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Section 3.0 Major Plant Equipment Description

The following is a brief description of equipment and the proposed manufacturer for the balance of plant equipment.

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.

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 coordinating the tie into the existing pipeline.

3.1.5 Demin Water to be supplied by Owner must meet the GE Gas Turbine Generators specifications below



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	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.

- 3.1.6 Demin Water – Contractor will install Demin Water interconnect piping to the Owners' Demin Tank as shown on the Plot Plan. Contractor to furnish and install 126,000 gallons of Demin Water Tanks with redundant forwarding pumps to supply the inlet air fogging system and the turbine water injection system. This will include redundant Demin Water Filters for each Turbine.
- 3.1.7 Liquid Fuel – Contractor will modify the (2) each Gas Turbines to run on liquid fuel complete with all package piping, instrumentation, etc. Contractor will furnish and install redundant liquid fuel forwarding pumps from a new Contractor Furnished 7000 Cu Meter DFO Tank, as shown on the Plot Plan. Furnish and install an 8" line from 7000 Cu Meter Tank to a new 1,000 Cu Meter Day Tank and redundant liquid filters for each gas turbine.
- 3.1.8 Fire Water – contractor will install Fire Water interconnect piping to the Owners' pipeline header system. The Owner will be responsible for coordinating the tie in. The contractor will furnish and install the fire water piping system complete with Monitors and Hydrants for the plant.
- 3.1.9 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.
- 3.1.10 Instrument/Service Air Compressors – Instrument and Service air will be supplied by one (1) instrument air packages designed to provide up to 185 scfm of dry air at 125 psig. The package will include two (2) compressors, filters, accumulator and a dryer designed to produce air at a -40°F dew point. The compressor is equivalent to an Ingersoll-Rand model UP6-50-125 electric reciprocating compressor. (See Vendor Catalog Sheet in Appendix 12)



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- 3.1.11 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 jeeped 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.

All low pressure piping for water service will be fabricated from fiberglass reinforced plastic (FRP) pipe to meet plant corrosion requirements.

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.

- 3.1.12 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 to serve (2) GTGs.
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



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- 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 Building
- 3.2.6 480 Volt Distribution Switchboard – Owner Supplied. This equipment is indoor, metal enclosed, floor mounted cabinets containing distribution breakers.
- 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.



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- 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.



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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 Gas Turbine 7EA High Voltage Equipment

Contractor to install Owner Furnished 13.8 / 230 KV GSU Transformer, 230 KV SF6 Breaker, 230 KV Disconnect, and Dead End Tower, Provide Metering and Protection Relay.

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



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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 and Office Building. The GTGCP is a Woodward Sequencer and Control.

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 Climatized Control and Office 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



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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



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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



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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 Contractor will perform removal as required of any existing buildings, structures, and underground piping systems on the project site.

3.4.2 Site Grading – The Contractor 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 provide storm water drainage for rainwater on 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



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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 from or after finishing concrete.
- Keep formwork wet until stripped.
- Moist curing shall be used for surfaces that will receive a separate finish or coating.



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(4) Testing

Contractor 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.



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3.5 Plant Buildings

A Climatized Control and Office 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.