	660,000 gallons Existing
Raw Liquid Fuel tank	660,000 gallons New
Treated Liquid Fuel tank	550,000 gallons New
Demin Water Treatment	12 gpm
Capacity	
Demin Water Storage	21,000 gallons fiberglass
Plant High Voltage	13.8 KV Underground Cable
Interconnect	to Owner's step-transformers
Utility Connection	115 KV Disconnects
Instrument Air System	185 scfm compressor by Contractor

3.2 Interconnect Points with Owner Facilities

Liquid Fuel Delivery	Plant Three (3) Truck Off-Loading Station by Contractor
Oily Water	Pumped to 10,000 gallon tank for Owner's truck disposal
Waste Water	Pumped to Owner's ditch
Telephone	6 lines at plant battery limits
Water Supply	Contractor to drill well on Owner's property

Section 4.0 Performance

Barinas I

Power Plant

Site Elevation	926.2 Feet
Design Temperature	81 F
Relative Humidity	70%

Simple Cycle

ID GTPRO 13

(4) FT4C-3F	
Gross Power KW	98187
Net Power KW	96395
Aux & Losses KW	1792.3
LHV Gross Heat Rate (BTU/kWh)	11574
LHV Net Heat Rate (BTU/kWh)	11790
LHV Gross Electric Eff %	29.48
LHV Net Electric Eff %	28.94
LHV Fuel (kBTU/h)	1136453
HHV Fuel (kBTU/h)	1210476
Fuel Gas (KPPH)	0
Fuel Gas (MMSCFD)	0.00
Liquid Fuel (KPPH)	62.11
Liquid Fuel (GPM)	143.60
Demin Water Centrifuges (KPPH)	5.00
Demin Water Centrifuges (GPM)	10.00

GT-PRO runs for FT4C-3F (not twin pac)

The GT-PRO expected performance runs used individual FT-4 machines

THE EXPECTED PERFORMANCE IS SHOWN: NOT GUARANTIED



GT PRO 19.0 ProEnergy

14.21 p
81 T
70 %RH
949.5 m
926.2 ft elev.

1X P+W FT4C-3F

183.6 p
745 T

176.3 p
1915 T

965 m

4 X GT
14.39 p
872 T
3860 M

Net Power 96395 kW
LHV Heat Rate 11790 BTU/kWh

74.96 %N2
15.32 %O2
3.362 %CO2
5.454 %H2O
0.9027 %Ar
0.0072 %SO2

14.07 p
81 T
949.5 m

No.2 Distillate 15.53 m
LHV 284113 kBTU/h

77 T

24547 kW

p[psia], T[F], M[kpph], Steam Properties: Thermoflow - STQUIK

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Section 5.0 Drawings

Plot Plan	10001
	10002
	10003
PFD	50001
	50002
	50003
	50004
	50005
	50006
Electric One line	60001
	60002
	60003
	60004