3.6 DUCT AND SOOT BLOWERS

3.6.1 Duct

The drawing list for the duct is shown in Table 3-11.

Seward Boiler 15 is a balanced draft boiler provided with two F.D. fans, two Ljungstrom air heaters, two twin chamber electrostatic precipitators (ESPs), and two I.D. fans. The two ESPs are joined by twin flue gas ducts that are referred to as A and B duct.

Figure 2-4 presents a plan view of the ESPs and flue gas ducting, with the old duct B replaced by the new duct B, which is used for desulfurization of the flue gas by the CZD system.

Figure 3-4 presents a plan view of the desulfurization duct, which has a 120 foot-long straight run for injection of the atomized lime slurry. This is the duct length necessary for the absorption of SO_2 from flue gas and for drying out the absorption products. The atomizing nozzles are located at the duct inlet. The duct is provided with four sets of thermocouples at four duct cross sections: B, C, D, and E. During normal operations, the B section thermocouples will be used only during testing. A summary of duct dimensions and construction is included in Figure 3-4.

Figure 3-5 illustrates the arrangement of thermocouples at one typical duct cross section. Single thermocouple probes can be inserted along the duct walls either 6 inches or 2 feet away from the duct walls. The near-wall thermocouples will be used only for test purposes.

The flue gas flows and temperatures will be measured at the inlet of the duct in the discharge plenum from the Research-Cottrell (R-C) precipitator, then at the E section of the duct, and also at the outlet from the I.D. fan. SO_2, NO_x, and CO_2 concentrations and gas temperatures will be measured at the discharge plenum from the R-C ESP and at the discharge from the I.D. fan. There will be an opacity meter in the discharge duct from the I.D. fan.

The utility requirements for the duct are limited to lighting and convenience outlets and water for an eye wash and sink.

The duct extension is passive in nature. The only thing to control will be the personnel safety lighting, which will be activated by an ambient light sensor.

There will be nothing to start up on the duct. The only foreseeable upset condition that could occur would be deposits that must be removed. There are three external entrances to the duct, each equipped with platforms and access ladders. Cleaning access is through any or all of the entrances.

3.6.2 Soot Blowers

Ten soot blowers placed in the bottom of B duct will reentrain any particles of ash and/or reacted lime into the gas stream, where they will be carried by the flue gas to the second ESP for removal. Four additional retractable soot blowers at the C cross section will clean the thermocouples on the turning vanes.

The equipment list for the soot blowers is shown in Table 3-12. The drawing list for the soot blowers installation is shown in Table 3-13.

The utility requirements for the soot blowers are:

- Steam (only one unit is activated at a time) – 16 lb/cycle of RB1 through RB10 and 254 lb/cycle for RB11 through RB14
- 480 V, 60 Hz, 3-phase power for rotation and the retraction motors for the retractable soot blowers
- 120 V, 60 Hz, 1-phase for the control circuits

The total combined requirements of the duct and soot blowers are as follows:

- Lighting (120 V) – 20 kW
- 480 V – 300 Wh/cycle
- 120 V – 166 Wh/cycle
- Steam – 1,176 lb/cycle

The soot blower operational control is located in the main control room. The operation of this unit is described in the Copes-Vulcan manual.

The startup of the soot blowers is covered in the Copes-Vulcan manual. Any upset in operation would require changing the injected medium in the duct from lime slurry to water.

Table 3-11
DUCT DRAWING LIST

Dwg. No. SK-	Sheet	Size	Drawing Title
E-408-1002	1 of 1	E	Foundations – Boiler Gas Flow System
E-518-1002	1 of 1	E	Duct Support Steel – Boiler Gas Flow System
E-518-1003	1 of 1	E	Support Steel – Boiler Gas Flow System
E-518-1004	1 of 1	E	Duct Plan Top – Boiler Gas Flow System
E-518-1005	1 of 1	E	Bottom Duct Plan – Boiler Gas Flow System
E-518-1006	1 of 2	E	Duct Elevations – Boiler Gas Flow System
E-518-1006	2 of 2	E	Duct Elevations – Boiler Gas Flow System
E-518-1007	1 of 3	E	Miscellaneous Steel and Platforms – Boiler Gas Flow System
E-518-1007	2 of 3	E	Miscellaneous Steel and Platforms – Boiler Gas Flow System
E-518-1007	3 of 3	E	Miscellaneous Steel and Platforms – Boiler Gas Flow System
E-518-1008	1 of 1	E	General Notes
E-110040-01	Spec.	A	CZD Duct Modification to Boiler Flue Gas Duct

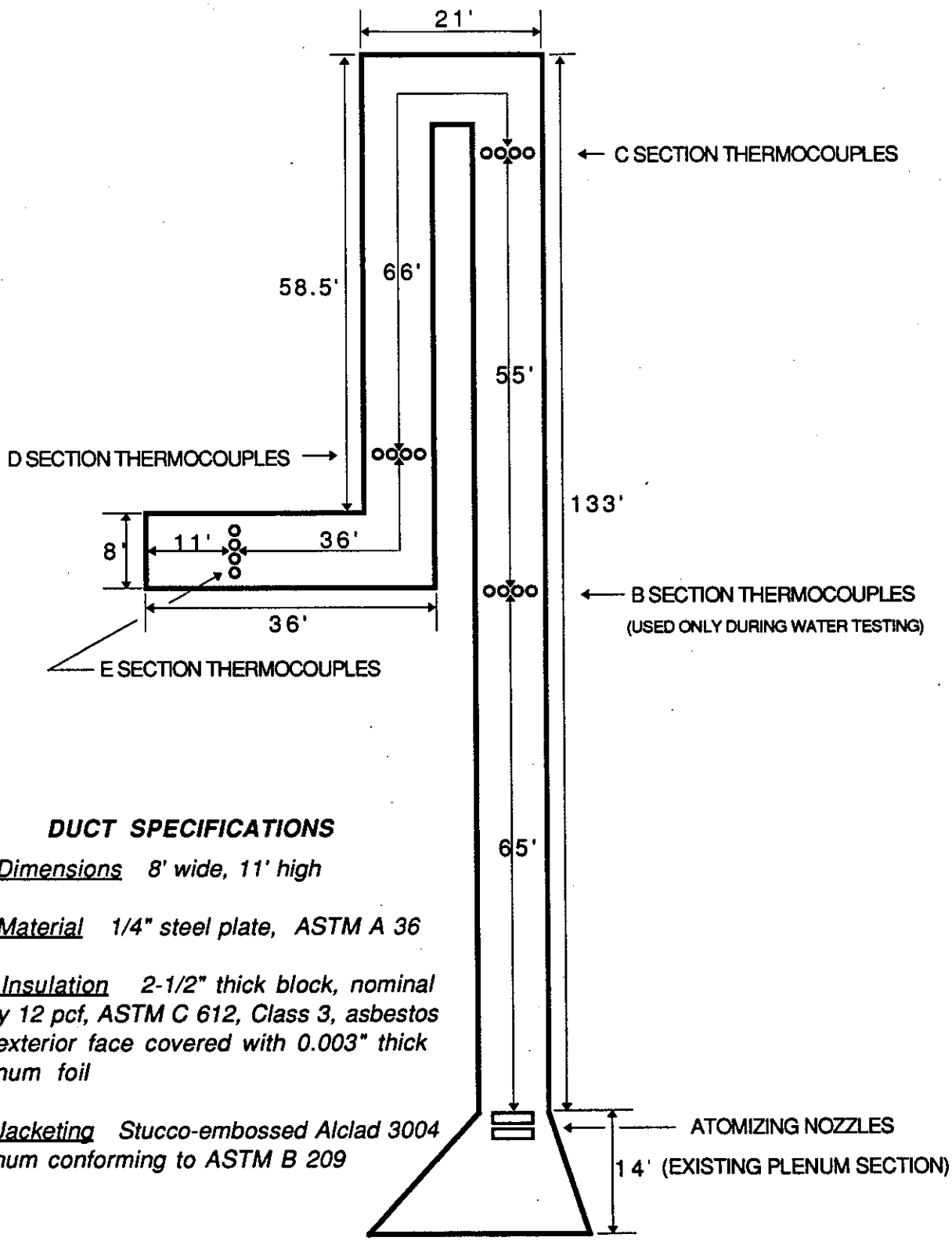
Table 3-12
SOOT BLOWER EQUIPMENT LIST

Equipment Number	Description	Purchase Order 21178-
RB1 – RB-10	Copes-Vulcan Model DS-E rotary soot blower	M002
RB-11 – RB-14	Copes-Vulcan Model T-20E retractable soot blower	M002
TDV	Copes-Vulcan 1 in. Class 600 lb thermal drain valve Dwg. E-191501	M-002
CV	Copes-Vulcan 2 in. Class 300 lb mainstream valve CV-600-2A	M-002
Isolation valve	2 in., 600 lb, 1,000°F steam valve	M-002
C-20	Copes-Vulcan controller panel – Type A	M-002

Table 3-13
SOOT BLOWER DRAWING LIST

Dwg. No.	Size	Drawing Title
D-335408	E	Copes-Vulcan Soot Blower Arrangement
D-335409	D	Copes-Vulcan D5-E Rotary Views
D-339791	D	Copes-Vulcan T-20EV Retractable Views
D-339792	D	Copes-Vulcan T-20EV Sleeve Views
D-333726	D	Copes-Vulcan Schematic Wiring Diagram
D-333725	D	Copes-Vulcan External Wiring Diagram-Panel
C-339803	C	Copes-Vulcan Starter Cabinet Assembly
B-297035	B	Copes-Vulcan Physical Wiring Diagram Rotary
C-339805	C	Copes-Vulcan Physical Wiring Diagram T-20E
A-335436	A	Copes-Vulcan Steam Consumption Data

Figure 3-4
PLAN VIEW OF DUCT WITH THERMOCOUPLE LOCATIONS



DUCT SPECIFICATIONS

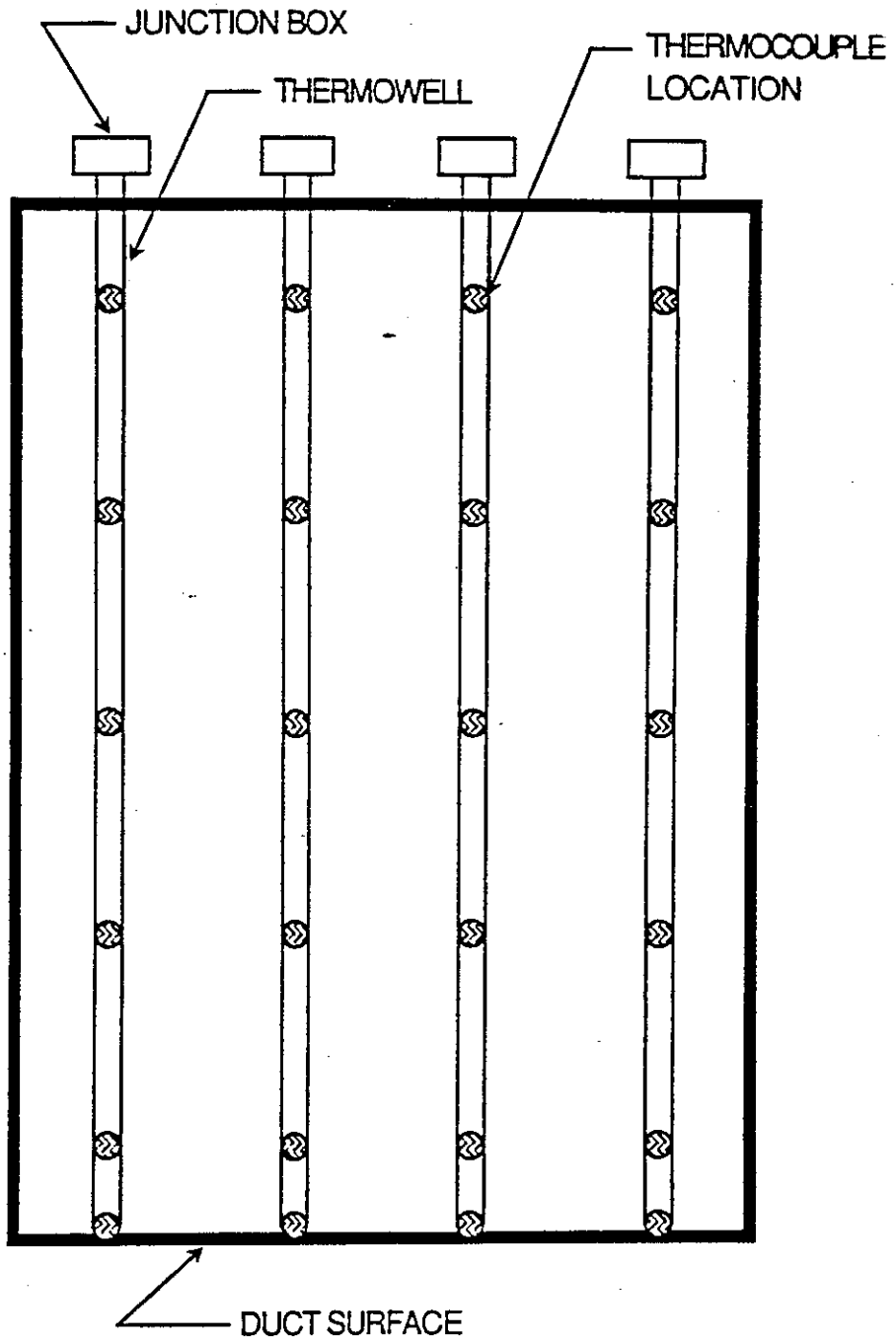
Duct Dimensions *8' wide, 11' high*

Duct Material *1/4" steel plate, ASTM A 36*

Duct Insulation *2-1/2" thick block, nominal density 12 pcf, ASTM C 612, Class 3, asbestos free, exterior face covered with 0.003" thick aluminum foil*

Duct Jacketing *Stucco-embossed Alclad 3004 aluminum conforming to ASTM B 209*

Figure 3-5
TYPICAL THERMOCOUPLE SECTION (6 THERMOCOUPLES PER THERMOWELL = 24 PER SECTION)



3.7 WINTERIZATION

The purpose of winterization of the CZD-FGD system is to allow the system to operate through winter extremes in temperature and other climatic variations associated with winter. The winterization enclosures were tailored to meet the needs of the equipment.

3.7.1 Environmental Enclosures

The environmental enclosures were fabricated from bolted and welded framework covered with 0.040-inch-thick, textured, corrugated aluminum siding. The siding is lined with foil-faced rigid fiberglass insulation that has been mechanically fastened to the interior surface. All seams are taped with matching foil-faced tape.

The interior environment of the enclosures will be heated by the natural convection heat from the duct, which will be adequate down to 25°F. Electric spot heaters will provide a minimum temperature of 40°F with the outside air at -25°F when the boiler is not in operation. The interior is lighted for inspection of equipment and observation of instruments.

During the summer, the exterior observation doors may be left open to moderate the interior temperature.

The configuration of the weather enclosure located at the top of the duct is shown in Figure 2-20.

3.7.2 Heat-Tracing and Insulation of the Interconnecting Piping

The interconnecting piping between the lime slurry preparation area and the lime slurry feed area is heat-traced and insulated to Penelec's standard.

The heat-tracing tape has a capacity of 6 W/ft and will be self-limiting. It is fastened to the pipe at intervals and connected to a separate power circuit through a thermostat to limit operation to appropriate temperatures. Each thermostat is equipped with an indicator light to allow the roving operator to ascertain that the circuit is activated when needed.

Insulation was applied over the heat-tracing tape and skinned after installation. The insulation type is preformed rigid fiberglass.

Jacket sheathing is 0.040-inch-thick textured aluminum sheathing.

The piping between the lime slurry feed area and the lime slurry injection area was treated in the same way as the piping between the lime slurry preparation area and the lime slurry feed area.

3.8 INSTRUMENTATION AND CONTROL (I&C) SYSTEM

3.8.1 Overview

Instrumentation and control (I&C) is broken down according to the plant locations at which CZD equipment and systems are found. These six operational areas/systems are:

- Atomizing air compression system
- Lime slurry preparation system
- Lime slurry feed system
- Lime injection system
- Duct flue gas monitoring and controls
- Control room

Startup, operation, and monitoring of the equipment and systems within these areas will be through a combination of actions performed locally or in the control room (remote operation). In general, all pump, mixers, and the initial startup of systems must occur locally. In this way, the operator can visually verify the condition of the equipment in the area and determine whether it is safe to put the equipment or system into operation. Once a system or equipment is in operation, monitoring the condition of equipment and the changing of system setpoints can occur remotely, at the control room, or locally through panel mounted switches and controllers.

The ready/standby system is also part of the CZD I&C and operates through the Bailey distributed control system (DCS) from the control room. The ready/standby switch provides the operator with the means to control whether or not lime slurry is injected into the duct, without unnecessarily upsetting CZD controls, and safeguards the operation of the Buell ESP. Low atomizing air pressure interlock logic is also provided.

Remote monitoring and control of the CZD process from the control room is carried out from the existing combustion control management control system (MCS) and supplemented by the process control view (PCV) station. Supplemental plant and process operating information is available from Leeds & Northrup (L&N) recorders located in the ESP control room and in the duct B weather enclosure.

3.8.2 System Description

The general types of equipment that will constitute the CZD architecture are as follows:

- Primary sensing elements that sense equipment and process stream parameters
- Field transmitters, with enclosures to suit the process area environment, which receive the signal from a primary sensing element and convert it to a 4-20 mA current loop or other industry standard output

- Final control elements that provide actuation or throttling capability, some of which are of an electropneumatic type and utilize an instrument air supply
- Instrument signal wiring or fiber optic cables, which are routed between the field transmitters, controllers, local indicators, and the DCS enclosures located at three locations in the plant and back to the control elements
- A DCS, based upon a Bailey Controls architecture, which includes electronic processors and other devices to monitor and control the CZD process
- Chart recorders which provide additional display, trending, and data logging capabilities to the system

3.8.3 Distributed Control System

A review of the CZD I&C begins with the DCS, which will enable the operators to operate and observe the CZD equipment and systems either locally or from the control room. The DCS, therefore, makes the best use of the benefits of observing, firsthand, the proper operation of CZD operations backed by observing all CZD operations to gain an overview understanding of the CZD systems.

A simplified block diagram of the proposed DCS is presented as Figure 3-6. The drawing shows the various elements of DCS components and their location throughout the plant.

3.8.3.1 Lime Preparation DCS Enclosure

In the lime preparation building, the DCS consists of the modules located in the remote input/output (RIO) No. 2 enclosure. This enclosure is a Bailey Controls Mini-90. All system instrumentation to the DCS for the lime slurry preparation system is wired to this enclosure and transmitted to the processor in the control room over a fiber optic link. This enclosure accepts digital and analog signals. This enclosure is sized for additional input/output (I/O) and loop controllers for future expansion of the DCS in this area, if desired.

The two loop controllers are located in this enclosure ~~is~~ Bailey Controls model DCS. These controllers are identical to those presently in use for Seward's combustion control system.

3.8.3.2 Lime Slurry Feed/Duct B Area

The DCS components for this area are located in two cabinets. The first cabinet is labeled "RIO No. 1" and contains all of the I/O modules for interfacing to field transmitter, thermocouples, and switches. The second enclosure contains the two loop controllers and two Leeds & Northrup (L&N) chart recorders. The L&N chart recorders are described in greater detail later in this section.

The loop controllers in this area are of a stand-alone type, Bailey's CLC03, which allows them to continue controlling the flow of lime slurry and water into the duct even if the rest of the DCS fails. This enables operators to shift to local-only control of lime or water injection into the duct.

It is highly recommended that the DCS and other instrumentation in this area receive their 120 Vac power through an uninterruptible power supply (UPS), thereby allowing full control capability of lime injection into the duct during a loss of control power. This would also enable the ready/standby valve to operate.

3.8.3.3 CZD Multifunction Processors

The CZD DCS uses three of Bailey Control's multifunction processors (MFPs). Two are of the MFP-01 type with the third a MFP-02.

The two MFP-01s are central to the operation of the CZD process. All CZD I/O wired to the various modules in the lime preparation building and the duct B weather enclosure will converge as data into these modules. The modules are programmed or configured with all interlock, analog, and digital controls, and calculations for CZD.

The two MFP-01s are also configured to be fully redundant. This means that both MFPs are programmed with the identical program at all times and that each will receive the same data from the I/O modules at the same time. During operation, only one MFP-01 will actually execute the configuration. The second MFP will act as a hot standby by monitoring the status of the first and will take over complete control of configuration execution in the event that the first MFP fails or is taken off line by the DCS technician. This hot standby capability permits modifications to the configuration to be made without shutting down any part of the CZD system. In addition, if changes are made to the configuration or to one module when that module is placed back in service, the change can be validated, after which the other module will be updated with the new configuration.

The MFP-01s accept and send out information through the various slave modules. One slave module, located in the plant control room, accepts the data and log inputs provided by Penelec's environmental group for the monitoring of stack and duct opacity, SO_2 concentration, etc. This slave module is interfaced directly to the MFP-01s through the slave bus. The slave buses for RIOs No. 1 and 2 are routed over a single pair of fiber optic cables to each remote enclosure. RIO modules will allow data to be transferred to and from the two remote enclosures to be multiplexed over the fiber optic link. The fiber optic link allows data to be transferred at such high speeds that the remote I/O slaves are treated the same as the one in the control room by the MFP-01s.

The fiber optic link will also be impervious to electrical noise of any type. This includes the highly noisy environment found in power plants.

The two MFP-01s also export and import data over the plant loop network. Network access allows data concerning the operating state of Boiler 15 to be incorporated into calculations or displays. Network access also permits all of the CZD operating data to be transmitted to and from operator display stations (or even other controllers).

3.8.3.4 L&N Chart Recorders

The L&N chart recorders will be used by engineers and operators to view, data-log, and/or trend CZD and boiler data right at the duct or ESP control room. The flexibility in viewing much of the plant operating data at these locations will be an important asset in the setup and tuning of the CZD system. Originally configured to handle all of CZD's processing requirements, the MFP-02 module is now dedicated to data switching with the L&N chart recorders. Because the module is connected to the MFP-02 over the RS-485 network, the chart recorders can receive all of their I/O over this data link.

The chart recorder in the ESP control room (AR-01) is dedicated to monitoring the performance of the Buell ESP.

3.8.3.5 Operator Interface Units

Operator interface units (OIUs) enable the control room operators to:

- View the overall operation of CZD
- Perform trending of CZD performance
- Make changes to flow and/or density setpoints to adjust CZD operation in response to boiler load changes
- Alert the operator as to alarm conditions
- Allow viewing of duct temperature profiles and skin temperatures

At the time of this writing, the specific operating screens for the OIU are being developed.

3.8.4 CZD Instrumentation

3.8.4.1 Lime Preparation Instrumentation

The I&C shown on CZD P&IDs for this area reflect just what is necessary for continuous lime mixing control.

- Star valve motor and variable-speed drive
- Nuclear-type density gauge and transmitter
- Capacitance-type RF level element and transmitter
- Recirculation loop pressure controller and valve

3.8.4.2 Lime Feed Instrumentation

The instrumentation in this area includes:

- Capacitance-type RF-level element and transmitter
- Recirculation loop pressure controller and valve

No instrumentation is furnished for the grits tank. The roving operator must periodically check these tanks and take the appropriate actions to empty them when necessary.

Switching of the lime slurry feed tanks (described earlier in this manual) also requires switching Controller LC-25. A switch is provided to change the process variable (PV) input to the controller to allow LC-25 to be used for either lime slurry feed tank.

3.8.4.3 Environmental Monitoring System (EMS)

Duct instrumentation for environmental monitoring CZD operation measures:

- Duct and stack opacity
- SO_2 in and out
- NO_x in and out
- CO_2 in and out

The responsibility for the maintenance of these instruments rests with Penelec's environmental group. This group is responsible for providing 4-20 mA signal outputs for each measurement to a terminal block next to the L&N recorder in the ESP control room. From this terminal block, the current loops are extended into the control room into the analog slave module.

3.8.4.4 Temperature Monitoring

The duct has many ports for insertion of probes that will be used for the testing of CZD. There will be three types of temperature measurement:

- Duct skin monitoring
- Duct profile monitoring (B through D sections)
- Duct wall measurement

The first two types of temperature measurements are brought into the DCS for display and data logging. They can be observed on the PCV station in the control room or on the chart recorders in the CZD shack. The loop diagrams for these units indicate that the thermocouple extension wire go into RIO No. 2 and are connected to isolating-type temperature transmitters. The transmitters convert the signals to 4-20 mA current loops, which go directly to the Bailey analog slave modules. The transmitters protect the DCS components by affording 1,000 V of isolation from the duct. The transmitters selected for CZD come with a programmer that enables the instrument technician to view the mV signal from the thermocouples and the output to the controllers without disconnecting any wiring. The programmer also acts to remove high-voltage charges that periodically build up on the individual thermocouples and extension wire.

Duct wall temperature measurements are made using the local panels provided.

3.8.4.5 Flue Gas Flow Monitoring

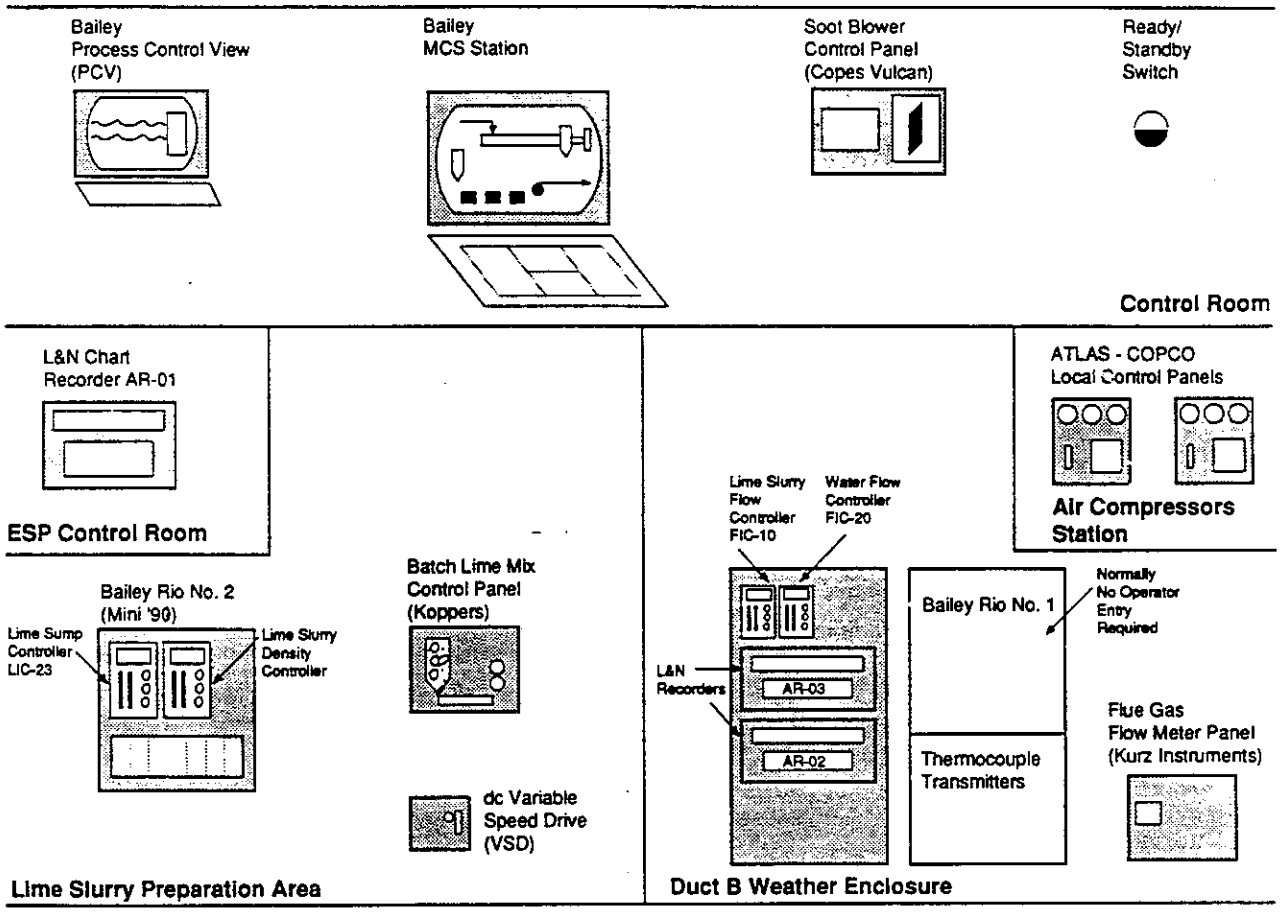
The flow of flue gas in the duct will be monitored at three locations using differential-temperature-type devices manufactured by Kurz Instruments: FT-11A, FT-11B, FIT-12, and FIT-19.

FT-11A and FT-11B are multipoint probes, and their inputs are brought into a dedicated panel (ADAM) in the duct B weather enclosure. In the ADAM panel, the flow measurements are digitally filtered and averaged to obtain their respective flow rates. The temperature at these locations is also monitored by the Kurz system. These flow measurements, combined with the environmental measurements, form the basis for determining the percent SO_2 reduction by CZD.

Flue gas flow monitor FIT-12 provides a single point measurement at the E Section of the duct.

Airflow monitor FIT-19 measures the flow of atomizing air to the compressed air header, which supplies the lances.

Figure 3-6
CZD DCS ELEMENTS



4.0

Startup Procedure, Startup Schedule, and Operational Testing

4.0 STARTUP PROCEDURE, STARTUP SCHEDULE, AND OPERATIONAL TESTING

4.1 STARTUP PROCEDURE

4.1.1 Lime Slurry Preparation System

Production of lime slurry will begin with the movement of dry lime from the lime delivery trailer to the 50-ton lime silo. Automatic operation of the baghouse will start when the fill pipe guard is lowered. The Koppers panel will include controls for automatic operation of the lime silo blower and the air sparging air compressor(s). The operator should be familiar with the operation of this panel before attempting to fill the lime silo with lime. Startup of the system assumes that the supply of lime in the lime silo is adequate, that the lime slurry sump is empty, and that the control room has set the CZD system to the standby condition.

The sequence of operation will be as follows (see CZD P&ID 21178-M-01):

1. ***Perform an initial checkout*** to ensure that the air supply to PIC-20 and LY-23 is adequate and that the process water supply block valve to LCV-23 is opened. Next, establish an initial low setpoint for PIC 20 and the block valves to allow flow from one of the two lime slurry sump pumps through PIC-20. Finally, check HCV-10A to ensure that the ready/standby system has set the flow of lime slurry to recirculate back to the lime slurry sump and that the piping to the lime slurry feed tank has been flushed with water. Set DIC-01 and LIC-23 to local control and zero their setpoints.
2. ***Start the water level control*** using Controller LIC-23 located in Enclosure RIO 2 (see Figure 3-6) by first setting it for local control and then advancing the sump level setpoint from zero to the sump's normal low level (NLL). During the time the lime slurry sump is filling with water, check LIC-23 to verify that it is indicating the proper sump level.
3. ***Start the lime slurry mixer and sump pump*** once you have visually verified that sufficient water has accumulated in the lime slurry sump (a point 3 feet from the sump cover). After the one lime slurry sump pump has been started, verify the flow of water through both PIC-20 and the standby recirculation loop. Next, verify the operation of the density indicating transmitter, DIT-01, and, if necessary, recalibrate it using the manufacturer's recommended procedures.*
4. ***Start the density control*** once the steps described in steps 1 through 3 have been completed (although it is not required that the lime slurry sump reach its setpoint level). Start the lime screw conveyor; then start the lime silo star valve variable-speed drive (VSD) through the Koppers batch control panel. Put the density controller, DIC-01, in manual control and set it so that lime is fed into the lime slurry sump. The lime feed rate may be increased using Controller DIC-01 to reduce the time the system takes to reach the desired slurry density. Never add more lime than can be

* A recalibration of the density transmitter may require providing a means to flush the line with clean process water.

easily handled by the mixer. Once the slurry has reached approximately 50 percent of the desired density, set DIC-01 to automatic control and adjust the setpoint.

5. ***Shift control to the control room (remote control)*** once the lime slurry density has been set and the flow of lime judged to be adequate. At this point, level and density setpoints are controlled from the control room. Once the lime slurry density has reached its setpoint, raise the lime sump level setpoint to its normal operating level; the system is now ready to supply lime slurry to the lime slurry feed tanks.

Remote monitoring and control from the control room of equipment in the lime preparation area will include:

- Lime silo high- or low-level alarm
- Screw conveyor (ON or OFF)
- Lime silo star valve VSD current draw
- Lime slurry sump level and level setpoint
- Lime slurry density and density setpoint

4.1.2 Lime Injection System

4.1.2.1 Pre-Startup Checkout of the CZD System

Before any portion of the CZD system is started up, the following procedure must be followed:

- Check with the shift supervisor that the boiler is ready for operation of the CZD system
- Verify with the plant maintenance supervisor that all maintenance work on the CZD system (if any has been carried out) has been completed and the equipment is ready for operation
- Verify the status of all CZD system equipment by plant inspection and see to it that:
  - All pumps and pipes are filled with water
  - All drains and vents are closed
  - All flushing and draining hoses are disconnected
  - All utilities (power, process water, cooling water, steam, and instrument air) are available
  - Check the sump and tanks status
- Notify the control room operator that you are going to start up the CZD system

4.1.2.2 Startup of the Atomizing Air System

Start up the atomizing air compressor and check that the cooling water is flowing to the air inter-coolers and after-coolers. Check the compressed air temperature and discharge pressure.

There are two atomizing air compressors, one working and one spare. They are arranged for automatic startup of the spare unit. After checking the operation of the running compressor, trip it and check the operation of the second compressor.

Check the air receiver for the presence of water, and drain if necessary.

Open the drain valves in the atomizing air distribution header, and blow them for few minutes until the discharge is clean (invisible).

Start up the flow of atomizing air to all atomizers and check their flow status. All atomizing air feed valves must be wide open. All pressure gauges on individual atomizer air feeders should indicate the same pressure. All atomizing air rotameters should indicate the same flow.

A low air atomizing air pressure can indicate a broken atomizer ceramic tip; a low flow can indicate plugging of the nozzle or air feeder. If either of these problems occurs, bring the matter to the attention of the plant maintenance supervisor. Any such problem must be corrected before continuing startup.

4.1.2.3 Startup of the Lime Slurry Injection System

To start up the lime slurry injection systems, use the following procedures:

- Check that the injection system valves are set up for injecting water into the flue gas stream
- Start up the water booster pump
- Check the water pressure in the injection header
- Check the operation of the water booster pump
- Start up water injection into the duct at 20 gpm and then increase it slowly until the temperature setpoint is reached. When injecting water, check the water pressure and the flow of water at the atomizer feeders. Flow obstructions can be checked by shutting off the water flow to individual atomizers and checking the water pressure. A rapid drop of water pressure when the feeder block valve is closed indicates the nozzle is not blocked. When the feeder pressure does not drop or drops slowly, it could indicate that either the nozzle or the pressure gauge is plugged. Correct the problem before proceeding further with the startup operation.
- Transfer the control to automatic

4.1.2.4 Startup of the Lime Slurry Feed System

If the lime feed tank is full, lime injection can be started after successful water injection. If the lime feed tank is empty, then it has to be first filled with lime slurry. It is assumed that the lime feed tank is full of lime slurry, the lime feed pump and piping are filled with water, and all drains and vents are closed.

Check that the seal water supply is available and set all the pump suction and discharge valves for recirculation of the lime slurry through the feed and return header. Check that the seal water is flowing into the pump at 0.2-0.4 gpm; then start the feed pump. Check to see that lime is circulating properly; then notify the control room so that they may switch from the standby mode to the ready (run) mode.

When the lime slurry feed tank is full, the valve that feeds the vibrating screen closes, preventing overfilling. If there is a failure in the agitator of tank A, the filling is transferred from the vibrating screen to tank B. If there is a failure in one of the lime slurry transfer pumps, the end of the line feeding the failed pump must be disconnected, moved to the backup pump, and be reconnected.

4.1.2.5 Ready/Standby Operation

The CZD system will be started up on water, checked for flue gas minimum temperatures at the C section, and then switched over to the lime injection. The switchover will be done from the control room.

When lime injection is first started, the injection rate should be set at about 35-40 gpm and increased slowly until the minimum C section temperature of 170°F is reached. Next, the concentration of the injected lime slurry should be adjusted until maximum SO_2 removal is achieved. It may be necessary to operate at a slightly lower temperature, but in no case should the C section temperature be allowed to drop below 150°F.

The CZD system is designed to inject either atomized lime slurry or atomized water into the flue gas. Operation using water alone will be the standby mode to which the operator can revert whenever he encounters problems with lime injection.

The switchover from normal (ready) to standby operation will be done by turning a hand switch in the control room. When actuated, this hand switch will (1) stop the injection of lime by diverting the flow of lime back to the feed tank and (2) start the flow of process water to the atomizing nozzles to flush them and to continue to cool and humidify the flue gas to prevent opacity excursions. During standby operation, the lime feed pump will continue to operate, recycling all its flow to the feed tank. The sump pump will also continue to operate, but there will be no transfer of lime from the sump to the feed tank. The lime slurry flow will be diverted back to the sump, and the transfer line will be automatically flushed with water and left full of water. The feed of lime and water to the lime sump will cease automatically on a signal from the sump density and level controllers.

When all problems encountered during lime injection have been resolved, normal plant operation can be resumed by returning the same hand switch in the control room to the ready position.

The reasons for switching from lime to water injection include:

- High stack opacity
- Low C section temperature
- Lime feed pump failure

- Lime transfer pump failure
- Lime slurry preparation problems
- Instrument control failures
- Shortage of lime
- Vibrating screen failure

Most of the above will require equipment inspection and possibly some maintenance work before resuming normal plant operation.

4.1.2.6 System Shutdown

The CZD system operates on Boiler No. 15 flue gas. Hence, whenever the boiler is down, the CZD system must also be shut down.

System shutdown involves stopping the lime slurry feed pump, stopping the flow of lime slurry from the sump to the feed tank, and flushing all idle lime slurry lines with water and leaving them full of water.

All agitators and one of the lime slurry sump pumps must be left working. The operation of the sump pump is necessary to provide lime for water treatment.

If it is not disconnected from the feed tank and feed header, the idled lime feed pump should be left pressurized with seal water and the discharge valve should be closed.

During winter operation, care should be taken not to turn off the heat tracing of lines, feed pumps, and other equipment subject to freezing.

4.2 STARTUP SCHEDULE

The project schedule, shown in Figure 4-1, indicates the periods for design, construction, and operation, as well as baseline testing and operational testing. Periods for equipment performance testing are also shown.

Construction and installation activities at the Seward Station will be performed in two phases. The first phase started in March 1991 and took about 4 months. The second phase will run from December 1991 to May 1992.

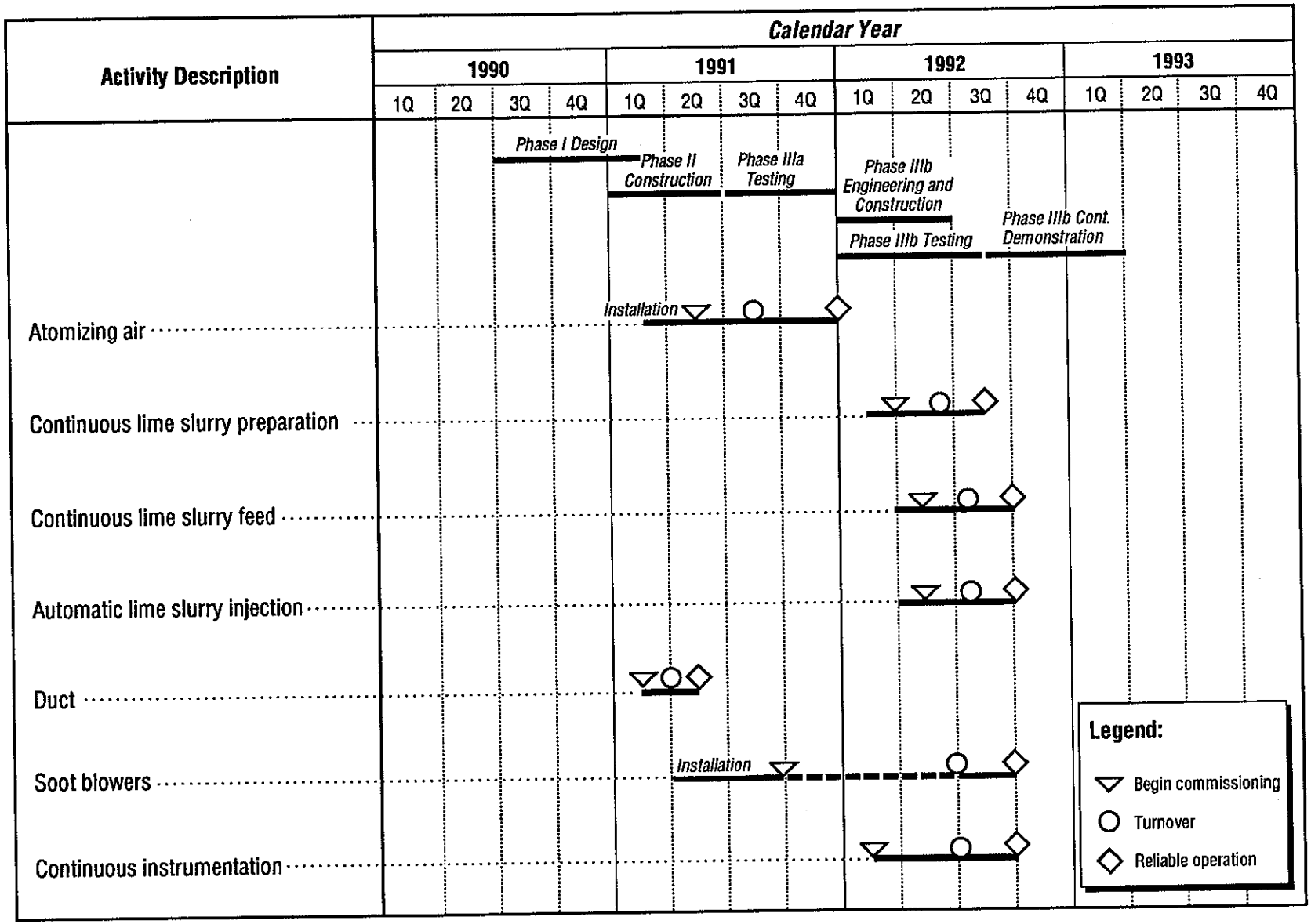


Figure 4-1 Startup Schedule

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CZD testing will be conducted in two phases. The first phase will last 6 months and include daily factorial runs to test different atomizers, limes, and slurry concentrations. Baseline and operational testing will be performed concurrently. Flue gas from locations upstream of the CZD slurry atomizers will be tested to determine conditions without the CZD Project (baseline testing), and flue gas downstream of the slurry atomizers will be tested to determine conditions with the CZD Project (operational testing). The first project phase will begin in July 1991, after the first phase of construction, and will be completed by December 1991.

The second phase, 12 months in length, will demonstrate the continuous performance of the CZD process under actual power station operating conditions. The atomizers, lime, and slurry concentration that prove to be the most effective during the 6-month test period will be used during the 12-month demonstration phase. The second project phase will begin in August 1992, after the second phase of construction, and continue through July 1993.

4.3 OPERATIONAL TESTING

4.3.1 Testing Overview

Bechtel and Penelec will jointly demonstrate Bechtel's CZD process for removing sulfur pollutants from the flue gases leaving a coal-fired boiler. Bechtel's overall approach is described below. Included is a discussion of the testing and demonstration program, methods of testing and evaluation, and demonstration test reports.

4.3.1.1 Overall Test Program

Bechtel will conduct a demonstration testing of the CZD process on Penelec's 147 MWe coal-fired generating Seward Station, Unit 15. The test is designed to demonstrate the viability of the process and its operability at a total cost of less than $300/ton of SO_2 removed. Of the two outlet flue gas ducts, only one – representing half of the flue gas produced by the boiler – will be used to demonstrate the CZD process.

Penelec will provide the site and site support for the test and will also be the subcontractor for the operation and maintenance as well as the construction and installation required for this demonstration. Bechtel will furnish the necessary management, supervision, engineering, procurement, and technical personnel required for the design and execution of the test program, and will evaluate and document the results of the test program.

4.3.1.2 CZD Process Description

CZD is a method for removing SO_2 from flue gases. It is covered by U.S. Patent No. 4,623,523 dated November 18, 1986. The main operating principles of the CZD system are as follows:

- Small particles of an aqueous dispersion of pressure-hydrated calcitic lime or pressure-hydrated dolomitic lime are injected into a confined zone within a flue gas stream flowing in a duct. The confined zone is defined by a surrounding slip zone of flue gas in the duct.

- The amount of the aqueous lime dispersion is large enough to reduce the SO_2 in the flue gas, but small enough so that the aqueous dispersion is dried within the confined zone.
- The confined zone is contained within the inside walls of the duct and is spaced apart from the walls so that the walls remain dry.

In the application of CZD technology to the removal of SO_2 from boiler flue gases, the CZD system may be installed in the boiler outlet ducting or in the inlet ducting of an ESP.

In the CZD system, proper atomization of the aqueous dispersion is extremely important. This atomization must be matched to the application. It may be accomplished by rotary atomizers, piezoelectric-driven nozzles, nozzles driven by a pressurized gas such as compressed air, or other specialized atomizers.

To maintain the efficacy and operability of the CZD system, proper preparation of the aqueous dispersion is important. The weight percent solids in the lime slurry, as well as the stoichiometric ratio of scavenger to SO_2, must be determined. To maintain high operating availability of the CZD system, proper handling, transfer, and distribution of the lime slurry are all important.

In summary, the CZD process comprises preparation of the aqueous dispersion of pressure-hydrated lime or pressure-hydrated dolomitic lime, transfer of the aqueous dispersion to and from the nozzles, injection of the aqueous dispersion into the ducting, design of the spray pattern, and control of the system operating variables, including temperature, pressure, and flow rates.

4.3.1.3 Summary of Activities

The work in this demonstration test program will be in three phases, as summarized below.

4.3.1.3.1 Phase 1

Bechtel developed a process design and P&IDs, and performed detailed engineering for a new extended duct to be used in the CZD demonstration in Unit 15 at Penelec's Seward Station. Bechtel prepared all the specifications for equipment and instruments and procured the materials. Interface with the appropriate environmental agencies was accomplished through Penelec, with Bechtel's assistance, as needed.

4.3.1.3.2 Phase 2

Bechtel will complete procurement of the equipment, instruments, materials, and fabrication of the new long duct. Penelec will construct and install these items in accordance with the specifications. Using Penelec operating and maintenance personnel, Bechtel will train the operators, start up (shake down) the CZD system, and verify that the installation and control system are functioning according to requirements. During this phase, the installation of equipment and instrumentation will be limited to that necessary for the parametric testing to be done in Phase 3.

4.3.1.3.3 Phase 3

Bechtel will plan and execute a parametric test program to optimize the performance of the CZD process. The test program will be designed to develop operating conditions that achieve high reliability and low-cost operation. Based on these results, Bechtel will complete additional design, procurement, installation, and facility construction, as necessary, to permit a 12-month continuous demonstration. The CZD system will be fully instrumented and integrated with the operation of Penelec's Unit 15. The goal will be to demonstrate the performance of the CZD process for SO_2 removal without affecting either boiler operation or particulate emissions. Using Penelec operating and maintenance personnel, Bechtel will train the operators, start up the CZD system, and operate the system. Bechtel will supervise the continuous demonstration and carry out various performance tests, data acquisition, and chemical analyses.

4.3.1.4 Test Program Goals

The goals of the testing and demonstration program will be to:

- Remove up to 50 percent of the SO_2 with up to 50 percent alkali utilization
- Show that there is no detrimental effect on normal boiler operation and no increase in particulate emissions and percent opacity
- Demonstrate the capability of operating with high- and low-sulfur coal
- Confirm reliable operation of the CZD process when integrated with the power station
- Achieve low capital and operating costs per ton of SO_2 removal (less than $300/ton)
- Carry out a program of tests that to provide the necessary experience and database for the detailed design, operation, control, and maintenance of large-scale commercial plants

4.3.1.5 Strategies for Achieving Test Program Goals

The CZD demonstration will be divided into two distinct periods: a testing period and a demonstration period.

In the testing period, different atomizers, degrees of atomization, reagents, percent sulfur in the coal, and changes in operating conditions will be tested to determine the optimum conditions for the highest SO_2 removal with maximum utilization of the reagents.

In the demonstration period, the CZD installation will be automated to operate continuously and be fully integrated with the power plant. All the optimum parameters developed during the testing period will be used as the basis for the continuous demonstration. The only exception will be testing of higher sulfur coal for a duration of 2 to 3 weeks during the demonstration period.

The test program will include the following investigations:

- The effect of injecting atomized lime slurry in a 120-foot-long straight duct, with a large number of atomizers, good gas/spray dispersion, and a closer approach to saturation temperature
- Degree of atomization (slurry/compressed air ratio) versus length of duct required for evaporation of atomized slurry
- Maximum volume of slurry that can be injected per square foot of duct section
- Relationship of the duct cross section and the confined zone dimensions to avoid deposits on duct surfaces
- Effect of flue gas inlet temperature on the evaporation characteristics, SO_2 removal, and alkali utilization
- Factorial injection tests with hydrated calcitic lime and freshly slaked calcitic lime slurry using the selected atomizing nozzles; conducting the same tests with dolomitic lime for comparison
- The effect of lime slurry concentration on:
  - FGD
  - Lime utilization
  - Maximum lime injection rate
  - Percent opacity
- Burning high- and low-sulfur coal, to determine:
  - The effects of lime injection on ESP performance, atomizer performance, and lime utilization
  - The effects of additives on percent SO_2 removal, lime utilization, and percent opacity
- Selection of different additives for improving lime utilization for the same percent SO_2 removal
- Optimum parameters for the lowest cost per ton of SO_2 removal
- If necessary, testing different methods for improving the ESP's performance (additives, improving rapping, improving automatic voltage control, etc.)

4.3.1.6 Test Sequence

The testing plan will include the following sequential activities:

- Calibration of atomizing nozzles
- Factorial water tests in flue gas duct
- Factorial dolomitic lime injection tests

- Factorial calcitic lime injection tests
- Continuous lime slurry injection tests

Different kinds of atomizing nozzles outside the duct will be calibrated in order to determine:

- Pressure and flow characteristics
- Minimum compressed air requirements
- Constraints concerning use of multiple atomizers with multiple tips

Factorial water tests of different kinds of atomizing nozzles in the flue gas duct will be made to determine:

- The best orientation of atomizers for maximum water rate
- The atomizing air/water ratio for fine atomization and complete evaporation
- The confined zone dimensions, for each case, with analysis of the temperature isotherms

4.3.2 Methods of Testing and Evaluation

4.3.2.1 Testing Matrices

After calibration of atomizing nozzles and factorial water tests in the flue gas duct, the factorial dolomitic lime injection test will be conducted to determine the optimum parameters for SO_2 removal, lime utilization, and low percent opacity. In general, an increase in the lime slurry concentration will increase the percent SO_2 removal, but will reduce the percent lime utilization and increase opacity. Therefore, selection of the optimum parameters will include not only the parameters for maximum SO_2 removal, but also those that ensure an economical solution and a permissible percent opacity. Test matrices will include:

- Testing with lime slurry injection rates from 30 to 55 gpm
- Testing with lime slurry concentrations from 4 to 15 percent
- Testing without additives and with various concentrations of different additives
- Testing with dolomitic and calcitic lime slurries
- Testing at low and high boiler loads
- Testing at low and high approach to saturation

By varying the operating parameters, we can determine the optimum concentrations of lime slurry needed to meet our goals. During the testing period, a computer program will be used to do the calculations for SO_2 removal and lime utilization for the different variables. Collection of this technical and environmental data will enable us to prepare detailed computerized analyses and monthly reports and to issue the final report.

Previous CZD testing results from the pilot unit and the proof of concept in a commercial unit should prove very useful in designing, planning, scheduling and programming the CZD demonstration.

4.3.2.2 Procedures for Measuring, Sampling, Testing, and Analysis

The procedures to be used are outlined below.

4.3.2.2.1 Measuring Flue Gas Flows

Flue gas flows will be measured daily for 5 consecutive days to determine the amount of gas flowing through the test duct. These measurements will be verified by comparing them with:

- Flue gas flow measurements by Kurz flow monitors mounted inside the duct upstream of the Buell ESP. (The flue gas velocity will be measured at three different levels in the duct, and the average flue gas velocity will be indicated and recorded.)
- Flue gas flows estimated from coal and flue gas analyses
- I.D. fan characteristics

Figure 4-2 shows a traverse point arrangement in the duct for velocity measurement.

Flue Gas Flow Measurements. The purpose of these measurements is to verify the actual gas flows and velocities prior to spraying the water into the flue gas stream.

Measuring Equipment Requirements. The required equipment will include:

- One 15'-0"-long S-type pitot tube with thermocouple
- One inclined tube manometer
- One bottle of red manometer oil
- An S-type pitot tube user's manual
- One temperature indicator
- One barometer
- One U manometer for measuring flue gas pressure

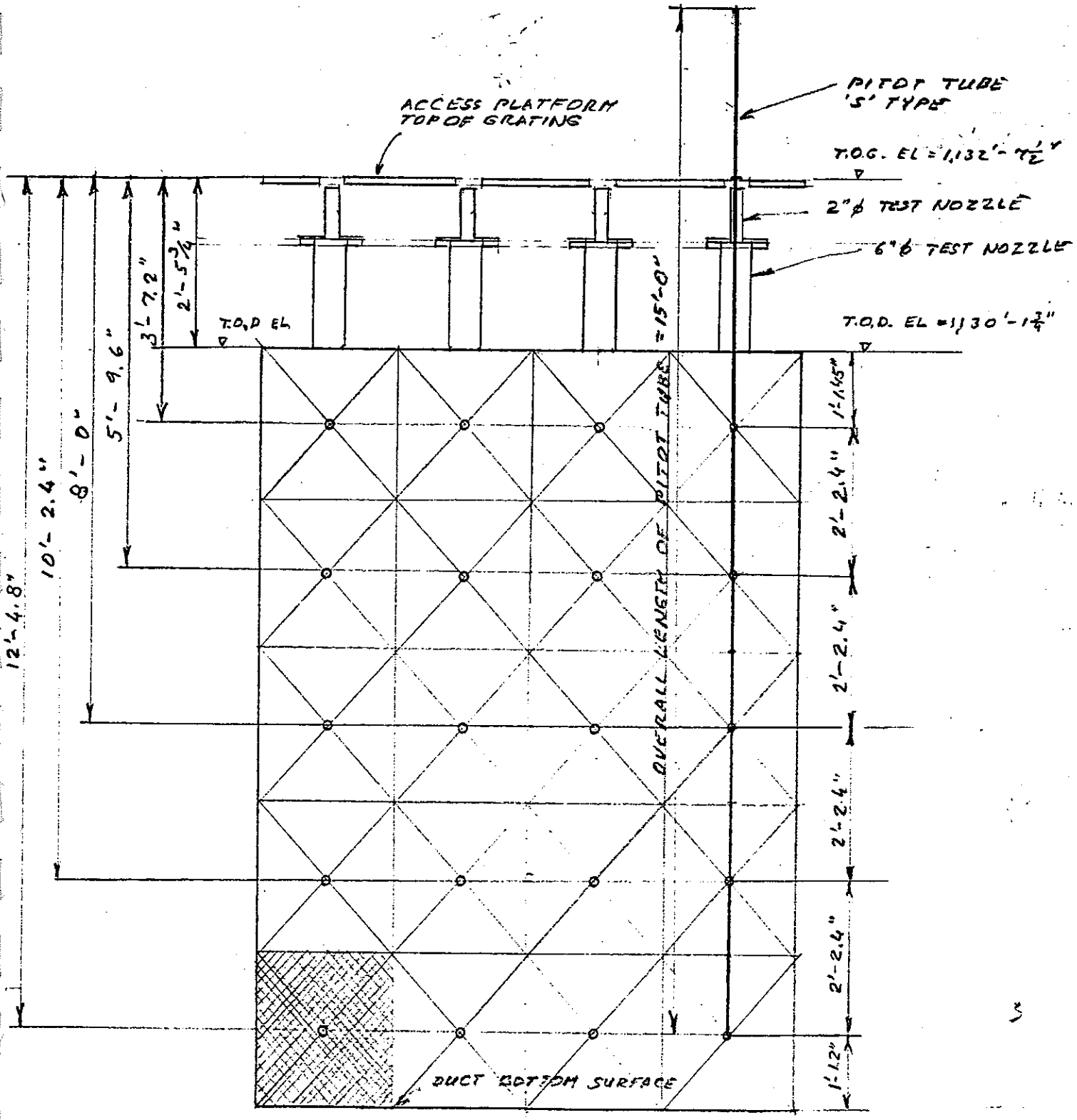
where:

h = Velocity head in inches of water as measured with an S-type pitot tube

$\rho_{F.G.}$ = Density of flue gas

$$= \frac{29}{379.5} \times \frac{520}{T + 460} \times \frac{B.P. - \frac{D.G.P.}{13.6}}{29.92}$$

Figure 4-2
TRAVERSE POINT ARRANGEMENT IN THE DUCT FOR VELOCITY MEASUREMENT



$$\rho_{F.G.} = 1.3281 \times \frac{B.P. - \frac{D.G.P.}{13.6}}{T + 460}$$

where:

T = Flue gas temperature, °F

B.P. = Barometric pressure, in. Hg

D.G.P. = Duct gauge pressure, in. W.C.

$\rho_{F.G.}$ = Flue gas density at flue gas temperature and pressure, lb/ft^3

$V = V_{average} \times A_{duct} \times 60$

where:

V = Flue gas flow, acfm

$V_{average}$ = Average gas velocity in the duct at the test nozzle, ft/sec

A_{duct} = Duct cross section, ft^2

The flue gas flow, in actual cubic feet per minute (acfm), will then be converted to the flow in standard cubic feet per minute (scfm), which will then be compared with the flow indicated by the Kurz instruments and also with the theoretical flue gas flow based on the latest coal analysis and oxygen content of flue gas.

4.3.2.2.2 Injection of Atomized Water into the Flue Gas

Atomized water will be sprayed into flue gas in the test duct to:

- Determine the maximum volume of water that can be injected into the flue gas and evaporated before reaching the turning vanes
- Verify or correct the initial arrangement of atomizers so as to avoid wetting the duct surfaces
- Ascertain the effects of atomizer operating parameters (liquid flow rates, air/liquid ratios, and operating pressures) on the flue gas stream temperature profiles across and along the gas flow path

The purpose of these tests is to verify the configuration of the atomizers and to determine the amount of water that can be injected into the flue gas without danger of wetting the duct walls, floor, and turning vanes.

The water for atomization tests will be provided from the standby water supply, which will use the same flow instrumentation as the lime supply.

Both atomizing air compressors will be used for these tests. The airflow will be regulated by controlling the air delivery pressure at the atomizing air feeders. An air pressure controller will be provided for this purpose.

The total atomizing air usage will be obtained by reading the airflow rotameters and totaling the readings. The airflow rotameters and the individual atomizer air pressure indicators will be employed to verify that the air distribution to all operations atomizers was even.

All temperature probes in the flue gas duct will be used to obtain the longitudinal and cross-sectional flue gas stream temperature profiles.

The adiabatic flue gas cooling temperature will be obtained by inserting a wet probe into the duct and measuring the flue gas temperature. As long as the probe remains wet, it should read the abiabatic flue gas saturation temperature. When read with the other temperature probes, this temperature will indicate wet flue gas or wet duct surfaces. (The duct floor and wall temperatures will be measured to find out if the atomized water wets the duct surfaces.)

To begin testing, six central atomizers will be mounted in the R-C ESP discharge plenum; the water rate will be 1-1/2 gpm/atomizer. After all flue gas temperature readings are obtained, the water rate will be increased to 2 and then 2-1/2 gpm/atomizer. The tests will start using 200 scfm/atomizer of the atomizing air. On the following day, if the results are satisfactory, these tests will be repeated at 150 scfm/atomizer of the atomizing air; on the third day, the rate will be reduced to 100 scfm/ atomizer. Different types of atomizers will consume different amounts of compressed air at 100 psig for the required liquid flow rate.

After evaluation of the test results, the four central atomizers from the first atomizer mounting nozzles in R-C ESP plenum will be added to the six previously tested atomizers, and the injection test will be repeated at the same flow rates as before. The four additional atomizers are not expected to affect the duct floor temperature.

After satisfactory testing of all atomizers together at a total water rate of 50 gpm and a total air rate of 4,000 scfm, all atomizers will be tested at reduced air rates. The reduced air rates will correspond to 175, 150, 125, and 100 scfm/atomizer. The objective of these tests is to verify the minimum quantity of atomizing air required for the operation of atomizers without wetting the duct surfaces.

During the water atomization tests, the computer and recorder will be used. This will maximize the amount of test information and provide practice in operating these devices.

4.3.2.2.3 Injection of Atomized Lime Slurry into the Flue Gas Duct

The purpose of the parametric lime slurry tests is to find out how SO_2 absorption and dryness of the absorption products are affected by atomizer operating characteristics. These characteristics include:

- The concentration of lime slurry
- The ratio of the lime slurry to atomizing air
- The degree of lime slurry degritting
- The type of lime used, e.g., dolomitic hydrate, calcitic hydrate, or freshly slaked lime

The new test results will be compared with 1987 results from the Seward Boiler 15 old flue gas duct and from the Campbell pilot plant to determine the effect of duct configuration on the CZD process performance.

Lime Slurry Atomization Tests. From the water atomization tests, the following will be determined:

- The correct arrangement of atomizers to avoid duct wetting
- The correct atomizing air/slurry ratio to produce droplets fine enough for complete evaporation in the available duct length
- The total volume of water that could be atomized without wetting the duct surfaces

Based on these data, operating parameters (e.g., the air/slurry ratio, slurry injection rate, slurry concentration) will be established for the initial atomization of lime slurry. These parameters will be based on the assumption that the lime slurry behaves very much like water and that the atomized slurry contains twice the stoichiometric quantity of lime required for the removal of one-half of the SO_2 present in one-half of the boiler flue gas.

Effect of Lime Slurry Concentration. The CZD lime slurry atomization section is designed to atomize up to 50 gpm of a lime slurry using up to 4,000 scfm of atomizing air for this purpose (total air output from both compressors) and to operate with varied slurry concentrations.

The higher degree of flue gas cooling by the atomized lime slurry is equivalent to a closer approach of flue gas to its adiabatic saturation. Lower temperature enhances the absorption of SO_2 by injected lime.

A lower concentration of atomized slurry increases lime utilization, thereby reducing lime usage.

Typically, each daily test run will be started by atomizing 50 gpm of the dilution water to cool the flue gas system to its operating temperature during lime injection. The cooling process will take 1 to 1-1/2 hours. The outlet flue gas temperature will be recorded, and this recording will be used to ascertain the system's thermal stabilization.

After the discharge flue gas temperature stabilizes at about 162°F to 172°F, the flow of dilution water will be replaced with lime slurry so that the total liquid feed rate to atomizers remains unchanged. The atomization of lime slurry will reduce the SO_2 concentration in the outlet flue gas, which will be monitored.

During factorial testing, the lime flow will be adjusted by increasing the concentration of lime in the lime sump and transferring the lime flow to the lime slurry feed tanks for injection.

During lime atomization, the temperatures of thermocouple probes in front of the first set of the duct-turning vanes will be checked. The flue gas temperatures along the duct between the atomizers and the first set of turning vanes will also be checked. Low temperatures at the turning vanes (120°F - 130°F) may indicate that these vanes are being wetted with water and that the vane deposits are being formed. Low duct floor temperatures (along the flue gas duct) may indicate the

presence of water on the duct floor and the formation of floor deposits. Low temperatures of the probes along the duct wall may indicate the formation of wall deposits.

To determine the cause of low flue gas temperature at the turning vanes, it will be necessary to:

- Verify the flow of atomizing air. It should be about 200 scfm/atomizer. Rotameters FI-21 should read about 75 scfm when the pressure gauges downstream of the rotameters read the atomizing air pressure of 100 psig and the atomizing air temperature is no more than 140°F.
- Verify the flow of diluted lime slurry at the atomizers by checking the slurry pressure at the atomizers. It must not exceed the pressure corresponding to the atomization of 50 gpm of pure water.

Measures for Avoiding Wetting the Duct Walls. Drying of atomized slurries in the flue gas will be studied by inserting pipe probes in the duct through the test nozzles. The pipe probes should remain in the duct for at least 30 minutes. Afterwards, they will be removed for inspection.

From previous testing we found that:

- The sections of the probes exposed to temperatures less than 140°F had very wet deposits.
- The sections of the probes exposed to temperatures of 140°F to 155°F had damp deposits.
- The sections of the probes exposed to temperatures of 155°F to 170°F had dry deposits.
- The sections of the probes that were above 170°F remained free of deposits.

From these observations, it was concluded that to prevent deposition of solids in the duct, the injection rate of atomized lime slurry had to be limited to an amount that would cool the gas to no lower than 170°F close to any duct surface, including turning vanes.

The objectives of the lime injection tests will be to:

- Find out how much lime slurry could be atomized and evaporated to dryness in the available flue gas duct
- Identify the effects of different slurry concentrations on SO_2 absorption and slurry evaporation
- Identify the effects of degritting the lime slurry on SO_2 absorption, slurry evaporation, and wetting of duct surfaces
- Determine how much SO_2 can be removed from flue gas in the existing duct

The duct will be equipped with 14 soot blowers to keep it clean, 10 at the bottom of the duct between the injection point and the turning vanes and 4 at the turning vanes. The soot blowers will be operated at least one cycle per hour. A soot blower cycle is defined as starting at turning vanes

14 through 11 then 10 through 1, which will be located in the bottom of the duct, followed immediately by the reverse order.

4.3.2.2.4 Flue Gas Temperature in the Duct (Temperature Profile)

The flue gas temperature in the duct is a very important parameter for the CZD process. Confined zone dispersion means that a hot gas zone separates the wet zone from the duct walls, to protect against the deposition of wet fly ash and lime slurry on the walls. During parametric testing, temperature profiles will be taken across the duct at different distances from the atomizing nozzles. The temperature profiles will indicate the distribution of the lime slurry atomized into the duct and the position of the hot zone along the duct walls.

4.3.2.2.5 Reagents, Fly Ash, and Waste Solids

Reagents. Pressure-hydrated dolomitic lime (PHDL) will be supplied by Rockwell Lime Company in Wisconsin, which will send a chemical analysis bulletin with each shipment of 25 tons. One grab sample will be taken from each of the loads of PHDL delivered to the site. Each batch of lime slurry will be analyzed at the site for total solids, specific gravity, and available alkalinity. These results will be listed in the monthly technical reports. Available alkalinity will be determined by titrating a 10 percent lime slurry with 10 percent sulfuric acid at a rate of 3 ml/min, to a final pH of 6, as shown in Figure 4-3.

Fly Ash. Grab samples of fly ash from the ESP hoppers will be taken and sent to an outside laboratory for chemical analysis. The fly ash will be sampled before, during, and after lime injection. The waste solids from the ESP hopper will be analyzed to determine how much of the calcium, magnesium, and sulfate (1) is coming from the lime slurry injected into the duct, (2) reacted with the SO_2 from the flue gas, and (3) is coming from the fly ash.

The fly ash samples from the ESP's hoppers will be taken from the sample ports already available. During the ESP testing for particulate removal efficiency, fly ash samples will be taken from the sampling ports in the duct immediately upstream of the ESP. These fly ash samples will be removed using a particulate-sampling train, by an outside company, and sent out for chemical analyses. Figure 4-4 shows the particulate sampling train. Samplings will be made in accordance with EPA's standards.

Waste Solids. During the CZD demonstration with continuous operation, whenever the ESP is tested (by an outside specialized company) for particulate removal efficiency, samples of fly ash containing the reacted products will be taken with the particulate sampling train. These samples will be removed through the sampling ports in the duct, upstream of the ESP. The solid particles will be sent to an outside laboratory for chemical analyses, to determine the concentration of calcium, magnesium, sulfite, sulfate, carbonate, nitrite, and nitrate.

Figure 4-3
TITRATION OF HYDRATED DOLOMITIC LIME AND HYDRATED LIME WITH 10% H_2SO_4 AT A RATE OF 3 ML/MIN

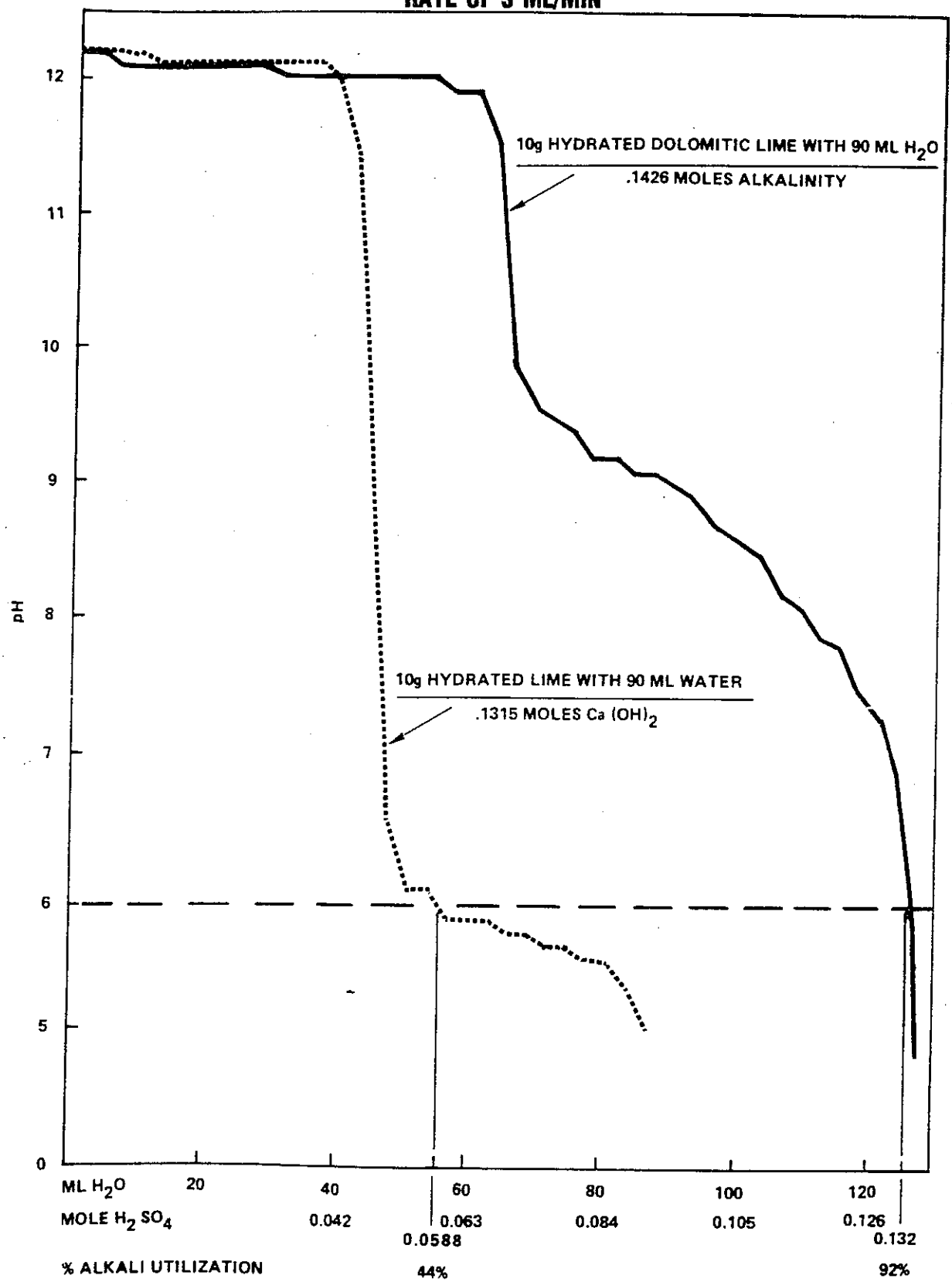


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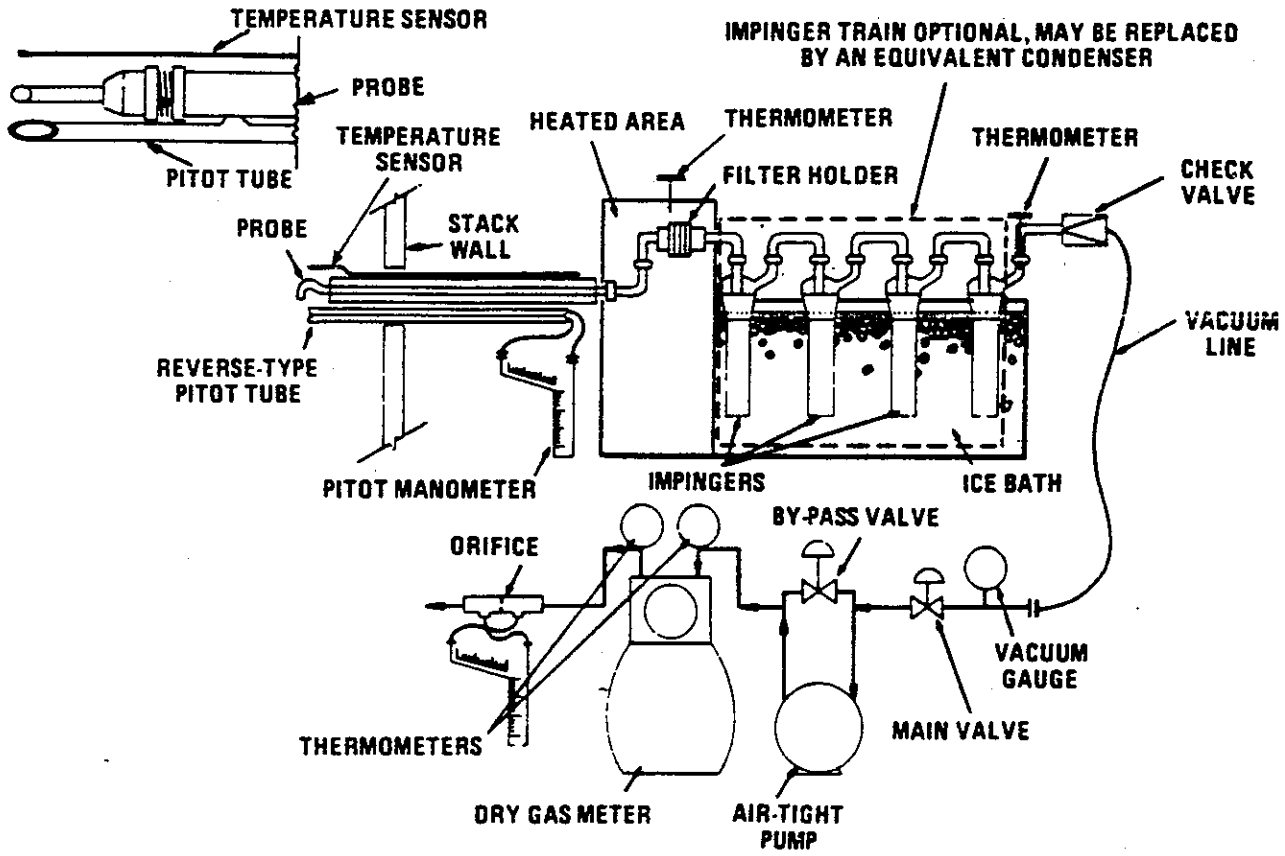
Figure 4-4
PARTICULATE SAMPLING TRAIN



Samples of waste solids will be sent to outside laboratories for analysis according to the EPA toxicity tests. Earlier experience indicated that the concentrations of 11 heavy elements in the leachate resulting from the EPA extraction procedure were well below the maximum concentrations allowed by EPA and by the Pennsylvania Department of Natural Resources.

During the testing period, samples of waste solids will be obtained by inserting probes into the duct ahead of the ESP. These samples will be sent to an outside laboratory to determine the concentration of the chemicals described earlier.

4.3.2.2.6 Flue Gas Analysis

To determine the percent SO_2 removed by the CZD process, it is necessary to know the concentrations of SO_2 before and after lime slurry injection. A standard dilution probe-type continuous emissions monitoring system will be used.

The sampling ports downstream of the I.D. fan, with the flue gas well mixed, will ensure a representative sample. Also, flue gas samples will be taken upstream of the injection of atomized slurry.

4.3.2.2.7 Atomizers Testing and Selection

The criteria for proper atomization of lime slurries were established during previous pilot-scale and proof-of-concept testing of the CZD process. For the current demonstration test program at Seward Station to be successful, atomizers selected for use in the program will have to meet the established criteria. Wind tunnel testing will provide a method for characterizing atomizing nozzles. Details regarding the design or modification of atomizers are considered proprietary information.

4.3.2.2.8 Electrostatic Precipitator (ESP) Tests

Particulate removal efficiency testing of the ESP, with and without lime slurry injection, will be conducted to determine the ability of the existing ESP to handle additional grain loading when atomized lime slurry is injected into the system. An online opacity monitor mounted in the stack will also be used to determine ESP performance during testing.

The plan to obtain comprehensive ESP operational data will include two particulate measurements made during periods when lime is not being injected:

- Before starting the lime factorial tests
- 3 weeks after the end of the lime slurry injection program

Other particulate measurements tests will be made:

- Once during the parametric tests
- Five times during the continuous lime slurry injection runs to cover different operating conditions

During testing, the ESP's plate voltage (kV) and current (mA) in each of the four fields will be recorded for secondary (dc) current and secondary (dc) voltage. These data will be tabulated with other data developed during testing for a better evaluation of the factors affecting the ESP's particulate removal efficiency and particulate emission, in correlation with the CZD system.

4.3.2.3 Data Manipulation Methods

Routine operating information will include data obtained from measurements needed to control the system and to assess its performance. During testing, the following data will be recorded :

- Time
- Gas temperature entering the duct, at four consecutive places downstream of the atomizers, upstream of the ESP, and downstream of the I.D. fan
- Gas flow rate into the duct
- Gas opacity at the stack
- Atomizing air to each nozzle, pressure and flow
- Liquid or slurry to each nozzle, pressure and flow
- SO_2 concentrations in the gas, upstream from the injection and downstream from the I.D. fan
- Oxygen concentration in the duct at the same locations and with the same frequencies as SO_2 concentrations
- Voltage and current of each ESP field
- Slurry feed tank level
- Lime slurry concentration and pressure at the atomizer

These data will allow SO_2 removal and lime utilization to be calculated for each set of observations.

A Bailey Infi 90 system will be employed to facilitate data reduction. Manually logged data and continuously recorded data will be entered into a computerized database, and measures of performance (percent SO_2 removal, SO_2 molar inlet rate, lime molar feed rate, lime feed ratio, and lime utilization) will be calculated according to prepared formulas.

Data in each category will be grouped into blocks of comparable operating conditions and then averaged. For most of the parametric tests, which will last only a few hours under relatively constant conditions, a block will usually contain all the data taken that day. For the continuous tests, where many variables (gas flow rate, gas inlet temperature, SO_2 inlet concentrations) will sometimes change significantly, the number of data in a block will vary from measurements taken during a few hours to those taken over a three-shift operation.

4.3.2.4 Success Criteria

The CZD test program will be considered a success if the program criteria are met. These criteria for success include the following:

- A CZD technology that does not adversely impact normal boiler operation and does not increase particulate emissions or percent opacity
- Removal of up to 50 percent of the SO_2 with up to 50 percent alkali utilization
- SO_2 removal costs of about \$300/ton SO_2

Another success criterion will be obtaining and compiling system design parameters that permit optimization of the system for application at different locations.

4.3.3 Emission Control Monitoring

An Environmental Monitoring Plan (EMP) is required by Bechtel's cooperative agreement with DOE. The EMP will describe environmental monitoring conducted at Seward Station during the course of the CZD Project. Environmental monitoring will be a key aspect of this project. The monitoring will supplement the National Environmental Policy Act documentation to ensure that the CZD Project does not result in impacts that violate applicable standards or are detrimental to human health or the environment. Environmental monitoring will also be used to develop a database for mitigation of potential environmental problems related to the technology and for replication of the technology independent of site-specific parameters.

Monitoring will be conducted to characterize air emissions, water and solid waste discharges, and other safety and health concerns. Monitoring requirements for compliance with federal, state, and local regulations will be discussed, along with supplemental monitoring requirements that are designed to provide further information about the CZD process performance. Bechtel will use standard EPA measurement procedures whenever possible.

Compliance monitoring will be conducted during all phases of the project: preconstruction (planning and design), construction, operation, and postoperation. Compliance requirements will be the same as current monitoring requirements under existing permits and state laws and regulations, and will remain unchanged throughout the project.

Supplemental monitoring will be performed during project operations, which will consist of a factorial test phase and a demonstration phase. The fundamental objectives of the supplemental monitoring program will be (1) to ensure that the CZD Project harms neither the employees nor the environment, (2) to develop an environmental and health database for the assessment of mitigation of impact associated with the replication of the CZD project, and (3) to evaluate the success of the CZD Project.

Information obtained during this monitoring effort will provide a database for future reference. This information will also be used to generate quarterly and annual reports for the Pennsylvania Department of Environmental Resources (PaDER), DOE, and Penelec. A comprehensive quality assurance and quality control program will be followed for data received through the continuous emissions monitoring system (CEMS) and supplemental monitoring programs.

5.0

Plant and Employee Safety

5.0 PLANT AND EMPLOYEE SAFETY

Penelec's Plant Safety Manual covers (1) safety and security and (2) fire protection. There are no special fire protection or fire fighting provisions incorporated into the CZD-FGD system because there are no special fire hazards.

Bechtel's Safety & Health Plan for Bechtel Employees at the Seward Station Project Site is contained in Appendix A.

6.0

Cost Summary

6.0 COST SUMMARY

The overall cost summary is shown in Table 6-1. Detailed area-by-area costs are shown in Appendix B.

The costs shown in Table 6-1 and Appendix B include everything required to provide a complete and operable CZD system at Seward Station. These costs include all proprietary or "business-sensitive" equipment such as atomizer lances (included as piping), nozzles, and associated headers, piping, instrumentation, and other parts of the slurry injection atomizer array system. The cost of individual items, e.g., *nozzles*, can be found in Appendix B, Plant 4, under the appropriate equipment category, e.g., *Special Equipment.*

Since earlier CZD proof-of-concept work was done at Seward Station, certain items of equipment do not need to be purchased and installed. These include the lime slurry feed and storage tanks, the grits tanks, the vibrating screen, and the water booster pump. In addition, Seward Station has an existing lime silo and lime preparation sump, as well as space in its existing buildings for installation of air compressors and a receiver. The total plant cost of about $4,367,400 shown in Table 6-1 is based on utilization of the existing equipment and space where possible. If the existing equipment and space were not available, the cost of the Seward Station CZD installation would increase to $5,146,300. The incremental cost increase of $778,900 may be broken down as follows:

Air compressors and receiver – add building, piping, wiring, etc.	$115,500
Lime slurry preparation – add silo, sump, building, etc.	272,700
Lime slurry feed area – add tanks, screen, etc.	262,700
Lime slurry injection area – add water booster pump	11,200
Balance of plant – connecting wiring, piping, instrumentation, etc.	116,800
Total installed cost	$778,900

It is expected that there will be some cost improvement in future plants, based on design maturity and plant operating experience, because the Seward Station CZD system is the first commercial installation. Although most of the CZD equipment is of standard off-the-shelf design, the atomizer nozzles are expensive, special prototypes. As the market for CZD installations develops and production quantities of nozzles are required, the nozzle cost will decrease.

In Appendix B, the abbreviation *S/C* denotes subcontracted work, while direct labor refers to set-in-place costs. Appendix B provides a complete breakdown of the total direct costs. Table 6-1 shows the total field cost, total home office costs, and grand total based on the total direct costs. Field distributables, which include small tools, expendable supplies, field office costs, and similar items, are added to direct costs to obtain total field costs. Home office costs, which include engineering, procurement, accounting, and other supporting groups, are added to the field cost to produce the grand total. No allowance for contingency or fee is included in the cost estimates furnished in this design report.

Table 6-1
OVERALL COST SUMMARY

CASE 1

	PLANT 1	PLANT 2	PLANT 3	PLANT4	PLANT 5	PLANT 7	PLANT 8	PLANT 9	PLANT 10	TOTAL
	ATOMIZING AIR COMPRESSOR	LIME SLURRY PREPARATION AREA	LIME SLURRY FEED AREA	LIME SLURRY INJECTION AREA	DUCT AND SOOTBLOWERS	WINTERIZATION	INST.	ELECTRICAL INTERCONNECT	PIPING AND MECHANICAL INTERCONNECT	
MAJOR EQUIPMENT	$339,013	$52,735	$90,031	$108,742	$466,932	$0	$312,876	$39,211	$22,825	$1,432,365
BULK MATERIALS	$0	$0	$1,022	$0	$0	$0	$0	$0	$0	$1,022
DIRECT LABOR	$0	$62,247	$97,351	$43,382	$140,613	$0	$2,706	$31,641	$41,511	$419,452
SUB CONTRACTS	$253,610	$0	$0	$42,343	$376,292	$121,162	$30,095	$0	$0	$823,501
SUB TOTAL	$592,623	$114,983	$188,404	$194,467	$983,837	$121,162	$345,678	$70,852	$64,336	$2,676,341
SHIPPING	$1,159	$1,175	$1,401	$1,077	$1,329	$0	$10,876	$1,587	$862	$19,467
TAX	$13,078	$301	$69	$474	$6	$0	$15,407	$971	$209	$30,516
TOTAL DIRECT COST	$606,861	$116,459	$189,873	$196,019	$985,172	$121,162	$371,961	$73,409	$65,407	$2,726,323
FIELD DISTRIBUTABLE	$37,961	$7,265	$11,877	$12,262	$61,626	$7,579	$23,267	$4,592	$4,091	$170,540
TOTAL FIELD COST	$644,822	$123,744	$201,750	$208,281	$1,046,798	$128,741	$395,228	$78,001	$69,498	$2,896,863
ENGINEERING	$247,380	$47,473	$77,400	$79,905	$401,594	$49,390	$151,625	$29,924	$26,662	$1,111,353
PROCUREMENT	$15,266	$7,637	$12,450	$12,853	$64,600	$7,945	$24,390	$4,814	$4,289	$178,772
OTHER HOME OFFICE COSTS	$15,266	$7,706	$12,563	$12,970	$65,185	$8,017	$24,611	$4,857	$4,328	$180,390
TOTAL HOME OFFICE COSTS	$277,912	$62,816	$102,413	$105,728	$531,379	$65,352	$200,626	$39,595	$35,279	$1,470,515
CONTINGENCY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
FEE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
GRAND TOTAL	$922,734	$186,560	$304,163	$314,009	$1,578,177	$194,093	$595,854	$117,596	$104,777	$4,367,378

The CZD process may be scaled as necessary to fit a variety of plant capacity requirements. The lime slurry preparation and feed areas offer no scaleup problems, and the lime slurry injection scaleup is a function of the site-specific plant characteristics. If existing plant ductwork is inadequate to provide the residence time and cross sectional area needed, new ductwork can be designed, similar to the retrofit at Seward Station, so that the injection requirements can be met. Consequently, duct size and length can be adjusted to satisfy the lime injection rates necessary to achieve the desired level of SO_2 removal.

A preliminary assessment has been made of the capital and operating costs for CZD installations at various unit capacities. Figure 6-1 shows the variation of capital costs, in dollars per kilowatt, for a generic retrofit of CZD on units of various sizes. The costs in this figure were derived from analysis of the retrofit cost for Seward Station. It was assumed that no existing equipment or space was available and a complete lime receiving, preparation, and storage system would need to be provided. An allowance was also made for replacement of an equivalent amount of ductwork, similar to Seward Station. Costs for larger or smaller units were factored using appropriate exponents for individual items of equipment. The individual costs were then summed to give the total direct costs. Appropriate percentages were then applied for field distributables, home office costs, fees, and paid-up royalties to arrive at the total capital costs. Figure 6-1 indicates that the total capital cost for plants in the range 150 MW to 500 MW varies from about $38/kW (500 MW) to $62/kW (150 MW). The capital costs rise sharply below 150 MW.

Figure 6-2 shows the projected operating and maintenance (O&M) costs for CZD, expressed as dollars per ton of SO_2 removed, versus the unit size in megawatts. The O&M costs are shown both as 30-year levelized costs and as annual costs. The levelized costs were derived using EPRI's Technical Assessment Guidelines (TAG). The annual costs are on the same basis, but exclude any capital charges and represent the actual costs before application of carrying charges and levelization factor. Lime costs of $55 per ton, including delivery, were assumed, with a lime utilization rate of 40%. Other factors used to derive the O&M costs were:

Flue gas flow	2,400 scfm/MW
Flue gas SO_2 concentration	2,000 ppmv
Coal HHV	11,200 Btu/lb
Plant capacity factor	65%
Plant heat rate	9,800 Btu/kW
Moisture in coal	12.0%
Sulfur in coal, dry basis	3.9%

As shown in Figure 6-2, the annual O&M costs vary from $310 per ton of SO_2 removed from a 50 MW unit, to $165 per ton of SO_2 removed from a 500 MW unit. Similarly, the levelized costs vary from $466 per ton of SO_2 removed from a 50 MW unit, to $220 per ton of SO_2 removed from a 500 MW unit.

Figure 6-1
CZD GENERIC RETROFIT CAPITAL COSTS FOR VARIOUS UNIT SIZES

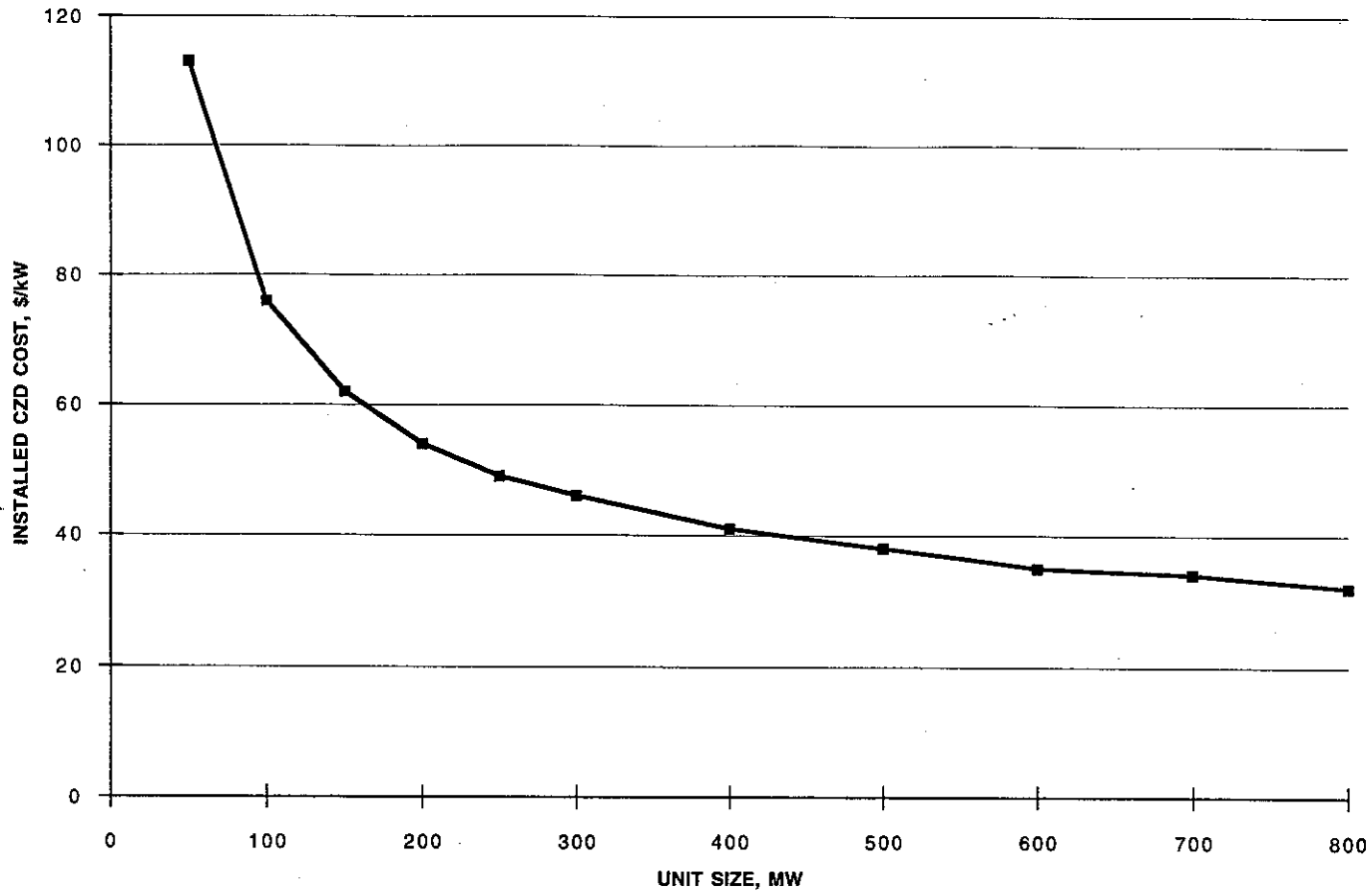
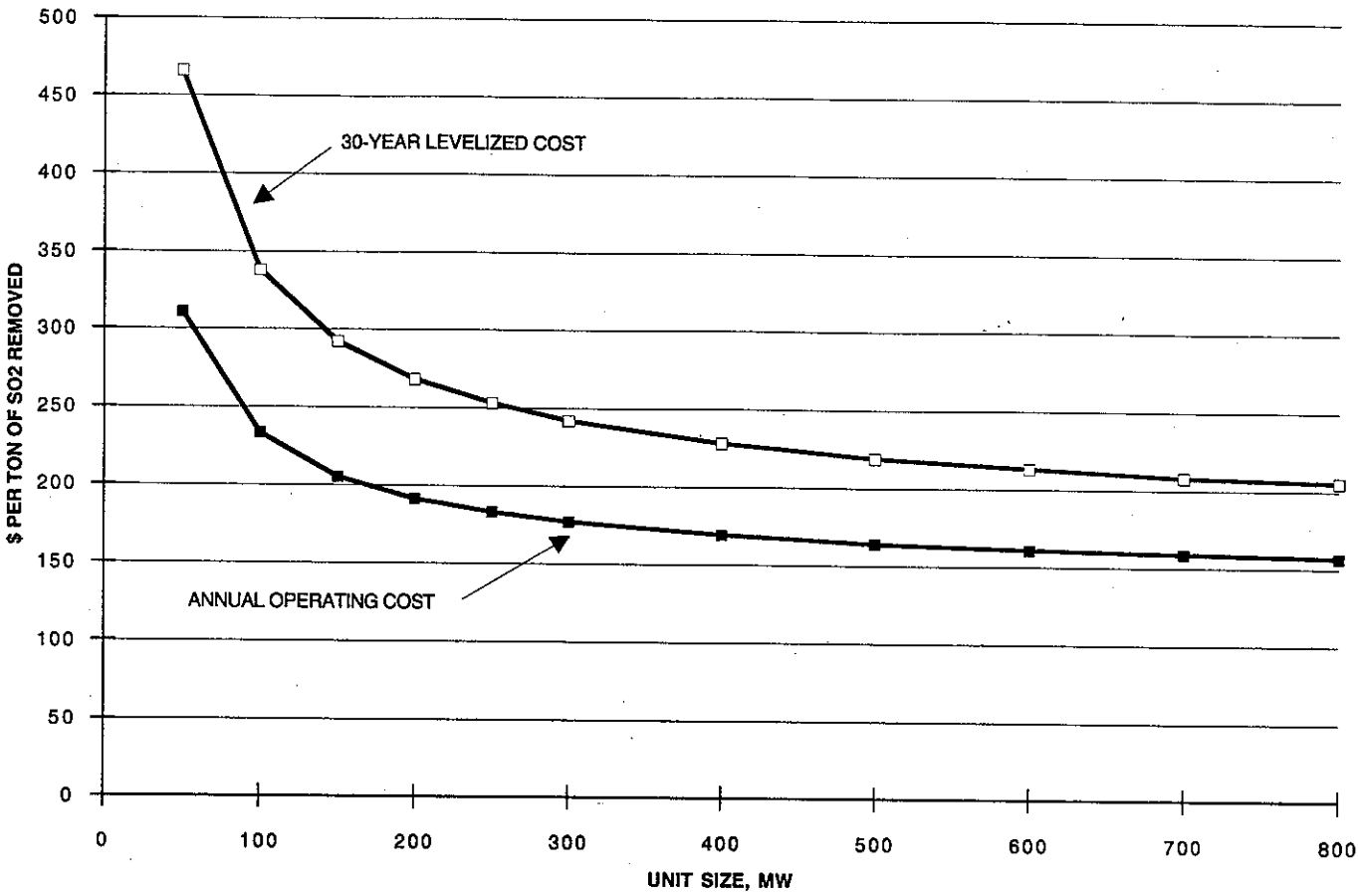


Figure 6-2
COST OF SO_2 REMOVAL FOR VARIOUS UNIT SIZES BASED ON 50% REMOVAL



For both the capital and O&M costs, unit size refers to a single unit and should not be confused with plant size or capacity. For example, a plant having a capacity of 600 MW may consist of four 150 MW units. In this case, capital costs should be determined from Figure 6-1 by referring to the cost for a 150 MW unit and multiplying by 4 to determine the total plant cost. Costs determined in this manner will be very conservative, because they do not reflect the economies of multiple units. For example, a single lime preparation plant could service multiple CZD units. Similarly, the O&M costs would be determined from Figure 6-2 by reference to the proper unit size (no multiplication necessary).

Appendix A

Safety & Health Plan for Bechtel Employees at the Seward Station Project Site

CONFINED ZONE DISPERSION
FLUE GAS DESULFURIZATION DEMONSTRATION

Safety & Health Plan
For Bechtel Employees at the
Seward Station Project Site

Prepared by:
Bechtel Corporation
Safety and Health Services
151 Lafayette Drive
Oak Ridge, TN 37830

January 15, 1992

SAFETY AND HEALTH PLAN FOR

BECHTEL EMPLOYEES AT THE

PENELEC SEWARD STATION CZD PROJECT

Developed by:

SAFETY AND HEALTH SERVICES

Rev. 1

January 15, 1992

APPROVED: Melvin D Atwood — Project Safety and Health Supervisor — 1/16/92 Date

APPROVED: C.R. Rountree — Safety Services — 1/20/92 Date

APPROVED: [signature] — Health Services — 1/16/92 Date

APPROVED: [signature] — Project Manager — 2/3/92 Date

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SITE SAFETY & HEALTH PLAN

I. PURPOSE AND SCOPE OF THE SAFETY AND HEALTH PLAN (SHP)

It is Bechtel's policy to provide our employees with a safe and healthy place in which to work. With this end in mind, the SHP is designed to meet all applicable federal, state, or local regulations including but not limited to the Occupational Safety and Health Administration (OSHA) standards. It is also designed to meet Bechtel corporate safety and health requirements. The SHP will be a working document and may require changes based on variations in site conditions or operations. It will be the responsibility of the Project Safety and Health Supervisor to make these changes in the SHP document as appropriate.

The purpose of the SHP is to provide guidance to Bechtel personnel for protection against physical and chemical hazards while conducting field tasks for the Confined Zone Dispersion (CZD) project located at the Pennsylvania Electric Company (PENELEC) Seward Station. This plan will incorporate general safety measures while working at the site, while at the same time providing an inorganic arsenic compliance program.

II. GENERAL INFORMATION

A. Site Identification

Site Name: Pennsylvania Electric Company (PENELEC) Seward Station

Client: Bechtel Research and Development

Site Location: 12 miles NW of Johnstown, Pennsylvania

SHP Prepared by: M. D. Atwood, Project Safety and Health Supervisor (PSHS)

B. Site Description and History

1. Site Type

[x] Active	[ ] Civilian	[ ] Landfill
[ ] Inactive	[ ] Fed. Government	[ ] Residential
[x] Secure	[ ] Arm	[ ] Commercial

[ ] Unsecured [ ] _____ [x]
Industrial

[ ] State Government [ ] Agricultural

[ ] Unknown

The Seward Station is a totally owned PENELEC facility that has three coal-fired boilers with a total capacity of 199 MW for the generation of electric power. The coal used for fuel at the Seward Station contains small amounts of inorganic arsenic, as well as other trace elements. As the pulverized coal is burned, non-combustible elements in the fuel such as arsenic are driven off and are present in the exhaust gases and flyash. In addition, offgases such as sulfur dioxide and nitrogen oxides are formed during combustion and are present in flue gases. Under normal operation conditions, this flyash, along with some arsenic, may adhere to the relatively cooler surfaces in the air pollution control system.

C. Description of Bechtel Activities

[ ] Preliminary Assessment [ ] Remedial Investigation/RI

[ ] Initial Investigation (walk-thru) [ ] Feasibility Study/FS

[ ] Initial Investigation (sampling) [ ] Remedial Design/RD

[x] Other (Specify) Research and Development - flue gas Desulfurization [ ] Cleanup

The CZD project involves a research and development task to scrub sulfur dioxide and nitrogen oxides from the Seward Station's exhaust duct by utilizing a proprietary lime slurry spray system inside the duct. PENELEC employees provide direct labor to Bechtel and are covered by PENELEC's Safety and Health Program. Specific tasks related to the CZD project include:

1. Mixing and storing lime slurry
2. Transporting and ejecting lime slurry into one of PENELEC's two main flue ducts
3. Monitoring flow, temperature, and other measurements.
4. Observing corrosion and flyash buildup inside the flue duct and downstream equipment.
5. Maintaining the CZD system equipment

It is during times of PENELEC operation shutdown when entry by Bechtel personnel into the flue duct or Electrostatic Precipitator (ESP) is made to determine

internal conditions such as flyash, slag or corrosion buildup. It is during this time that exposure to inorganic arsenic, sulfur dioxide, nitrogen oxides, and other toxic chemicals may be encountered. Bechtel will take the necessary steps to control the number of employees entering the duct where inorganic arsenic could exceed OSHA's action levels (AL) of 5 micrograms per cubic meter ($\mu g/M^3$) of air and/or permissible exposure limit of 10 $\mu g/M^3$ (PEL). Typically, only one or two Bechtel employees may enter the flue duct.

The CZD operations located in the southeast portion of the Seward Station Plant require Bechtel to access portions of PENELEC's operating facility. These areas are:

1. First floor elevator area
2. Second floor elevator area and walkway to the ESP Control Room
3. Third floor supervisor's shower and the subsequent walkway to the shower
4. Fourth floor elevator area
5. Vicinity of the flyash truck loading area

III. HAZARD EVALUATION

Both physical and chemical hazards are or may be present at the CZD project site.

A. Physical Hazards

Physical hazards from PENELEC's plant operations and from Bechtel's onsite activities are described below.

1. Noise

Bechtel employees may work at locations where motors, pumps, and other potentially noisy equipment are operating. Typically noise levels are below 85 decibels as a time-weighted average measured on the "A" network of a sound level meter/dosimeter. Because potential for noise to exceed 85 dB(A) does exist during abnormal conditions such as equipment malfunction, a hearing conservation program will be implemented and noise protection devices will be available onsite for compliance with OSHA standards (29 CFR 1910.95).

2. Eye Damage

Bechtel employees will be in the general area of tanks, pumps, valves and other associated equipment that may be under pressure. This system will carry a corrosive/ irritating substance, lime. In addition, access to

operating portions of the plant may subject individuals to eye hazards from operations that are specific to the PENELEC plant processes. Consequently, all Bechtel employees will wear safety glasses at all times while inside the plant area.

3. Falling Objects

Bechtel employees will operate on three levels that are separated by "catwalk" grating. Individuals may accidentally drop tools or other equipment. Hard hats will be required to protect against this hazard.

4. Oxygen Deficiency

Entry into the flue duct is considered a confined space and may subject individuals to oxygen deficient and/or toxic atmospheres. Confined space entry procedures including monitoring will be conducted prior to entry into the duct.

5. Electrical

Electrical equipment will be used as onsite equipment to operate motors, pumps, and etc. Ungrounded equipment may produce electrical shock. In addition, high voltage equipment related to ESP operations present electrical hazards in that area.

6. Heat Stress

Heat stress may occur while individuals are inside the flue duct. The atmosphere inside the duct may be humid and warm, especially during summer months. This atmosphere, coupled with protective clothing and equipment, can cause heat cramps, exhaustion, or stroke.

B. Chemical Hazards

Chemical hazards related to the CZD project operations are described below.

1. Inorganic Arsenic

Studies performed by PENELEC have indicated that flyash resulting from the burning of pulverized coal may contain trace amounts of inorganic arsenic, approximately 130 milligrams per kilogram (mg/kg), which can be hazardous to employee health. OSHA has promulgated regulations (29 CFR 1910.1018) for protection against occupational exposures to inorganic arsenic.

Arsenic is a systemic poison and a suspected carcinogen. Symptoms of exposure to arsenic are vomiting, nausea, weight loss, irritability, cramps and death. The major routes of entry into the body while performing work at the CZD project site may include inhalation of dust and/or ingestion through poor hygiene practices. Ingestion of arsenic may occur while eating, drinking beverages, chewing gum or tobacco, or smoking. Inhalation of dust may occur during entry into the flue duct, or any other PENELEC arsenic-regulated areas.

2. Inorganic Lead

Trace amounts (approximately 80 mg/kg) of lead in the flyash has also been documented by PENELEC. Exposure to lead may be achieved similarly to arsenic described above. Controls against exposure to inorganic arsenic will control exposure to lead. The action level for lead is not expected to be exceeded; however, lead monitoring will be conducted for personnel entering the flue duct.

Lead is considered to be a neurotoxin, teratogen, mutagen, and suspected carcinogen. It damages the blood, kidneys, central nervous system, and the peripheral nervous system. Symptoms of exposure include irritability, dark gums, weight loss, loss of memory, anemia, loss of appetite, insomnia, and death.

3. Sulfur Dioxide

Sulfur dioxide exposure may occur during entry into the flue duct. Sulfur dioxide is an acid gas that irritates eyes, skin and mucous membranes. Symptoms of exposure include burning eyes, skin rash and irritation to nose, throat and lungs.

4. Hydrogen Sulfide

Sulfides may exist in the flyash inside the flue duct. When mixed with water, sulfides may produce hydrogen sulfide, a chemical asphyxiant. Symptoms of exposure to hydrogen sulfide are asphyxiation and death, even though the quantity of available oxygen is appropriate to sustain life.

5. Nitrogen Dioxide

Oxides of nitrogen, specifically nitrogen dioxide, exists initially inside the flue duct. Nitrogen dioxide is a reddish-brown gas with a pungent, acrid odor. Exposure to nitrogen dioxide affects the respiratory and cardiovascular system. Symptoms of

exposure include cough, mucoid frothy sputum, dysporea, chest pain, pulmonary edema, cyanosis, and eye irritation.

6. Other Hazardous Gases

Other hazardous gases such as carbon monoxide (CO) may also exist within the duct and should be considered and vented prior to confined space entry.

IV. PROTECTIVE MEASURE FOR SPECIFIC TASKS OR LOCATIONS

The following requirements shall be adhered to by Bechtel personnel unless deviation from these requirements has been specifically approved by the PSHS.

A. Lime Mixing Operation/Area

(1) Description:

Mixing lime or hydrated lime with water to form a lime slurry. It is anticipated that Bechtel personnel may be in the area, but not performing the physical labor.

(2) Personal Level of Protective Equipment:

Primary: Hard hat, faceshield and splash-proof goggles, neoprene gloves, long sleeve shirts or tyvek, and work shoes

Contingency: Tyvek, full facepiece negative pressure respirator with HEPA filters, hard hat, neoprene gloves, and work shoes

(3) Engineering Controls:

(a) Lime addition to tanks shall be done from a dumping platform, or lift, or other safe means.

(b) Electrical equipment shall be properly grounded, weatherproofed, and meet all applicable requirements of the American National Standards Institute (ANSI).

(c) Provide eyewash facilities.

(d) Provide shower facilities.

(4) Administrative Controls:

(a) Provide each employee with hazard communication, respiratory protection, and other training as applicable.

(b) Use proper lifting techniques

(c) Practice good housekeeping.

(d) Train employees in the hazards of the task and proper procedures

(5) Schedule:

Accomplished on an as-needed basis.

(6) Comments:

Bechtel employees who are not immediately involved in the mixing operation should remain at a safe distance. The above personal protective equipment, excluding hard hat, goggles and safety shoes, may be downgraded by the Site Safety and Health Officer (SSHO) if the individual is not in the immediate mixing area. However, Hydrated and pressure-hydrated lime also presents caustic (high pH) hazards and, due to their ultra fine particle size, a potential dust and inhalation hazard may exist in the lime storage and mixing area.

B. Maintenance of the CZD Lime System Equipment

(1) Description:

Maintaining the CZD lime slurry system equipment includes replacing or repairing leaking or otherwise defective valves, pipes, pumps, etc.

(2) Personal Protective Equipment:

Primary: Hard hat, face shield, and/or goggles (if the equipment is pressurized both must be used), work shoes, neoprene gloves, and long-sleeved shirts.

Contingency: Hard hat, face shield and goggles, work shoes, neoprene gloves, and tyvek.

(3) Engineering Controls:

(a) Use correct tools in facilitating repair.

(b) Depressurize leach system prior to implementing repairs.

(c) Immediately repair or replace defective equipment.

(d) Provide eyewash facility.

(e) Provide shower facility.

(4) Administrative Controls:

(a) Provide training to each employee including hazard communication.

(b) Practice good "housekeeping".

(c) "Lockout" equipment such as tanks, motors, and other similar equipment prior to conducting maintenance work.

(5) Schedule:

Conduct as necessary.

(6) Comments:

Bechtel employees will generally be in the work area in close proximity to where maintenance is ongoing. The SSHO may downgrade personal protective equipment for this task only after approval from the PSHS.

The high-pressure lime and water sprays present a safety hazard. Liquids ejected from the fine spray nozzles reach supersonic velocities which can easily tear gloves, clothing, and cause injury if contacted with body parts. Connecting hoses and temporary test piping may burst unexpectedly due to high pressures or nozzle pluggage. This failure potential leads to potential hazards in the vicinity of the slurry injection areas.

C. Entry into the Flue Duct and Associated Equipment

(1) Description:

Onsite personnel enter the exhaust flue duct and associated equipment such as the precipitator to observe slag and corrosion buildup. Entry into these areas will be conducted as confined space entry.

(2) Confined Space Requirements to Enter the Flue Duct:

A confined space is any space having a limited means of egress, which is subject to the accumulation of toxic or flammable contaminants or has an oxygen deficient atmosphere. Confined or enclosed spaces include, but are not limited to, storage tanks, process vessels, bins, boilers, ventilation or exhaust ducts, sewers, underground utilities vault,

tunnels, pipe lines, and open top spaces more than four feet in depth such as pits, tubs, vaults, and vessels, including lime storage silos, ducts, ESP housing, chimney breachings, and mix tanks.

Requirements for entry into the CZD project flue duct (or other confined spaces in the area) will include the following:

(a) Employees shall be instructed as to the nature of the hazard, special procedures, communication requirements, protective equipment, and the required emergency/rescue responses.

(b) A Hazardous Work Permit (HWP), Figure 1, must be completed and issued by the SSHO, reviewed by the entering employee(s) and posted at the entrance to the flue duct or other confined space prior to each entry. Coordination with PENELEC and PENELEC-required permits must also be reviewed prior to entry.

(c) Whenever the flue duct or other confined space is considered to be unsafe for entry, it shall be promptly reported to the SSHO and posted with warning signs to prevent unauthorized entry.

(d) A trained attendant (watchman) shall be stationed outside the confined space and shall monitor persons working inside the area. Communications and rescue equipment shall be available at all times in the event of an emergency or if rescue should become necessary. The watchman shall not enter or attempt rescue in the confined space until help has been summoned. PENELEC's emergency rescue services will be utilized in the event a rescue is required.

(e) Communication (visual, voice, telephone, two-way radio or other communication methods) shall be maintained with all personnel inside the confined space.

(f) Monitoring for oxygen deficiency and sulfur dioxide shall be conducted inside the confined space prior to personnel entry. These measurements shall be made only with instrumentation designed and calibrated for that purpose. Monitoring results shall appear on the hazardous work permit.

HAZARDOUS WORK PERMIT (HWP)

SITE NUMBER [ ][ ][ ] – [ ][ ][ ][ ]

WORK DESCRIPTION	WORK LOCATION
	EST. START DATE
	REQUESTED BY
	REQUEST DATE

HAZARDOUS CONDITIONS	SITE SURVEYS			
	TYPE	NUMBER	DATE	BY

REQUIRED PERSONNEL PROTECTIVE CLOTHING AND EQUIPMENT

HEAD / EYES	FEET	HANDS	BODY	RESPIRATORY
SAFETY GLASSES ☐	RUBBER BOOTS ☐	COTTON GOVES ☐	COVERALLS/COTTON ☐	HALF-FACE (NEGATIVE PRESSURE)* ☐
GOGGLES ☐	PLASTIC BOOTS ☐	PLAYTEX GLOVES ☐	COVERALLS/TYVEX (REGULAR) ☐	FULL-FACE (NEGATIVE PRESSURE)* ☐
FACE SHIELD ☐	HIP WADERS ☐	RUBBER GLOVES ☐	COVERALLS/TYVEX (SPECIAL STATE TYPE) ☐	POWERED AIR PURIFYING* ☐
HARD HAT ☐	STEEL-TOE SHOES ☐	NEOPRENE GLOVES ☐		*Specify Cartridge/ Cannister Type Below*
	DISPOSABLE SHOE COVERS ☐	SURGICAL GLOVES ☐	TYPE	SUPPLIED AIR HOOD ☐
		POLYVINYL ALCOHOL GLOVES ☐	RUBBER SUIT ☐	SUPPLIED AIR FULL FACE ☐
		LEATHER GLOVES ☐	ACID SUIT ☐	SANDBLAST HOOD ☐
			RAIN SUIT ☐	SELF CONTAINED (SCBA) ☐
			MOON SUIT ☐	

SPECIAL INSTRUCTIONS

WATCHMAN	☐	"BUDDY SYSTEM" IN EFFECT	☐
ELECTRICAL LOCKOUT	☐	JOB COVERAGE BY SAFETY PROFESSIONAL	☐
PRE-ENTRY MONITORING	☐	SPECIAL TRAINING REQUIRED	☐
EMERGENCY EQUIPMENT	☐		

MISCELLANEOUS

TAPE GLOVES AND BOOTS TO COVERALLS ☐
LIFE LINE ☐
SAFETY BELT ☐

DOSIMETRY	INDV.	GROUP
TLD BADGE		
EXTREMITY TLD		
SRD 0-200 mR		
SRD (High)		
DIGITAL ALARMING DOSIMETER		

I.H. MONITORING	INDV.	GROUP

EXPIRATION DATE

APPROVALS	DATES
DSSHR	
SITE SUPERINTENDENT	

TERMINATION	DATES
DSSHR	
SITE SUPERINTENDENT	
REASON	

1 14 0997.3

Review of data indicates that no sources of flammable gases or vapors should exist inside the duct and consequently will not be monitored. Although toxic gases in addition to sulfur dioxide may exist prior to ventilation, the twelve to twenty-four hours of exhausting the duct should remove even trace amounts of these contaminants. Consequently, sulfur dioxide has been identified as the indicator contaminant, and if detected, other gases will be considered present.

(g) Ventilation shall be maintained inside the flue duct with the purpose of reducing the toxic/hazardous atmospheres to within the following limits:

- **oxygen: >19% <22%**
- **sulfur dioxide: <50 ppm** TBD H/C ?
- **hydrogen sulfide <100 ppm**
- **carbon monoxide <50 ppm**
- **nitrogen dioxide <1 ppm (STEL)**

(h) A lifeline shall be attached to each employee entering the flue duct.

(3) Personal Protective Equipment

Personal protective equipment shall be specified on the hazardous work permit. The level of protection shall be determined based on air monitoring results. As a minimum the personal protective equipment defined below shall be worn:

Minimum Equipment

- **Hooded and booted tyvek (all connecting parts should be taped)**
- **Disposable cotton or neoprene gloves**
- **Full facepiece respirator with acid gas and HEPA cartridges**
- **Hard hat**
- **Rubber or neoprene overboots**

Optional Equipment

- **Two-way radio**
- **Self-contained breathing apparatus**

Should air monitoring indicate the presence of sulfur dioxide, other airborne contaminants that have been identified below should be monitored and the appropriate personal protective equipment provided. If the additional monitoring is not conducted, the

contaminants listed below shall be considered present at toxic levels and personal protective equipment shall be upgraded to include self contained breathing apparatus (SCBA) or supplied air with an escape pack.

- **Oxygen - Less than 19.5%**
- **Sulphur dioxide - greater than 50 ppm**
- **Hydrogen sulfide - greater than 100 ppm**
- **Carbon monoxide - greater than 50 ppm**
- **Oxides of nitrogen - greater than 1 ppm (STEL)**

(4) Emergency Response

Since PENELEC personnel will also enter the flue duct at the same time as Bechtel personnel, Bechtel will utilize the PENELEC emergency rescue system.

(5) Instrumentation Required to Monitor Inside the Flue Duct

The following instrumentation shall be available onsite for monitoring the atmosphere inside the flue duct prior to personnel entry.

- **Oxygen meter**
- **Sulfur dioxide meter**
- **Personal sampling air pumps**
- **Calibration equipment**

All instrumentation shall be calibrated prior to each use and as applicable after each use (e.g., personal air sampling pumps).

(6) Optional Equipment for Monitoring Inside the Flue Duct Prior to Personnel Entry

The following equipment may be onsite; however, because sulfur dioxide will be the indicator gas, their presence onsite will not be mandatory.

- **Draegar tube equipment to detect carbon monoxide**
- **Draegar tube equipment to detect nitrogen dioxide**
- **Hydrogen sulfide monitor or draeger tube equipment to detect hydrogen sulfide**

NOTE: Toxic gases should not be present because of ventilating the duct at a rate of 38.5 ft per second over a 12- to 24-hour period. Sulfur dioxide is the logical choice of contaminants to be routinely monitored, since it is initially present, may adhere to dust particles, and be liberated upon

discontinuing the ventilation. The presence of sulfur dioxide will result in assuming the presence of other gases and require the use of the designated optional monitoring equipment to determine actual concentrations or, as a minimum, the use of self-contained breathing apparatuses.

V. TRAINING

A. Hazard Communication (HAZCOM) Training Program

A HAZCOM Training Program shall be developed and utilized for Bechtel's CZD project operations. As a minimum, the HAZCOM Program must meet the following criteria:

- Meet the site-specific and PENELEC requirements
- Maintain an inventory of all hazardous material onsite
- Maintain a site-specific labeling system (e.g., tanks, pipes, etc.)
- Maintain material safety data sheets
- Disseminate information to each employee and multiple contractor
- Ensure that procurement is aware of their responsibilities
- Maintain permanent records

The SSHO will be the HAZCOM coordinator at the CZD project site. His responsibilities shall include:

- Conduct HAZCOM training as each employee arrives onsite and assure that each employee has free access to the list of chemicals onsite and their Material Safety Data Sheets (MSDSs).
- Maintain documentation of HAZCOM training .
- Inventory all hazardous chemicals on-site or in the facility.
- Develop an alphabetical list of chemicals onsite and maintain this list in the HAZCOM Program.
- Assure that chemicals brought onsite are properly stored.

- Assure that each chemical brought onsite is properly labeled in English and not defaced. Portable containers for immediate use will not require labeling except where multiple employers are involved.

HAZCOM training topics shall include the following:

- Description and names of chemicals brought onsite.
- Discussion of MSDS information.
- Hazards from exposure to onsite chemicals.
- Symptoms of exposure to onsite chemicals.
- Location, use, and storage protocols for onsite chemicals.
- Safe practice procedure for use of the onsite chemicals.

Where multiple employers are involved, each employer shall be provided with a copy of the list of chemicals brought onsite.

B. Safety Meetings

Safety meetings shall be held at least weekly to discuss issues related to the CZD operations. These meetings are meant to reinforce overall safety among employees and to address specific issues that may be of concern. It is in this forum that changes in safety requirements are discussed. Weekly safety meeting agendas and attendees shall be documented and maintained with the site records. Because of the small number of Bechtel site personnel, it is recommended and been arranged with PENELEC for Bechtel employees to attend the PENELEC weekly safety meeting.

VI. NOISE PROTECTION AND HEARING CONSERVATION PROGRAM

Noise measurements shall be conducted by the SSHO for each work location. Noise measurements that exceed 85 dB(A) time-weighted average or 50% of the allowable dose shall result in enrolling personnel in a Hearing Conservation Program. Documentation of noise measurements shall be provided to PSHS for each affected employee.

VII. EMERGENCY RESPONSE

Bechtel will be required to adhere to all PENELEC safety and health requirements. Since PENELEC Seward Station has an Emergency Response Plan, Bechtel will be required to adhere to this plan.

As a representative of Bechtel, the senior onsite representative will have the responsibility to assure that all Bechtel site personnel are accounted for during an emergency. He, or his designee, shall assure that each Bechtel site employee is aware of the protocols related to the PENELEC Emergency Response Plan.

VIII. PROHIBITED ACTIVITIES

The following activities shall be prohibited onsite:

- Horseplay
- Speeding above the PENELEC posted speeds
- Entry into a hot duct or associated equipment
- Use of defective or unauthorized equipment
- Eating, drinking, or chewing outside of the designated area
- Flue duct entry by personnel who have not been qualified by the SSHO or PSHS
- Use of alcoholic beverages and drugs that have not been medically authorized (e.g., cocaine, heroin)

IX. ARSENIC COMPLIANCE PROGRAM

As a result of sampling studies by PENELEC, a potential health hazard from inorganic arsenic has been identified at the Seward Station. This potential can be effectively minimized by good occupational health practices, which establish control of employee exposure to inorganic arsenic. The applicability of inorganic arsenic controls for Bechtel employees who are associated with the CZD project work will be assessed by an ongoing air and swipe sampling program.

The control measures chosen by Bechtel to protect its employees have been carefully selected based on regulatory requirements, experience, and understanding of the work environment and personnel who are potentially exposed. This Arsenic Compliance Program addresses responsibilities, training, procedures, and safe practices, medical surveillance, regulated areas, engineering controls, hygiene and lunchroom facilities, air sampling, personal protective clothing and equipment, and necessary documentation of inorganic arsenic exposure and control during all Bechtel related activities at the Seward Station.

A description of the Seward Station facility and Bechtel's operations onsite is provided in Section II of this document.

A. Regulatory Requirements for Control of Inorganic Arsenic

Bechtel will adhere to all applicable Occupational Safety and Health Administration (OSHA) standards including, but not limited to, 29 CFR 1910.1018, "Inorganic Arsenic" 29 CFR 1910.134, "Respiratory Protection."

B. Arsenic Regulated Area

There is presently one regulated area for inorganic arsenic at the PENELEC Seward Station Bechtel CZD operation. This regulated area is the interior of the flue gas duct which Bechtel employees enter to determine buildup of slag flyash and the extent of corrosion or damage that may be related to the lime process. Bechtel employees enter the duct only on an infrequent basis, and only during a PENELEC shut-down; Bechtel employees are generally inside the duct for no more than one hour. This also applies to any other duct or ESP area accesses or ports used during test inspections of interior components.

As an inorganic arsenic-regulated area, the number of personnel entering the duct will be controlled. Except in an emergency, no more than two individuals at any time will be allowed inside the duct in order to reduce the number of personnel subjected to inorganic arsenic.

C. Responsibilities for Controlling Inorganic Arsenic Exposure

Project Manager (PM)

The PM has overall responsibility for safety and health of Bechtel employees working on the CZD project. The PM will assure that an adequate Safety and Health Program is developed and that resources are available to implement the program.

Project Safety and Health Supervisor (PSHS)

The PSHS shall develop the safety and health requirements, including arsenic compliance, that are necessary for conducting field activities related to the CZD project. The PSHS will review the results of the sample analysis, resolve safety and health issues, audit safety and health field operations, train and supervise the SSHO and consult with the occupational physician. Changes to this plan shall have the concurrence of the PSHS.

Senior Site Representative (SSR)

The SSR shall have responsibility for enforcing all safety and health requirements onsite for the CZD project. The

SSR shall assure that no unsafe activities take place onsite.

Site Safety and Health Officer (SSHO)

The SSHO shall be trained by the PSHS to properly function as the SSHO. As the SSHO, he shall implement all safety and health requirements onsite. The SSHO will report on safety and health matters to the PSHS.

D. Medical Surveillance

Personnel who have access to the interior of the CZD flue duct shall be provided a medical examination prior to entering the duct and periodically thereafter based on the following criteria:

- Individuals 45 years of age or older shall be provided an examination semi-annually.
- Individuals under 45 years of age shall be provided an examination annually.
- Individuals shall be provided an examination upon termination or relocation from the site.

Baseline Health Assessment Criteria defined in the Safety and Health Services Procedure Manual, Volume II, HSP 2.1.80, "Medical Surveillance" shall be adhered to for employees entering the CZD flue duct. Special tests shall include sputum cytology, urinary arsenic and blood lead.

Bioassays for urinary arsenic and blood lead shall be conducted on employees routinely assigned to the site and who periodically enter the duct. These tests shall be conducted on a quarterly basis by Meditect Center for Occupational Safety and Health located in Pittsburgh, PA.

The SSHO will insure that no individual who has failed to pass the medical examination or who exhibits a body burden of arsenic or lead (bioassays determined on a quarterly basis) shall be allowed to enter the flue duct.

E. Training

All Bechtel personnel involved in field activities at the CZD site will be provided training related to inorganic arsenic prior to entry into a regulated area. This training shall be developed by the PSHS and be conducted onsite by the SSHO. The training shall include, but not be limited to the following.

- Media and concentration of inorganic arsenic (e.g, flue dust)
- Location of arsenic regulated areas

- Hazards of exposure to inorganic arsenic
- Mechanisms and routes of exposure
- Safe work practices and procedures related to control of inorganic arsenic
- Prohibited activities
- Personal protective equipment and their use for entry into the inorganic arsenic regulated areas
- Medical surveillance requirements

F. Engineering Controls

Flue duct gases shall be discontinued through the duct while employees are inside the duct. Since the interior of the duct is a confined space, special requirements have been defined in Section IV of this plan. Ventilation through the duct is required prior to entry by Bechtel personnel. Ventilation inside the duct removes combustion gases and generally aerates respirable fine particulate dust that contains inorganic arsenic that has accumulated inside the duct. Whenever practical, the dust buildup inside the duct shall be vacuumed prior to entry by Bechtel personnel. This practice will reduce the levels of arsenic and other respirable dust such as residual lime to which individuals are subjected.

G. Personal Protective Clothing and Equipment (PPE)

PPE for entry into the flue duct has been identified in Section IV of this plan. No Bechtel employee shall enter the flue duct without donning the minimum PPE required.

Respiratory protection devices shall not be shared by individuals prior to cleaning and sanitizing the respirator. It is recommended that respirators be individually assigned. Each individual assigned a respirator should be required to clean and sanitize the respirator at the end of each days use. Respirators shall be sealed in a plastic bag and be stored and maintained in a clean and sanitary location. Respirators shall not be stored in the work area. No individual shall wear a respirator unless he has been medically qualified and properly fit-tested for the specific respirator he is to use. Each individual assigned a respirator shall be properly trained by the SSHO in the proper use, limitations, and care of the respirator. Criteria defined in the Safety and Health Services Procedures Manual, Volume II, HSP 2.1.65, "Respiratory Protection" shall be complied with by the CZD project. Respiratory protective

equipment criteria for entry into the flue duct shall meet the following criteria.

1. Concentrations of inorganic arsenic greater than the action level of 5 micrograms per cubic meter of air ($\mu g/m^3$) but less than or equal to 500 $\mu g/m^3$ shall require a minimum of a full facepiece negative pressure respirator with a combination of acid gas and high efficiency particulate air (HEPA) filter. Respirator and filters shall be NIOSH/MSHA approved.

2. Concentrations of inorganic arsenic greater than 500 $\mu g/m^3$ but less than or equal to 10,000 $\mu g/m^3$ shall require, as a minimum, the use of one of the following respirator devices:

   - **Full facepiece supplied air respirator operated in a positive pressure mode**
     or
   - **Self-contained breathing apparatus**

   At the present time, the full facepiece negative pressure respirator is considered adequate for entry into the flue duct. This respirator will be upgraded by the SSHO as stated in this section and in Section IV if air monitoring results indicate the need to do so.

   Personal protective clothing to be used inside the flue duct for protection against inorganic arsenic shall be a disposable hooded and bootied tyvek, disposable gloves, and neoprene boots. All connecting parts shall be taped prior to the individual's entry into the duct. Upon exiting the duct, each individual shall remove his disposable clothing and place them inside a plastic bag that is located at the exit point outside the duct. The bag shall be sealed, labeled and provide to PENELEC for disposal. Neoprene boots shall be decontaminated with soap and water and retained for future use.

H. Inorganic Arsenic Monitoring

Inorganic arsenic sampling shall be conducted by the SSHO at the CZD project site. This sampling will be conducted for the purpose of defining areas to be regulated, areas above the action level, adequacy of personal protective clothing and equipment, and the effectiveness of the housekeeping program.

Area air samples shall be collected initially and semi-annually thereafter in each area of the site where Bechtel employees operate and concentrations of inorganic arsenic is not expected to exceed OSHA's permissible exposure limit (PEL) of 10 $\mu g/m^3$, however, may exceed the action level.

In addition, personal air samples shall be collected on a quarterly basis as a verification of negative exposure.

Personal air samples shall be collected each time Bechtel personnel enter the flue duct up to three consecutive entries. Thereafter, personal air samples shall be collected once per quarter as verification that the identified level of protection is still adequate.

Air sample results shall be analyzed by an American Industrial Hygiene Association (AIHA) accredited laboratory capable of performing inorganic arsenic by NIOSH Method 7901. Samples shall be collected at approximately 2 liter of air per minute for a minimum of 7 hours on 0.8 micron pore size mixed cellulose ester fiber (MCEF) filters. For air sampling inside the flue duct, the filter cassette shall be removed upon exiting the duct. It is anticipated that this sample may only be 60 minutes or less in duration. The PSHS shall review all data and provide guidance to the SSHO. All air sampling pumps shall be calibrated prior to and after use.

Three swipe samples shall be collected quarterly inside the approved lunch room (office trailer) and analyzed for inorganic arsenic and lead. The swipe samples shall be collected on 3-inch diameter 0.45 micron filters using distilled water for wetting. The samples will confirm the effectiveness of the housekeeping program. Any concentrations of inorganic arsenic or lead detected above 1 μg and 5 μg, respectively, on the filter shall be grounds for immediately strengthening the housekeeping program.

I. Shower and Change Rooms

Street clothing will not be permitted inside an arsenic regulated area. All personnel who must enter the flue duct shall utilize the PENELEC Supervisor's shower and change room facilities located on the third floor of the plant. Prior to entering the flue duct, each individual shall change out of street clothing and don work clothing. Prior to leaving, the Seward Station site, each individual who entered the flue duct shall be required to shower prior to donning his street clothing. Work clothing shall be laundered after each flue duct entry by an approved

laundry facility capable of receiving arsenic-contaminated clothing.

J. Lunch Room

No individual shall be allowed to eat, drink beverages, chew tobacco or gum, or smoke in any part of the Seward Station plant except in those areas that have been designated by Bechtel or PENELEC as approved lunch rooms. The Bechtel approved lunch room shall be the Bechtel Office Trailer. This trailer shall be maintained in a clean and sanitary fashion. The trailer shall be wet mopped at least three times a week, or more often as necessary.

Each individual shall be required to wash his hands and face with soap and water prior to eating, drinking, chewing, or smoking after performing any task onsite. The PENELEC Supervisor's shower and change room is available to Bechtel personnel for this purpose.

K. Recordkeeping

The following safety and health records shall be maintained by the SSHO onsite with the project files.

1. Safety meeting reports
2. OSHA Form 200
3. Instrument calibration records
4. Equipment inspection records
5. Field logs
6. Incident reports
7. General communications
8. Safety and health plan
9. Injury and illness reports.

Records that shall be maintained by the PSHS in Oak Ridge shall include the following records:

1. Personal exposure records
2. Medical records
3. Swipe sample results
4. General area air sampling results
5. S&H audit reports

At the close of the project the PSHS shall forward to Health Services in Oak Ridge all medical examination, bioassay and personal exposure records. Swipe sample results and general areas air sampling result shall be returned to the project files.

Appendix B

Cost Data

PENELEC
SEWARD STATION

SUMMARY

CASE I

PLANT	PLANT DESCRIPTION	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
1	ATOMIZING AIR COMPRESSOR	$339,010.00	$0.00	0.00	$0.00	$253,610.00	$1,160.00	$13,080.00	$606,860.00
2	LIME SLURRY PREPARATION AREA	$52,740.00	$0.00	1564.00	$62,250.00	$0.00	$1,180.00	$300.00	$116,470.00
3	LIME FEED AREA	$90,030.00	$1,020.00	2450.00	$97,350.00	$0.00	$1,400.00	$70.00	$189,870.00
4	LIME INJECTION AREA	$108,740.00	$0.00	1090.00	$43,380.00	$42,340.00	$1,080.00	$470.00	$196,010.00
5	DUCT	$466,930.00	$0.00	3533.00	$140,610.00	$376,290.00	$1,330.00	$10.00	$985,170.00
7	WINTERIZATION	$0.00	$0.00	0.00	$0.00	$121,160.00	$0.00	$0.00	$121,160.00
8	INSTRUMENTATION	$312,880.00	$0.00	68.00	$2,710.00	$30,090.00	$10,880.00	$15,410.00	$371,970.00
9	INTERCONNECT WIRING	$39,210.00	$0.00	791.00	$31,640.00	$0.00	$1,590.00	$970.00	$73,410.00
10	INTERCONNECT PIPING AND MECHANICAL	$22,820.00	$0.00	1043.00	$41,510.00	$0.00	$860.00	$210.00	$65,400.00
TOTAL		$1,432,360.00	$1,020.00	10539.00	$419,450.00	$823,490.00	$19,480.00	$30,520.00	$2,726,320.00

PENELEC
SEWARD STATION

PLANT 1
ATOMIZING AIR COMPRESSOR

CASE I

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
K-101A	AIR COMPRESSOR, ATLAS-COPCO, ZR-5, 500 HP, 125 PSIG, 2000CFM	M-100	$106,087.50		0.00	$0.00	$79,363.00	INC	$6,365.00	$191,815.50
K-101B	AIR COMPRESSOR, ATLAS-COPCO, ZR-5, 500 HP, 125 PSIG, 2000CFM	M-100	$106,087.50		0.00	$0.00	$79,363.00	INC	$6,365.00	$191,815.50
T-105	AIR RECEIVER, 5'-6" DIAMETER X 18'-0" LONG , HANSON MANUFACTURING CO. LOS ANGELES	M-100	$53,388.38		0.00	$0.00	$39,939.31	$1,097.00	$305.20	$94,729.89
					0.00	$0.00				$0.00
COST CODE K	**MAJOR EQUIPMENT TOTALS**		$265,563.38	$0.00	0.00	$0.00	$198,666.32	$1,097.00	$13,035.20	$478,360.90
TI-01	TEMPERATURE INDICATOR, AIR TO FIRST STAGE ATOMIZING HEADER, 200 DEG F. ASHCROFT 50-E1-60E	J-100	$133.00		0.00	$0.00	$99.50	INC	$9.31	$241.81
PI-12	PRESSURE INDICATOR, ATOMIZING AIR RECEIVER, GLYCERINE FILLED , 0-160 PSIG ASHCROFT MODEL 45-1009-AL-04L,	J-100	$170.00		0.00	$0.00	$127.18	INC	$11.90	$309.08
	MASS FLOW INDICATOR	J-105	$3,132.25		0.00	$0.00	$2,343.20	$62.25		$5,537.70
	AC CURRENT TRANSFORMER	P-005	$790.00		0.00	$0.00	$590.99	INC	$4.01	$1,385.00
PI-01A	PRESSURE INDICATOR, ATOMIZING AIR PRESSURE , GLYCERINE FILLED , 0-160 PSIG ASHCROFT MODEL 25-1009-AWL-C2B	J-100	$170.00		0.00	$0.00	$127.18	INC	$11.90	$309.08
COST CODE J	**INSTRUMENTATION TOTALS**		$4,395.25	$0.00	0.00	$0.00	$3,288.04	$62.25	$37.12	$7,782.66
								$0.00		
V-530 V-531 V-534	BALL VALVE, 4 INCH-STEEL BODY-150 LB FLANGE - FULL		S/C		0.00	$0.00	INC			$0.00
V-544 V-545	CHECK VALVE, SWING TYPE - 4 INCH-STEEL BODY, BRASS		S/C		0.00	$0.00	INC			$0.00
V-540 V-541	CHECK VALVE, SWING TYPE - 2 1/2 INCH-STEEL BODY,		S/C		0.00	$0.00	INC			$0.00
V-501 V-502 V-503 V-518	GATE VALVE, STEEL BODY 4 INCH-150 LB FLANGES		S/C		0.00	$0.00	INC			$0.00
V-504 V-505 V-506 V-507	GATE VALVE,STEEL BODY -2 1/2 INCH-150 LB FLANGES		S/C		0.00	$0.00	INC			$0.00
V-516 V-509 V-510	BALL VALVE, 1/2 " NPT - BRASS BODY, S/S BALL - FULL		S/C		0.00	$0.00	INC			$0.00

PENELEC
SEWARD STATION

PLANT 1
ATOMIZING AIR COMPRESSOR

CASE I

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
V-514 V-516 V-532										
V-533	BALL VALVE, 1"NPT-BRASS BODY, S/S BALL-FULL PORTED		S/C		0.00	$0.00	INC			$0.00
V-552	PRESSURE RELIEF VALVE, KUNKLE MFG SPRING TYPE 150 LB SET POINT,4 INCH INLET FLANGE		$99.80		0.00	$0.00	$74.66	INC	$5.98	$180.44
COST CODE L	PIPING TOTAL		$99.80	$0.00	0.00	$0.00	$74.66	$0.00	$5.98	$180.44
	MCC,4160V				0.00	$0.00				$0.00
	SWITCHGEAR, CAM CO.	E-1	$67,725.00		0.00	$0.00	$50,664.40			$118,389.40
	CIRCUIT BREAKER, WES CO.	E-3	$1,230.00		0.00	$0.00	$920.15			$2,150.15
COST CODE P	ELECTRICAL TOTAL		$68,955.00	$0.00	0.00	$0.00	$51,584.55	$0.00	$0.00	$120,539.55
					0.00					$0.00
			$0.00		0.00	$0.00	$0.00			$0.00
			$0.00		0.00	$0.00	$0.00			$0.00
COST CODE S	SITE WORK TOTAL		$0.00	$0.00	0.00	$0.00	$0.00	$0.00	$0.00	$0.00
					0.00	$0.00				$0.00
					0.00	$0.00	$0.00			$0.00
					0.00	$0.00	$0.00			$0.00
COST CODE R	BUILDING TOTAL		$0.00	$0.00	0.00	$0.00	$0.00	$0.00	$0.00	$0.00
					0.00	$0.00				$0.00
					0.00	$0.00				$0.00
					0.00	$0.00				$0.00
COST CODE Q	CONCRETE WORK TOTAL		$0.00	$0.00	0.00	$0.00	$0.00	$0.00	$0.00	$0.00

PENELEC
SEWARD STATION

PLANT 1
ATOMIZING AIR COMPRESSOR

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
					0	$0.00				$0.00
					0	$0.00				$0.00
					0	$0.00				$0.00
					0	$0.00				$0.00
COST CODE N	INSULATION & FIREPROOFING TOTAL		$0.00	$0.00	0	$0.00	$0.00	$0.00	$0.00	$0.00
	PLANT 1 TOTAL		$339,010.00	$0.00	0.00	$0.00	$253,610.00	$1,160.00	$13,080.00	$606,860.00

PENELEC
SEWARD STATION

PLANT 2
LIME SLURRY PREP AREA

CASE I

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
P-103A	LIME SLURRY SUMP PUMP-LAWRRENCE PUMP CO.50 HP.	P-025	$13,125.00		0.00	$0.00		$337.50		$13,462.50
P-103B	LIME SLURRY SUMP PUMP-LAWRRENCE PUMP CO.50 HP.	P-025	$13,125.00		0.00	$0.00		$337.50		$13,462.50
	ADAPT SUMP FOUNDATIONS	MMT-137	$37.00		160.00	$6,368.00				$6,405.00
	REMOVE OLD PUMPS,CLEAN SUMP AND SURVEY FOR NEW	MMT-138	$2,000.00		208.00	$8,278.40				$10,278.40
COST CODE G	**PUMP TOTALS**		**$28,287.00**	**$0.00**	**368.00**	**$14,646.40**	**$0.00**	**$675.00**	**$0.00**	**$43,608.40**

Y-1	AGITATOR- PTERO MODEL- 5 HP-68 RPM-1800 RPM 3 PHASE 60 HERTZ,230/460 VOLTS	EXISTING			0.00	$0.00				$0.00
T-1	HYDRATED LIME STORAGE SILO-SPROUT-WALDRON CO.-15 FT DIA, 3000 CUBIC FEET, 60 DEGREE SLOPING HOPPER 50 TON CAPACITY	EXISTING			0.00	$0.00				$0.00
T-1A	BIN VENT FILTER-FLEX KLEEN MODEL NO.A58BV-16- THIS UNIT IS EXISTING	EXISTING			0.00	$0.00				$0.00
Y-3	EXISTING STAR VALVE	EXISTING			0.00	$0.00				$0.00
M-1	2/1 CHAIN REDUCTION AND A GEAR REDUCER WITH A VARIABLE SPEED DC DRIVE MOTOR		$1,358.91		4.00	$159.20			$12.05	$1,528.16
	CHAIN	F-032	$241.41		0.00	$0.00		$2.60	$13.02	$257.03
M-2	SCREW CONVEYOR DRIVE MOTOR-EXISTING	EXISTING			0.00	$0.00				$0.00
Y-2	SCREW CONVEYOR-EXISTING	EXISTING			0.00	$0.00				$0.00
	REPLACE ROTARY LOCK HOPPER DRIVE	MMT-138	$44.00		80.00	$3,184.00				$3,228.00
COST CODE T	**MAJOR EQUIPMENT TOTALS**		**$1,642.32**	**$0.00**	**84.00**	**$3,343.20**	**$0.00**	**$2.60**	**$25.07**	**$5,013.19**

DX-01 DE-01 DIT-01	DENSITY GAUGE / TRANSMITTER, LIME SLURRY TRANSFER LINE	J-107	$4,609.14		0.00	$0.00		$76.14		$4,685.28
LE-23	LIME PIT - LEVEL INDICATOR,	J-118B	$2,063.00		0.00	$0.00		$47.20		$2,110.20

PENELEC
SEWARD STATION

PLANT 2
LIME SLURRY PREP AREA

CASE I

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
LT-23										
LE-02	LIME PIT - HIGH-HIGH LEVEL INDICATOR,	J-118B	$563.00		0.00	$0.00		$30.53		$593.53
LCV-23	PROCESS WATER CONTROL VALVE , MAKE-UP WATER TO LIME SLURRY PIT, FISHER MODEL 546, 150 PSIG ,GLOBE, 2 1/2 IN BODY / 1 IN PORT, WITH DIAPHRAGM ACTUATOR	J-100	$3,082.60		0.00	$159.20			$215.80	$3,457.80
PI-01 PI-20	PRESSURE INDICATOR, ATOMIZING AIR PRESSURE , GLYCERINE FILLED ASHCROFT MODEL 45-1279ASL-04L 0/160 PSI WITH 50-101SB-04T-CG GLYCERINE FILLED DIAPHRAGM ISOLATOR	J-100	$342.00		0.00	$0.00				$342.00
PIC-20	PRESSURE INDICATING CONTROLLER-		$2,289.71		0.00	$0.00		$41.40		$2,331.11
	INSTALL LEVEL CONTROLLER	MMT-135	$50.00		16.00	$0.00				$50.00
COST CODE J	**INSTRUMENTATION TOTAL**		**$12,999.65**	**$0.00**	**16.00**	**$159.20**	**$0.00**	**$195.27**	**$215.80**	**$13,569.92**

HCV-10A	READY/STRANDBY VALVE,4 WAY PLUG VALVE WITH BETTIS 5000 SR 4 ACTUATOR WITH WESTLOCK ACCUTRACK 2004 POSITION INDICATOR AND NEMA4 SOLENOID XOMOX MODEL 047-WCB-316TEF		$2,762.67		0.00	$0.00		$404.22		$3,166.89
HCV-10B	READY/STRANDBY VALVE,2 WAY PLUG VALVE WITH BETTIS 5000 SR 4 ACTUATOR WITH WESTLOCK ACCUTRACK 2004 POSITION INDICATOR AND NEMA4 SOLENOID XOMOX MODEL 067-WCB-316TEF		$2,762.67		0.00	$0.00		$404.22		$3,166.89
PV-20	PRESSURE CONTROL VALVE, READY STANDBYRECIRCULATION. MONYO PINCH VALVE, 2" 150 LB FLANGED		$2,080.00		0.00	$0.00		$201.80		$2,281.80
V-1A V-1B V-1C	GATE VALVE. 1/2" NPT MOUNTING , BRASS BODY 150 LB SERVICE		$45.00		0.00	$0.00				$45.00
V-3 V-4 V-50 V-51	PLUG VALVE, 150 LB SERVICE, 2 INCH 150 LB FLANGES, STEEL BODY, STAINLESS STEEL PLUG		$1,000.00		0.00	$0.00				$1,000.00
V-2 V-5	BALL VALVE, 1 INCH NPT PORTS, BRASS BODY STAINLESS STEEL BALL		$30.00		0.00	$0.00				$30.00

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
V-8	PLUG VALVE, 150 LB SERVICE, 2 1/2 INCH 150 LB FLANGES, STAINLESS STEEL BODY, STAINLESS STEEL PLUG		$300.00		0.00	$0.00				$300.00
	SOLELENOID VALVE	F-078	$68.50			$0.00		$16.75		$85.25
	FABRICATE AND INSTALL PIPING	MMT-167	$31.00		57.00	$2,268.60				$2,299.60
COST CODE L	**PIPING TOTAL**		**$3,554.50**	**$0.00**	**57.00**	**$2,268.60**	**$0.00**	**$218.55**	**$0.00**	**$12,375.43**
	CABLE	F-053	$300.00		0.00	$0.00		$78.20	$22.70	$400.90
	CONTACT BLOCKS	F-070	$86.71		0.00	$0.00			$5.20	$91.91
	TERMINAL BLOCKS	F-074	$309.72		0.00	$0.00			$17.33	$327.05
	MUFFLERS	F-071	$14.04		0.00	$0.00		$5.75		$19.79
	RELAYS AND SOCKETS	F-068	$77.61		0.00	$0.00				$77.61
	TERMINAL BLOCKS	F-064	$78.00		0.00	$0.00			$4.68	$82.68
	RELAY AND SOCKET	F-057	$25.72		0.00	$0.00			$1.58	$27.30
	WIRE	F-056	$141.15		0.00	$0.00			$8.65	$149.80
	REPLACE MOTOR STARTERS AND INSTALL NEW CABLING	MMT-139	$4,149.00		146.00	$5,810.80				$9,959.80
	INSTALL WIRING	MMT-166	$28.00		73.00	$2,905.40				$2,933.40
	INSTALL MINI-90	MMT-169	$145.00		191.00	$7,601.80				$7,746.80
	INSTALL WIRING FROM MCC TO MINI-9	MMT-183			410.00	$16,318.00				$16,318.00
	INSTALL WIRING FROM LIME SILO CONTROL PANEL TO MINI-90	MMT-184	$26.00		74.00	$2,945.20				$2,971.20
	MEASURE DISTANCE FROM LIME PIT TO CONTROL ROOM FOR FIBEROPTIC CABLE	MMT-130	$56.00		68.00	$2,706.40				$2,762.40
	MOUNT TWO BAILEY CONTROLLERS	MMT-152	$690.00		32.00	$1,273.60				$1,963.60
	INSTALL LEVEL INDICATOR	MMT-159	$125.00		45.00	$1,791.00				$1,916.00
		MMT-182				$0.00				$0.00
COST CODE P	**ELECTRICAL TOTAL**		**$6,251.95**	**$0.00**	**1039.00**	**$41,352.20**	**$0.00**	**$83.95**	**$60.14**	**$47,748.24**

PENELEC
SEWARD STATION

PLANT 2
LIME SLURRY PREP AREA

CASE I

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
TOTAL PLANT 2			$52,740.00	$0.00	1564.00	$62,250.00	$0.00	$1,180.00	$300.00	$116,470.00

PENELEC
SEWARD STATION

PLANT 3
LIME FEED AREA

CASE I

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
T-103	GRITS WASHING TANK, 7'-6" DIAMETER X 7'-6" HIGH, CARBON STEEL				0.00	$0.00				$0.00
T-104	GRITS WASHING TANK, 7'-6" DIAMETER X 7'-6" HIGH, CARBON STEEL				0.00	$0.00				$0.00
T-101	DEGRITTED LIME STORAGE/FEED TANK, 12' DIAMETER X 12' HIGH, CARBON STEEL				0.00	$0.00				$0.00
T-102	DEGRITTED LIME STORAGE/FEED TANK, 12' DIAMETER X 12' HIGH, CARBON STEEL				0.00	$0.00				$0.00
COST CODE D	TANKS TOTAL		$0.00	$0.00	0.00	$0.00	$0.00	$0.00	$0.00	$0.00

Y-103	GRITS WASHING TANK AGITATOR, CHEMINEER, 1 1/2 HP	M-003	$2,701.13		50.00	$1,990.00		$98.88		$4,790.01
Y-104	GRITS WASHING TANK AGITATOR, CHEMINEER , 1 1/2 HP	M-003	$2,701.13		50.00	$1,990.00		$98.88		$4,790.01
VS-101	VIBRATING SCREEN, 48" DIA. 316SS, 3BHP				0.00	$0.00				$0.00
Y-101	DEGRITTED LIME STORAGE/FEED TANK AGITATOR, CHEMINEER, 37 RPM, 5 BHP	M-003	$4,395.87		50.00	$1,990.00		$90.63		$6,476.50
Y-102	DEGRITTED LIME STORAGE/FEED TANK AGITATOR, CHEMINEER, 37 RPM, 5 BHP	M-003	$4,395.87		50.00	$1,990.00		$90.63		$6,476.50
COST CODE T	SPECIAL EQUIPMENT TOTAL		$14,194.00	$0.00	200.00	$7,960.00	$0.00	$378.02	$0.00	$22,533.02

P-102A	LIME SLURRY FEED PUMP, LAWRENCE MODEL	P-025	$22,183.50		0.00	$0.00		$337.50		$22,521.00
P-102B	LIME SLURRY FEED PUMP, LAWRENCE MODEL	P-025	$22,183.50		0.00	$0.00		$337.50		$22,521.00
	INSTALL PUMPS AND PIPING	MMT-165	$81.00		334.00	$13,293.20				$13,374.20
COST CODE G	PUMPS & DRIVERS TOTAL		$44,448.00	$0.00	334.00	$13,293.20	$0.00	$675.00	$0.00	$58,416.20

PI-05	PRESSURE INDICATOR, LIME TRANSFER PUMP RECIRCULATION LINE,GLYCERINE FILLED, 0-300 PSIG ASHCROFT MODEL 45-1009-AL-04L DIAPHRAGM SEAL 1/2-100-22-04T	J-100	$222.00		4.00	$159.20				$381.20
PI-28	PRESSURE INDICATOR, LIME TRANSFER PUMP RECIRCULATION LINE,GLYCERINE FILLED, 0-300 PSIG ASHCROFT MODEL 45-1009-AL-04L DIAPHRAGM SEAL 1/2-100-22-04T	J-101	$222.00		4.00	$159.20				$381.20
PI-17A	PRESSURE INDICATOR, LIME FEED, FISHER MODEL 4195 BE, 0-160 PSIG , 316 SS	J-100	$149.00		4.00	$159.20				$308.20

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
TI-25A TI-25B	TEMPERATURE INDICATOR, ASHCROFT 50-E1-60E,LIME SLURRY FEED TANK	J-100	$133.00		8.00	$318.40				$451.40
PI-25	PRESSURE INDICATOR, ATOMIZING AIR RECEIVER, 0-200PSIG GLYCERINE FILLED ASHCROFT MODEL 45-1009-AL-04L,	J-100	$262.00		4.00	$159.20				$421.20
FCV-102A FCV-102B	FLOW CONTROL VALVE, KATES MODEL DB-111T-DM-LIME SLURRY FEED PUMP, EXPELLER FEED WATER	J-115	$2,266.52		0.00	$0.00				$2,266.52
LE-25A LE-25B	LEVEL PROBE, LIME SLURRY FEED TANK, DREXELBROOK	J-118B	$5,055.67		0.00	$0.00		$61.69		$5,117.36
LT-25A LT-25B	LEVEL TRANSMITTER, LIME SLURRY FEED TANK, DREXELBROOK	INC ABOVE	INC ABOVE		0.00	$0.00		INC ABOVE	INC ABOVE	$0.00
LC-25	LEVEL CONTROLLER, LIME SLURRY FEED TANKS	INC ABOVE	INC ABOVE		0.00	$0.00		INC ABOVE	INC ABOVE	$0.00
	INSTALL LEVEL SENSORS IN LIME FEED TANKS	MMT-144	$220.00		480.00	$19,104.00				$19,324.00
	FLOW INDICATOR	P-004	$1,095.00	$0.00	0.00	$0.00				$1,095.00
COST CODE *J*	**INSTRUMENTATION TOTAL**		$9,625.19	$0.00	484.00	$19,263.20	$0.00	$61.69	$0.00	$29,746.08

V-32 V-33	CHECK VALVE, BALL TYPE- 1/2 NPT PORTS, STEEL BODY, STAINLESS STEEL CHECK BALL	LOT			0.00	$0.00				$0.00
V-34 V-35 V-35 V-18 V-15 V-22 V-12	BALL VALVE, 1/2 NPT PORTS. BRASS BODY, STAINLESS STEEL BALL	LOT				$0.00				$0.00
V-7	PLUG VALVE, 150 LB BODY, 2 INCH 150 LB FLANGES, STEEL BODY & PLUG	LOT			0.00	$0.00				$0.00
V-20 V-13 V-28 V-21 V-14 V-24 V-16 V-17 V-25 V-23 V-19 V-26 V-27	PLUG VALVE, 1 INCH NPT MOUNTING, STEEL BODY & PLUG	LOT			0.00	$0.00				$0.00
HS-25	HAND SWITCH, LEVEL CONTROLLR, ALLEN-BRADLEY WITH LOGIC REED BLOCK 800T-H2A SWITCH WITH 800T-XA2R & 800T-XA4R CONTACT BLOCKS		$75.00		80.00	$3,184.00				$3,259.00

PENELEC
SEWARD STATION

PLANT 3
LIME FEED AREA

CASE I

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
V-10 V-11	GATE VALVE, 1 1/2 INCH SOCKET WELD , STEEL BODY, 150 LB SERVICE	EST			0.00	$0.00				$0.00
LV-25	CONTROL VALVE, ROBINS & MEYERS RKL PINCH VALVE 2 1/2 INCH 150 LB FLANGE MOUNTING	J-101	$2,080.00		0.00	$0.00		$201.80		$2,281.80
PCV-25					0.00	$0.00				$0.00
SV-25					0.00	$0.00				$0.00
LY-25					0.00	$0.00				$0.00
V-8	GATE VALVE, 1" BODY, SOCKET WELD , STEEL BODY	EST			0.00	$0.00				$0.00
V-9	GATE VALVE, 1/2" BODY, SOCKET WELD , STEEL BODY	EST			0.00	$0.00				$0.00
V-29 V-30 V-31	BALL VALVE, 1/2 INCH NPT MOUNTING, BRASS BODY,STAINLESS STEEL BALL	EST			0.00	$0.00				$0.00
	SPRAY NOZZLES	F-063	$127.38		0.00	$0.00				$127.38
	HOSE	F-036	$242.40		0.00	$0.00				$242.40
	CLAMPS	F-037	$232.16		0.00	$0.00				$232.16
	ADAPTER	F-036	$88.55		0.00	$0.00				$88.55
	ADAPTER	F-038	$57.60		0.00	$0.00				$57.60
	HOSE AND CLAMP	F-024	$51.56		0.00	$0.00				$51.56
	HOSE AND FITTINGS	F-026	$638.85		0.00	$0.00				$638.85
	CLAMPS	F-028	$49.60		0.00	$0.00				$49.60
	FABRICATE AND INSTALL TWO PIPE SPOOLS	MMT-126	$115.00		164.00	$6,527.20				$6,642.20
	INSTALL AIR LINE	MMT-151	$29.00		15.00	$597.00				$626.00
	FAB AND INSTALL PIPING FROM VIBRATING SCREEN TO TANKS	MMT-160	$7.00		80.00	$3,184.00				$3,191.00
	INSTALL PUMPS AND PIPING	MMT-165	$81.00		334.00	$13,293.20				$13,374.20
COST CODE L	PIPING TOTAL		$3,875.10	$0.00	673.00	$26,785.40	$0.00	$201.80	$0.00	$30,862.30
	FOUNDATIONS R&L CONSTRUCTION	F-069		$1,022.13	300.00	$11,940.00				$12,962.13
COST CODE Q	CONCTETE TOTAL		$0.00	$1,022.13	300.00	$11,940.00	$0.00	$0.00	$0.00	$12,962.13
	INSTALL ELECTRICAL FEEDER	MMT-166	$593.00		406.00	$16,158.80				$16,751.80

PENELEC
SEWARD STATION

PLANT 3
LIME FEED AREA

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
	STARTERS	F-027	$7,232.15		0.00	$0.00				$7,232.15
	CIRCUIT BREAKER	F-030	$1,150.00		0.00	$0.00				$1,150.00
	STARTERS FOR P-102A & P-102B	F-027	$7,763.22		0.00	$0.00		$83.26		$7,846.48
	CIRCUIT BREAKER FOR P-102A & B	F-030	$1,150.00		0.00	$0.00			$69.00	$1,219.00
	CHECKOUT INTERLOCK	MMT-145			49.00	$1,950.20				$1,950.20
COST CODE P	ELECTRICAL TOTAL		$17,898.37	$0.00	455.00	$18,109.00	$0.00	$83.26	$69.00	$36,148.63
	TOTAL		$90,030.00	$1,020.00	2450.00	$97,350.00	$0.00	$1,400.00	$70.00	$189,870.00

PENELEC
SEWARD STATION

PLANT 4
LIME INJECTION AREA

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
P-104	WATER BOOSTER PUMP, GOULD	EST			0.00	$0.00				$0.00
COST CODE G	PUMPS AND DRIVERS		$0.00	$0.00	0.00	$0.00	$0.00	$0.00	$0.00	$0.00
	NOZZLES	N-002	$25,370.00		300.00	$11,940.00		$170.00		$37,480.00
COST CODE T	SPECIAL EQUIPMENT TOTAL		$25,370.00	$0.00	300.00	$11,940.00	$0.00	$170.00	$0.00	$37,480.00
PI-17A PI-17B PI-29 PI-34 PI-11 PI-19	PRESSURE INDICATOR, GLYCERINE FILLED, 0-200 PSI ASHCROFT MODEL 45 - 1009 - AL - 04L, DIAPHRAGM SEAL 1/2 - 100 - 22 - 04T	J-100	$870.00		0.00	$0.00	S/C	$75.00		$945.00
FIT-20	FLOW INDICATING TRANSMITTER, 0-150 GPM ,150 PSIG BODY , 4-20 MA., 2" FLANGES, STEEL BODY	J-102	$1,620.00		164.00	$6,527.20		$45.00		$8,192.20
PIT-10	PRESSURE INDICTING TRANSMITTER, LIME SLURRY DISTRIBUTION HEADER PRESSURE, FISHER MODEL 1151GP, 0-160 PSIG RANGE, DIAPHRAGM TYPE	J-100	$1,624.00		28.00	$1,114.40				$2,738.40
TI-01	TEMPERATURE INDICATOR, AIR TO FIRST STAGE ATOMIZING HEADER, ASHCROFT 50-E1-60E	J-100	$133.00		0.00	$0.00	S/C	$7.50		$140.50
FT-11A FT-11B	KURZ MULTI POINT PROBE	J-105	$42,710.99		0.00	$0.00	S/C			$42,710.99
PCV-19	PRESSURE CONTROL VALVE, ATOMIZING AIR SUPPLY, FISHER MODEL 399-161, 100-125 PSIG OPERATING RANGE, 6X4-300 LB BODY CARBON STEEL BODY	J-100	$3,082.00		0.00	$0.00	S/C			$3,082.00
PI-01A	PRESSURE INDICATOR, ATOMIZING AIR PRESSURE , GLYCERINE FILLED ASHCROFT MODEL 25-1009-AWL-C2B	J-100	$39.00		0.00	$0.00	S/C			$39.00
FI-21A	FLOW INDICATOR, ATOMIZING AIR TO NOZZLE , KETEMA TYPE 20-1340-B10S, 200SCFM	J-109	$330.50		0.00	$0.00	S/C	$7.88		$338.38
PI-02A	PRESSURE INDICATOR , LIME INJECTION PRESSURE GLYCERINE FILLED ASHCROFT MODEL 25-1009-AL-02L WITH DIAPHRAGM SEAL MODEL NUMBER 1/2 -100SS-02T	J100	$149.00		0.00	$0.00	S/C			$149.00
PI-01B	PRESSURE INDICATOR, ATOMIZING AIR PRESSURE , GLYCERINE FILLED ASHCROFT MODEL 25-1009-AWL-C2B	J-100	$39.00		0.00	$0.00	S/C			$39.00

PENELEC
SEWARD STATION

PLANT 4
LIME INJECTION AREA

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
FI-21B	FLOW INDICATOR, ATOMIZING AIR TO NOZZLE , KETEMA TYPE 20-1340-B10S, 200SCFM	J-109	$330.50		0.00	$0.00	S/C	$7.88		$338.38
PI-02B	PRESSURE INDICATOR , LIME INJECTION PRESSURE GLYCERINE FILLED ASHCROFT MODEL 25-1009-AL-02L WITH DIAPHRAGM SEAL MODEL NUMBER 1/2 -100SS-02T	J100	$149.00		0.00	$0.00	S/C			$149.00
PI-01C	PRESSURE INDICATOR, ATOMIZING AIR PRESSURE , GLYCERINE FILLED ASHCROFT MODEL 25-1009-AWL-C2B	J-100	$39.00		0.00	$0.00	S/C			$39.00
FI-21C	FLOW INDICATOR, ATOMIZING AIR TO NOZZLE , KETEMA TYPE 20-1340-B10S, 200SCFM	J-109	$330.50		0.00	$0.00	S/C	$7.88		$338.38
PI-02C	PRESSURE INDICATOR , LIME INJECTION PRESSURE GLYCERINE FILLED ASHCROFT MODEL 25-1009-AL-02L WITH DIAPHRAGM SEAL MODEL NUMBER 1/2 -100SS-02T	J100	$149.00		0.00	$0.00	S/C			$149.00
PI-01D	PRESSURE INDICATOR, ATOMIZING AIR PRESSURE , GLYCERINE FILLED ASHCROFT MODEL 25-1009-AWL-C2B	J-100	$39.00		0.00	$0.00	S/C			$39.00
FI-21D	FLOW INDICATOR, ATOMIZING AIR TO NOZZLE , KETEMA TYPE 20-1340-B10S, 200SCFM	J-109	$330.50		0.00	$0.00	S/C	$7.88		$338.38
PI-02D	PRESSURE INDICATOR , LIME INJECTION PRESSURE GLYCERINE FILLED ASHCROFT MODEL 25-1009-AL-02L WITH DIAPHRAGM SEAL MODEL NUMBER 1/2 -100SS-02T	J100	$149.00		0.00	$0.00	S/C			$149.00
PI-01E	PRESSURE INDICATOR, ATOMIZING AIR PRESSURE , GLYCERINE FILLED ASHCROFT MODEL 25-1009-AWL-C2B	J-100	$39.00		0.00	$0.00	S/C			$39.00
FI-21E	FLOW INDICATOR, ATOMIZING AIR TO NOZZLE , KETEMA TYPE 20-1340-B10S, 200SCFM	J-109	$330.50		0.00	$0.00	S/C	$7.88		$338.38
PI-02E	PRESSURE INDICATOR , LIME INJECTION PRESSURE GLYCERINE FILLED ASHCROFT MODEL 25-1009-AL-02L WITH DIAPHRAGM SEAL MODEL NUMBER 1/2 -100SS-02T	J100	$149.00		0.00	$0.00	S/C			$149.00
PI-01F	PRESSURE INDICATOR, ATOMIZING AIR PRESSURE , GLYCERINE FILLED ASHCROFT MODEL 25-1009-AWL-C2B	J-100	$39.00		0.00	$0.00	S/C			$39.00
FI-21F	FLOW INDICATOR, ATOMIZING AIR TO NOZZLE , KETEMA TYPE 20-1340-B10S, 200SCFM	J-109	$330.50		0.00	$0.00	S/C	$7.88		$338.38
PI-02F	PRESSURE INDICATOR , LIME INJECTION PRESSURE GLYCERINE FILLED ASHCROFT MODEL 25-1009-AL-02L WITH DIAPHRAGM SEAL MODEL NUMBER 1/2 -100SS-02T	J100	$149.00		0.00	$0.00	S/C			$149.00
PI-01G	PRESSURE INDICATOR, ATOMIZING AIR PRESSURE , GLYCERINE FILLED ASHCROFT MODEL 25-1009-AWL-C2B	J-100	$39.00		0.00	$0.00	S/C			$39.00
FI-21G	FLOW INDICATOR, ATOMIZING AIR TO NOZZLE , KETEMA TYPE 20-1340-B10S, 200SCFM	J-109	$330.50		0.00	$0.00	S/C	$7.88		$338.38
PI-02G	PRESSURE INDICATOR , LIME INJECTION PRESSURE GLYCERINE FILLED ASHCROFT MODEL 25-1009-AL-02L WITH DIAPHRAGM SEAL MODEL NUMBER 1/2 -100SS-02T	J100	$149.00		0.00	$0.00	S/C			$149.00
PI-01H	PRESSURE INDICATOR, ATOMIZING AIR PRESSURE , GLYCERINE FILLED ASHCROFT MODEL 25-1009-AWL-C2B	J-100	$39.00		0.00	$0.00	S/C			$39.00

PENELEC
SEWARD STATION

PLANT 4
LIME INJECTION AREA

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
FI-21H	FLOW INDICATOR, ATOMIZING AIR TO NOZZLE , KETEMA TYPE 20-1340-B10S, 200SCFM	J-109	$330.50		0.00	$0.00	S/C	$7.88		$338.38
PI-02H	PRESSURE INDICATOR , LIME INJECTION PRESSURE GLYCERINE FILLED ASHCROFT MODEL 25-1009-AL-02L WITH DIAPHRAGM SEAL MODEL NUMBER 1/2 -100SS-02T	J100	$149.00		0.00	$0.00	S/C			$149.00
PI-01I	PRESSURE INDICATOR, ATOMIZING AIR PRESSURE , GLYCERINE FILLED ASHCROFT MODEL 25-1009-AWL-C2B	J-100	$39.00		0.00	$0.00	S/C			$39.00
FI-21I	FLOW INDICATOR, ATOMIZING AIR TO NOZZLE , KETEMA TYPE 20-1340-B10S, 200SCFM	J-109	$330.50		0.00	$0.00	S/C	$7.88		$338.38
PI-02I	PRESSURE INDICATOR , LIME INJECTION PRESSURE GLYCERINE FILLED ASHCROFT MODEL 25-1009-AL-02L WITH DIAPHRAGM SEAL MODEL NUMBER 1/2 -100SS-02T	J100	$149.00		0.00	$0.00	S/C			$149.00
PI-01J	PRESSURE INDICATOR, ATOMIZING AIR PRESSURE , GLYCERINE FILLED ASHCROFT MODEL 25-1009-AWL-C2B	J-100	$39.00		0.00	$0.00	S/C			$39.00
FI-21J	FLOW INDICATOR, ATOMIZING AIR TO NOZZLE , KETEMA TYPE 20-1340-B10S, 200SCFM	J-109	$330.50		0.00	$0.00	S/C	$7.88		$338.38
PI-02J	PRESSURE INDICATOR , LIME INJECTION PRESSURE GLYCERINE FILLED ASHCROFT MODEL 25-1009-AL-02L WITH DIAPHRAGM SEAL MODEL NUMBER 1/2 -100SS-02T	J100	$149.00		0.00	$0.00	S/C			$149.00
PI-01K	PRESSURE INDICATOR, ATOMIZING AIR PRESSURE , GLYCERINE FILLED ASHCROFT MODEL 25-1009-AWL-C2B	J-100	$39.00		0.00	$0.00	S/C			$39.00
FI-21K	FLOW INDICATOR, ATOMIZING AIR TO NOZZLE , KETEMA TYPE 20-1340-B10S, 200SCFM	J-109	$330.50		0.00	$0.00	S/C	$7.88		$338.38
PI-02K	PRESSURE INDICATOR , LIME INJECTION PRESSURE GLYCERINE FILLED ASHCROFT MODEL 25-1009-AL-02L WITH DIAPHRAGM SEAL MODEL NUMBER 1/2 -100SS-02T	J100	$149.00		0.00	$0.00	S/C			$149.00
PI-01L	PRESSURE INDICATOR, ATOMIZING AIR PRESSURE , GLYCERINE FILLED ASHCROFT MODEL 25-1009-AWL-C2B	J-100	$39.00		0.00	$0.00	S/C			$39.00
FI-21L	FLOW INDICATOR, ATOMIZING AIR TO NOZZLE , KETEMA TYPE 20-1340-B10S, 200SCFM	J-109	$330.50		0.00	$0.00	S/C	$7.88		$338.38
PI-02L	PRESSURE INDICATOR , LIME INJECTION PRESSURE GLYCERINE FILLED ASHCROFT MODEL 25-1009-AL-02L WITH DIAPHRAGM SEAL MODEL NUMBER 1/2 -100SS-02T	J100	$149.00		0.00	$0.00	S/C			$149.00
PI-01M	PRESSURE INDICATOR, ATOMIZING AIR PRESSURE , GLYCERINE FILLED ASHCROFT MODEL 25-1009-AWL-C2B	J-100	$39.00		0.00	$0.00	S/C			$39.00
FI-21M	FLOW INDICATOR, ATOMIZING AIR TO NOZZLE , KETEMA TYPE 20-1340-B10S, 200SCFM	J-109	$330.50		0.00	$0.00	S/C	$7.88		$338.38
PI-02M	PRESSURE INDICATOR , LIME INJECTION PRESSURE GLYCERINE FILLED ASHCROFT MODEL 25-1009-AL-02L WITH DIAPHRAGM SEAL MODEL NUMBER 1/2 -100SS-02T	J100	$149.00		0.00	$0.00	S/C			$149.00
PI-01N	PRESSURE INDICATOR, ATOMIZING AIR PRESSURE , GLYCERINE FILLED ASHCROFT MODEL 25-1009-AWL-C2B	J-100	$39.00		0.00	$0.00	S/C			$39.00

PLANT 4
LIME INJECTION AREA

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
FI-21N	FLOW INDICATOR, ATOMIZING AIR TO NOZZLE , KETEMA TYPE 20-1340-B10S, 200SCFM	J-109	$330.50		0.00	$0.00	S/C	$7.88		$338.38
PI-02N	PRESSURE INDICATOR , LIME INJECTION PRESSURE GLYCERINE FILLED ASHCROFT MODEL 25-1009-AL-02L WITH DIAPHRAGM SEAL MODEL NUMBER 1/2 -100SS-02T	J100	$149.00		0.00	$0.00	S/C			$149.00
PI-01P	PRESSURE INDICATOR, ATOMIZING AIR PRESSURE , GLYCERINE FILLED ASHCROFT MODEL 25-1009-AWL-C2B	J-100	$39.00		0.00	$0.00	S/C			$39.00
FI-21P	FLOW INDICATOR, ATOMIZING AIR TO NOZZLE , KETEMA TYPE 20-1340-B10S, 200SCFM	J-109	$330.50		0.00	$0.00	S/C	$7.88		$338.38
PI-02P	PRESSURE INDICATOR , LIME INJECTION PRESSURE GLYCERINE FILLED ASHCROFT MODEL 25-1009-AL-02L WITH DIAPHRAGM SEAL MODEL NUMBER 1/2 -100SS-02T	J100	$149.00		0.00	$0.00	S/C			$149.00
PI-01Q	PRESSURE INDICATOR, ATOMIZING AIR PRESSURE , GLYCERINE FILLED ASHCROFT MODEL 25-1009-AWL-C2B	J-100	$39.00		0.00	$0.00	S/C			$39.00
FI-21Q	FLOW INDICATOR, ATOMIZING AIR TO NOZZLE , KETEMA TYPE 20-1340-B10S, 200SCFM	J-109	$330.50		0.00	$0.00	S/C	$7.88		$338.38
PI-02Q	PRESSURE INDICATOR , LIME INJECTION PRESSURE GLYCERINE FILLED ASHCROFT MODEL 25-1009-AL-02L WITH DIAPHRAGM SEAL MODEL NUMBER 1/2 -100SS-02T	J100	$149.00		0.00	$0.00	S/C			$149.00
PI-01R	PRESSURE INDICATOR, ATOMIZING AIR PRESSURE , GLYCERINE FILLED ASHCROFT MODEL 25-1009-AWL-C2B	J-100	$39.00		0.00	$0.00	S/C			$39.00
FI-21R	FLOW INDICATOR, ATOMIZING AIR TO NOZZLE , KETEMA TYPE 20-1340-B10S, 200SCFM	J-109	$330.50		0.00	$0.00	S/C	$7.88		$338.38
PI-02R	PRESSURE INDICATOR , LIME INJECTION PRESSURE GLYCERINE FILLED ASHCROFT MODEL 25-1009-AL-02L WITH DIAPHRAGM SEAL MODEL NUMBER 1/2 -100SS-02T	J100	$149.00		0.00	$0.00	S/C			$149.00
PI-01S	PRESSURE INDICATOR, ATOMIZING AIR PRESSURE , GLYCERINE FILLED ASHCROFT MODEL 25-1009-AWL-C2B	J-100	$39.00		0.00	$0.00	S/C			$39.00
FI-21S	FLOW INDICATOR, ATOMIZING AIR TO NOZZLE , KETEMA TYPE 20-1340-B10S, 200SCFM	J-109	$330.50		0.00	$0.00	S/C	$7.88		$338.38
PI-02S	PRESSURE INDICATOR , LIME INJECTION PRESSURE GLYCERINE FILLED ASHCROFT MODEL 25-1009-AL-02L WITH DIAPHRAGM SEAL MODEL NUMBER 1/2 -100SS-02T	J100	$149.00		0.00	$0.00	S/C			$149.00
PSL-19	PRESSURE SET LIMIT SWITCH- SET AT 60 PSI		$35.00		16.00	$636.80			$2.10	$673.90
FE-22 FIT-22	FLOW ELEMENT, FLOW INDICATING TRANSMITTER-LIME SLURRY SERVICE, ALTOFLUX "K" SERIES	J-118A	$3,757.01		0.00	$0.00		$6.67		$3,763.68
PIC-17C	PRESSURE INDICATING CONTROLLER, FISHER CONTROLS MODEL 4195K	J-104	$2,400.00		0.00	$0.00		$9.81	$135.00	$2,544.81
PV-17C	PRESSURE CONTROL VALVE, ROBBINS & MEYERS RKL PINCH VALVE WITH POSITIONER, 1 1/2" 150 LB FLANGE MOUNT WITH 1" PORT	J-101	$2,452.00		0.00	$0.00		$244.00		$2,696.00

PENELEC
SEWARD STATION

PLANT 4
LIME INJECTION AREA

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
HCV-10D	READY/STRANDBY VALVE,4 WAY PLUG VALVE WITH BETTIS 5000 SR 4 ACTUATOR WITH WESTLOCK ACCUTRACK 2004 POSITION INDICATOR AND NEMA4 SOLENOID XOMOX MODEL	F-035	$2,762.67		0.00	$0.00		$47.50		$2,810.17
FCV-10	PRESSURE CONTROL VALVE, ROBBINS & MEYERS RKL PINCH VALVE WITH POSITIONER, 2 1/2" 150 LB FLANGE MOUNT	J-101	$2,452.00		0.00	$0.00	S/C	$244.00		$2,696.00
FCV-20	PRESSURE CONTROL VALVE, FISHER CONTROL VALVE WITH POSITIONER, 1 1/2" 150 LB FLANGE MOUNT WITH 1" PORT	J-100	$5,156.03		0.00	$0.00	S/C		$337.31	$5,493.34
FE-12 FIT-12	KURZ MULTI-POINT PROBE PURCHASED 1987 REBUILT AT FACTORY AND CALIBREATED 1992	F-079	$1,737.00		0.00	$0.00		$86.00		$1,823.00
COAST CODE J	**INSTRUMENTATION TOTAL**		**$80,124.70**	**$0.00**	**208.00**	**$8,278.40**	**$0.00**	**$807.32**	**$474.41**	**$89,784.83**

V-47	6" GATE VALVE, 300 LB STEEL BODY , 300 LB FLANGE MOUNT		S/C		0.00	$0.00	S/C			$0.00
V-46	2" GLOBE VALVE, 300 LB FLANGE MOUNTED STEEL BODY		S/C		0.00	$0.00	S/C			$0.00
V-44	BALL VALVE, 1" NPT MOUNTING, BRASS BODY , STAINLESS STEEL BALL		S/C		0.00	$0.00	S/C			$0.00
V-45 V49 V51 V-53	BALL VALVE, 1/2" NPT MOUNTING, BRASS BODY, STAINLESS STEEL BALL		S/C		0.00	$0.00	S/C			$0.00
V-43 V-48	3" GLOBE VALVE, BUTT WELDED, 300 LB STEEL BODY		S/C		0.00	$0.00	S/C			$0.00
V-42	2" GATE VALVE,150 LB FLANGE MOUNT STEEL BODY				0.00	$0.00	S/C			$0.00
V-50	1/2" GATE VALVE, NPT MOUNTING,BRASS BODY				0.00	$0.00	S/C			$0.00
V-41	2" FLANGE MOUNTED BALL CHECK VALVE, GLASS IMPREGNATED BALL CHECK, XOMOX		S/C		0.00	$0.00	S/C			$0.00
V-52	1" FLANGE MOUNTED BALL CHECK VALVE, GLASS IMPREGNATED BALL CHECK, XOMOX		S/C		0.00	$0.00	S/C			$0.00
V-36	3" FLANGE MOUNTED BALL CHECK VALVE, GLASS IMPREGNATED BALL CHECK, XOMOX		S/C		0.00	$0.00	S/C			$0.00
V-40	1 1/2" FLANGE MOUNTED BALL CHECK VALVE, GLASS IMPREGNATED BALL CHECK, XOMOX		S/C		0.00	$0.00	S/C			$0.00
V-37	1 1/2" FLANGE MOUNTED PLUG VALVE, STEEL BODY		S/C		0.00	$0.00	S/C			$0.00
V-38	2 1/2" FLANGE MOUNTED PLUG VALVE, STEEL BODY		S/C		0.00	$0.00	S/C			$0.00

PENELEC
SEWARD STATION

PLANT 4
LIME INJECTION AREA

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
	HOSE	F-010	$294.00		0.00	$0.00	S/C			$294.00
	CLAMPS	P-013	$236.80		0.00	$0.00	S/C			$236.80
	ADAPTERS	PO-010	$1,846.04		0.00	$0.00	S/C			$1,846.04
	ADAPTERS	PO-014	$372.36		0.00	$0.00	S/C			$372.36
	SUBCONTRACTOR, PULLMAN POWER PRODUCTS	-002			0.00	$0.00	$42,343.00			$42,343.00
	FABRICATE AND INSTALL READY STANDBY PIPING	MMT-171	$249.00		310.00	$12,338.00				$12,587.00
	FABRICATE READY STANDBY PIPING AT BROOKVILLE	MMT-174	$249.00		256.00	$10,188.80				$10,437.80
	INSTALL CONTROL AIR TO THE READY STANDBY VALVE	MMT-181			16.00	$636.80				$636.80
COST CODE I		PIPING TOTAL	$3,247.20	$0.00	582.00	$23,163.60	$42,343.00	$0.00	$0.00	$68,753.80
		TOTAL	**$108,740.00**	**$0.00**	**1090.00**	**$43,380.00**	**$42,340.00**	**$1,080.00**	**$470.00**	**$196,020.00**

PENELEC
SEWARD STATION

PLANT 5
DUCT AND SOOTBLOWERS

CASE I

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
	DUCT FABRICATION BY WILLIAMSBURG FABRICATORS AND ERECTION BY PULLMAN POWER PRODUCTS	S/C	$358,445.00		0.00	$0.00	$316,102.00	INC		$674,547.00
	INSTALL HAND RAILS AROUND LANCE OPENINGS	MMT-147	$55.00		96.00	$3,820.80				$3,875.80
	PREFABRICATE PLATFORMS AT BROOKVILLE	MMT-179	$1,472.00		1281.00	$50,983.80				$52,455.80
	DETAIL PLATFORMS, GARY BORDEN ENGINEERING	MMT-179	$2,638.48		0.00	$0.00				$2,638.48
	FABRICATE PLATFORMS	MMT-195	$3,352.00		47.00	$1,870.60				$5,222.60
	INSTALL PLATFORMS	MMT-163	$8.00		16.00	$636.80				$644.80
COST CODE M	**STRUCTURAL STEEL TOTAL**		**$365,970.48**	**$0.00**	**1440.00**	**$57,312.00**	**$316,102.00**	**$0.00**	**$0.00**	**$739,384.48**
	ROTARY SOOT BLOWERS RB-1 THRU RB-6	M-002	$33,807.00		0.00	$0.00				$33,807.00
	INSTALLATION OF RB-1 THRU RB-6 ZACK CONSTRUCTION COMPANY	S/C			0.00	$0.00	$60,189.53			$60,189.53
	ROTARY SOOT BLOWERS RB7 THRU RB-14	M-002	$48,281.00		0.00	$0.00				$48,281.00
	COPES VULCAN MISC.	M-002	$5,063.00		0.00	$0.00		$956.00		$6,019.00
	INSTALLATION FO RB-7 THRU RB-14	MMT-162	$2,255.00		1803.00	$71,759.40				$74,014.40
COST CODE T	**SPECIAL EQUIPMENT TOTAL**		**$89,406.00**	**$0.00**	**1803.00**	**$71,759.40**	**$60,189.53**	**$956.00**	**$0.00**	**$222,310.93**
	LIGHTING	001-E-6	$3,959.66		0.00	$0.00	S/C			$3,959.66

PENELEC
SEWARD STATION

PLANT 5
DUCT AND SOOTBLOWERS

CASE I

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
	INSTALL CONTROL WIRING TO RB-7 THRU RB-14	MMT-178	$441.00		0.00		S/C			$441.00
	LIGHTING TRANSFORMER	001-E-5	$490.59		0.00	$0.00	S/C	$113.17		$603.76
	AIR CONDITIONER	F-052	$675.00		48.00	$1,910.40				$2,585.40
	HOIST	P-020	$2,279.30		10.00	$398.00				$2,677.30
COST CODE P	ELECTRICAL TOTAL		$7,846.55	$0.00	58.00	$2,308.40	$0.00	$113.17	$0.00	$10,287.12
	INSULATE SKIN THERMOCOUPLES	MMT-121			24.00	$955.20				$955.20
COST CODE J	INSTURMENTATION TOTAL		$0.00	$0.00	24.00	$955.20	$0.00	$0.00	$0.00	$955.20
	FLOW CONTROL FOR EYE WASH	J-1028	$390.00		32.00	$1,273.60				$1,663.60
	FILTERS & CARTRAGES FOR EYEWASH STATIONS	F-020	$126.06		32.00	$1,273.60				$1,399.66
	BACK FLOW PREVENTER, POTABLE WATER SUPPLY	C-001	$1,932.78		32.00	$1,273.60				$3,206.38
	SINKS	MMT-106	$94.00		20.00	$796.00			$5.64	$895.64
	SAFETY SIGNS	P-009	$102.71		0.00	$0.00		$253.00		$355.71

PENELEC
SEWARD STATION

PLANT 5
DUCT AND SOOTBLOWERS

CASE I

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
	EYE WASH STATIONS	P-007	$530.56		60.00	$2,388.00		$7.21		$2,925.77
	SEAL AIR LINE TO SOOT BLOWERS	MMT-157	$534.00		0.00	$0.00	S/C			$534.00
	INSTALL WATER FILTERS	MMT-115			32.00	$1,273.60				$1,273.60
COST CODE L	PIPING TOTAL		$3,710.11	$0.00	208.00	$8,278.40	$0.00	$260.21	$5.64	$12,254.36
	TOTAL		$486,930.00	$0.00	3533.00	$140,610.00	$376,290.00	$1,330.00	$10.00	$985,170.00

PENELEC
SEWARD STATION

PLANT 7
WINTERIZATION

CASE I

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
	FABRICATE AND INSTALL A WEATHER ENCLOSURE AT THE TOP OF THE DUCT	EST					$38,612.00			$38,612.00
	FABRICATE AND INSTALL WEATHER ENCLOSURES AROUND PUMPS, HEAT TRACE AND INSULATE LINES IN THE LIME SLURRY INJECTION AREA	ACT					$30,300.00			$30,300.00
	HEAT TRACE AND INSULATE THE LIME SLURRY TRANSFER LINE	ACT					$26,000.00			$26,000.00
	HEAT TRACE AND INSULATE PIPING	ACT					$26,250.00			$26,250.00
										$0.00
										$0.00
										$0.00
COST CODE N	INSULATION TOTAL		$0.00	$0.00	0.00	$0.00	$121,160.00	$0.00	$0.00	$121,160.00

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
	L & N MULTIPOINT RECORDER	J-103	$20,788.65		$0.00	$0.00	S/C	$196.72	$1,165.58	$22,150.95
	L & N COMMUNICATION CARD	P-017	$556.97		$0.00	$0.00	S/C	$8.74	$5.73	$571.44
	BAILEY	J-113	$46,525.52		$0.00	$0.00	INC		$2,633.52	$49,159.04
	BAILEY	J-113A	$74,721.52		$0.00	$0.00	INC		$4,229.52	$78,951.04
	BAILEY	J113A	$80,005.56		$0.00	$0.00	INC		$4,800.33	$84,805.89
	L & N	P-026	$180.00		$0.00	$0.00	S/C			$180.00
	L & N	F-015	$1,288.10		$0.00	$0.00	S/C	$104.00		$1,392.10
	L & N	P-026	$1,496.50		$0.00	$0.00	S/C	$9,595.00		$11,091.50
	M-SYSTEM THERMOCOUPLE INTERFACES	J-114	$25,270.56		$0.00	$0.00				$25,270.56
	THERMO ELECTRIC THERMOCOUPLE CABLE	P-008	$330.00		$0.00	$0.00	S/C			$330.00
	BLACK BOX CONVERTER	F-089	$636.53		0.00	$0.00	S/C	$27.50	$36.03	$700.06
	BLACK BOX	F-089	$103.63		0.00	$0.00		$14.50	$5.87	$124.00
	BLACK BOX	P-023	$214.12		0.00	$0.00		$52.00	$12.12	$278.24

PENELEC
SEWARD STATION

PLANT 8
INSTRUMENTATION

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
	ESP UPGRADE	J-111	$12,550.00		0.00	$0.00	INC	$257.23		$12,807.23
	TURNING VANE THERMOCOUPLES	F-040 MMT-191	$3,765.31		16.00	$636.80				$4,402.11
	FIBEROPTIC CABLE	F-011 MMT-143	$1,368.00		52.00	$2,069.60		$27.18		$3,464.78
	FIBEROPTIC CABLE	MMT-132	$1,469.00		0.00	$0.00				$1,469.00
	THERMOELECTRIC THERMOCOUPLES INSTALLED BY ZACK	J-104 S/C	$41,606.50		0.00	$0.00	S/C	$593.00	$2,518.60	$44,718.10
	ZACK INSTALLATION OF THERMOCOUPLES AND L&N RECORDERS	S/C			0.00	$0.00	$30,094.76			$30,094.76
					0.00	$0.00				$0.00
COST CODE J	**INSTRUMENTATION TOTAL**		$312,680.00	$0.00	68.00	$2,710.00	$30,090.00	$10,880.00	$15,410.00	$371,970.00

PENELEC
SEWARD STATION

PLANT 9
INTERCONNECT WIRING

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
	MOSEBACH ELECTRIC	E-4	$2,738.19		0.00	$0.00		$148.20	$154.99	$3,041.38
	MOSEBACH ELECTRIC	F-021	$183.38		0.00	$0.00			$10.38	$193.76
	MOSEBACH ELECTRIC	F-022	$21.54		0.00	$0.00			$15.94	$37.48
	MOSEBACH ELECTRIC	F-032	$162.75		0.00	$0.00			$9.21	$171.96
	MOSEBACH ELECTRIC	F-034	$2,210.65		0.00	$0.00		$190.51	$125.13	$2,526.29
	MOSEBACH ELECTRIC	F-044	$58.30		0.00	$0.00		$16.00	$3.30	$77.60
	MOSEBACH ELECTRIC	F-045	$3,792.69		0.00	$0.00		$788.21	$214.68	$4,795.58
	MOSEBACH ELECTRIC	F-048	$276.40		0.00	$0.00		$19.25	$15.65	$311.30
	MOSEBACH ELECTRIC	F-049	$504.16		0.00	$0.00		$59.08	$28.54	$591.78
	MOSEBACH ELECTRIC	F-051	$91.91		0.00	$0.00			$5.20	$97.11
	MOSEBACH ELECTRIC	F-054	$62.33		0.00	$0.00		$30.60	$3.53	$96.46
	MOSEBACH ELECTRIC	F-055	$61.12		0.00	$0.00		$2.42	$3.46	$67.00
	MOSEBACH ELECTRIC	F-065	$383.25		0.00	$0.00		$103.15	$21.70	$508.10
	MOSEBACH ELECTRIC	F-081	$220.56		0.00	$0.00		$0.00	$12.48	$233.04
	MOSEBACH ELECTRIC	F-083	$104.07		0.00	$0.00		$0.00	$5.89	$109.96
	MOSEBACH ELECTRIC	F-084	$30.14		0.00	$0.00		$0.00	$1.70	$31.84
	MOSEBACH ELECTRIC	P-011	$1,725.75		0.00	$0.00		$0.00	$97.68	$1,823.43
	MOSEBACH ELECTRIC	P-015	$1,060.93		0.00	$0.00		$0.00	$60.07	$1,121.00

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
	MOSEBACH ELECTRIC	P-026	$1,496.50		0.00	$0.00		$95.95		$1,592.45
	MOSEBACH ELECTRIC	P-027	$642.14		0.00	$0.00		$100.50	$10.01	$752.65
	MOSEBACH ELECTRIC	P-026	$180.00		0.00	$0.00		$0.00		$180.00
	MOSS ELECTRIC ADAPTER	P-014	$297.90		0.00	$0.00		$14.67	$20.85	$333.42
	TRANSDUCER	F-047	$155.00		0.00	$0.00		$6.00		$161.00
	FLOW CONTROLLER	J-102	$2,500.00		0.00	$0.00		$12.49	$150.16	$2,662.65
	INSTALL CONDUIT FROM MCC TO WEATHER ENCLOSURE	MMT-180	$7.00		150.00	$5,970.00		$0.00		$5,977.00
	MISC. ELECTRICAL AND CONTROL WIRING	MMT-175	$109.00		101.00	$4,019.80		$0.00		$4,128.80
	REWIRE KURZ UNIT	MMT-146			24.00	$955.20		$0.00		$955.20
	PULL POWER CABLES	MMT-150	$135.00		20.00	$796.00		$0.00		$931.00
	8000 LINE MCC	EST	$20,000.00		500.00	$19,900.00		$0.00		$39,900.00
					0.00	$0.00		$0.00		$0.00
					0.00	$0.00		$0.00		$0.00
					0.00	$0.00		$0.00		$0.00
					0.00	$0.00		$0.00		$0.00
					0.00	$0.00		$0.00		$0.00
COST CODE P	**ELECTRICAL TOTAL**		$39,210.00	$0.00	795.00	$31,640.00	$0.00	$1,590.00	$970.00	$73,410.00

PENELEC
SEWARD STATION

PLANT 10
INTERCONNECT PIPING AND MECHANICAL

CASE 1

EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
	GOODING & LEWIS	F-010	$325.31			$0.00		$13.67	$17.64	$356.62
	GOODING & LEWIS	F-026	$651.44			$0.00		$12.59		$664.03
	GOODING & LEWIS	F-033	$310.65		0.00	$0.00		$37.75		$348.40
	GOODING & LEWIS	F-036	$120.61		0.00	$0.00		$26.75	$5.31	$152.67
	GOODING & LEWIS	F-038	$404.44		0.00	$0.00		$52.94	$19.90	$477.28
	GOODING & LEWIS	F-039	$252.47		0.00	$0.00		$10.07		$262.54
	GOODING & LEWIS	F-059	$174.22		0.00	$0.00		$32.38		$206.60
	GOODING & LEWIS	F-060	$71.50		0.00	$0.00		$14.50		$86.00
	GOODING & LEWIS	F-061	$75.13		0.00	$0.00		$37.25		$112.38
	GOODING & LEWIS	F-062	$483.51		0.00	$0.00		$75.25		$558.76
	GOODING & LEWIS	F-072	$41.87		0.00	$0.00		$17.50		$59.37
	GOODING & LEWIS	P-010	$2,031.09		0.00	$0.00		$0.00		$2,031.09
	GOODING & LEWIS	P-031	$5,220.42		0.00	$0.00		$345.03	$45.22	$5,610.67
	McMASTER-CARR	F-030	$148.56		0.00	$0.00		$22.50		$171.06
	McMASTER-CARR	F-024	$75.73		0.00	$0.00		$25.20		$100.93
	McMASTER-CARR	F-028	$55.00		0.00	$0.00		$5.40		$60.40

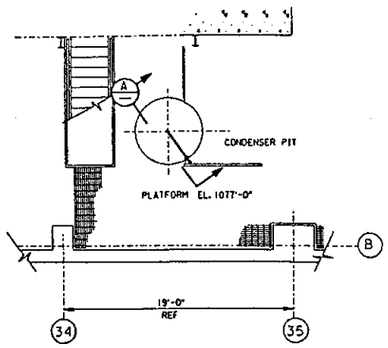
PENELEC
SEWARD STATION

PLANT 10
INTERCONNECT PIPING AND MECHANICAL

CASE 1

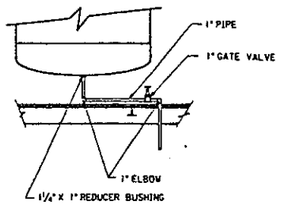
EQUIPMENT NUMBER	DESCRIPTION	PURCH ORDER 21178-	PLANT EQUIPMENT	BULK MATERIALS	MAN HOURS	DIRECT LABOR	S/C	SHIPPING	TAX	TOTAL
	McMASTER-CARR	F-037	$268.91		0.00	$0.00		$36.75		$305.66
	McMASTER-CARR	F-052	$674.82		0.00	$0.00		$0.00		$674.82
	McMASTER-CARR	F-063	$129.91		0.00	$0.00		$2.53		$132.44
	McMASTER-CARR	F-067	$117.15		0.00	$0.00		$0.00		$117.15
	McMASTER-CARR	F-075	$85.60		0.00	$0.00		$5.80		$91.40
	PIPING - ALTOONA PIPE	C-001	$2,142.25		0.00	$0.00		$88.22	$121.25	$2,351.72
	IN PLANT OFFICE, GREGORY EQUIPMENT CO.	P-002	$4,989.00		0.00	$0.00		$0.00		$4,989.00
	FLOW CONTROL, BELILOVE	J-102B	$390.00		0.00	$0.00		$0.00		$390.00
	FLOW METER INSTALLATION	MMT-128	$111.00		72.00	$2,865.60		$0.00		$2,976.60
	FABRICATE AND INSTALL PIPING FROM LIME SLURRY PREPARATION AREA (PLANT 2)TO THE LIME SLURRY FEED AREA (PLANT 3)	MMT-182	$2,697.00		955.00	$38,009.00		$0.00		$40,706.00
	MATERIAL FOR MMT-182	MMT-118	$777.00		16.00	$636.80		$0.00		$1,413.80
					0.00	$0.00		$0.00		$0.00
					0.00	$0.00		$0.00		$0.00
					0.00	$0.00		$0.00		$0.00
COST CODE L	PIPING TOTAL		$22,820.00	$0.00	1043.00	$41,510.00	$0.00	$860.00	$210.00	$65,400.00

Appendix C
Drawings



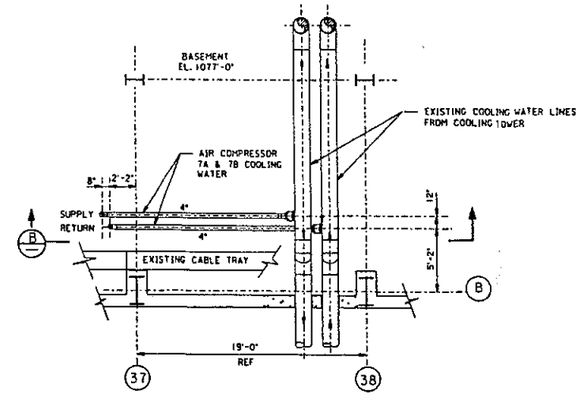
ENLARGED
AIR RECEIVER DRAIN PIPING

SCALE 1/4"= 1'-0"



ENLARGED
SECTION (A)

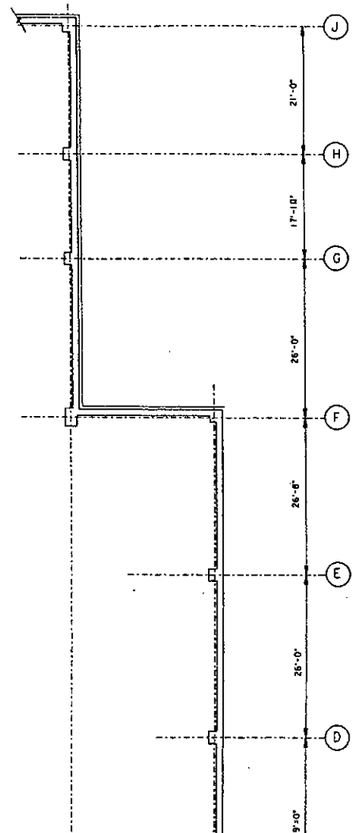
SCALE 1/2"= 1'-0"

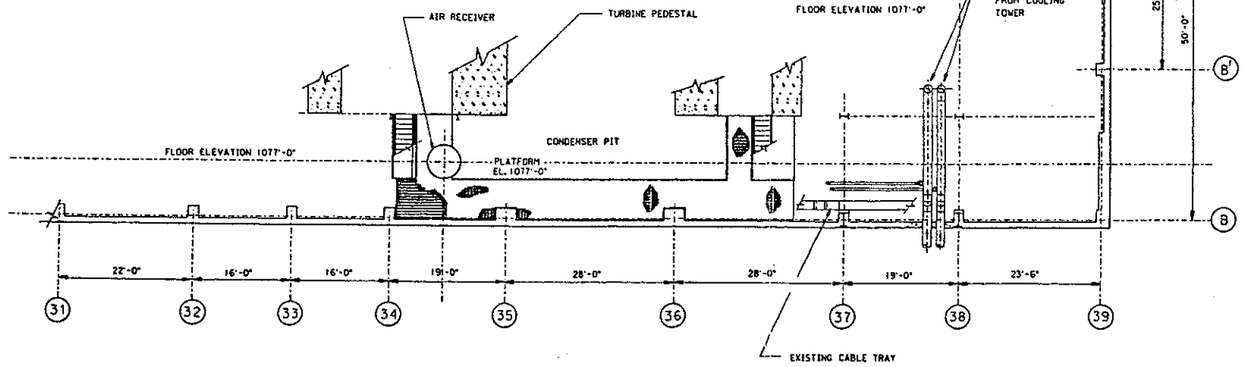


SECTION (B)

COOLING WATER PIPING
ENLARGED

SCALE 1/4"= 1'-0"





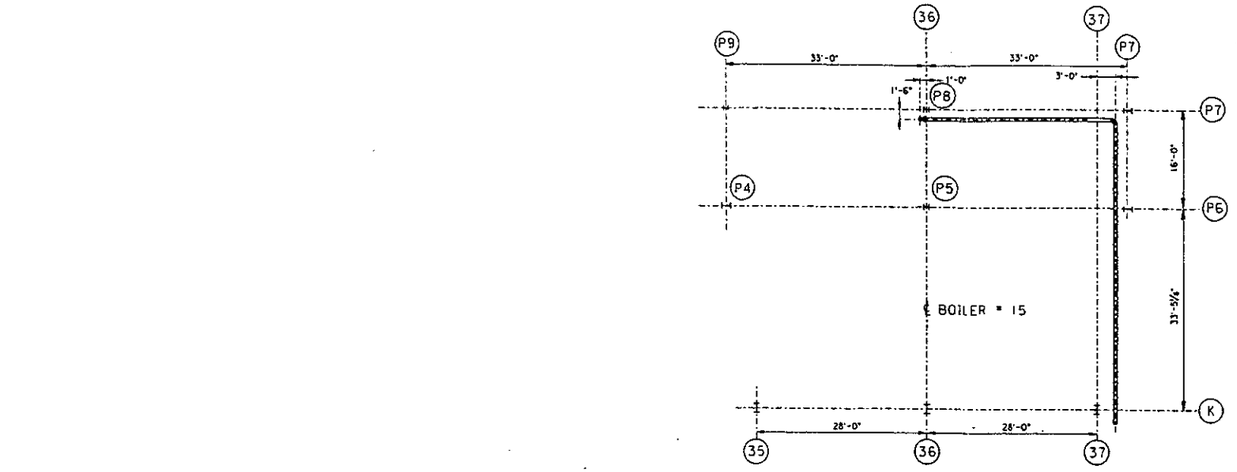
SCALE 1/8"= 1'-0"

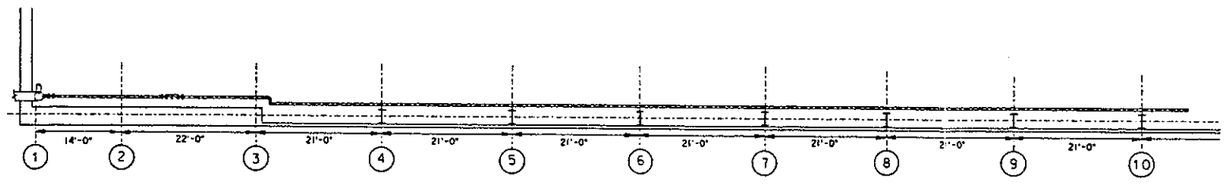
AS BUILT

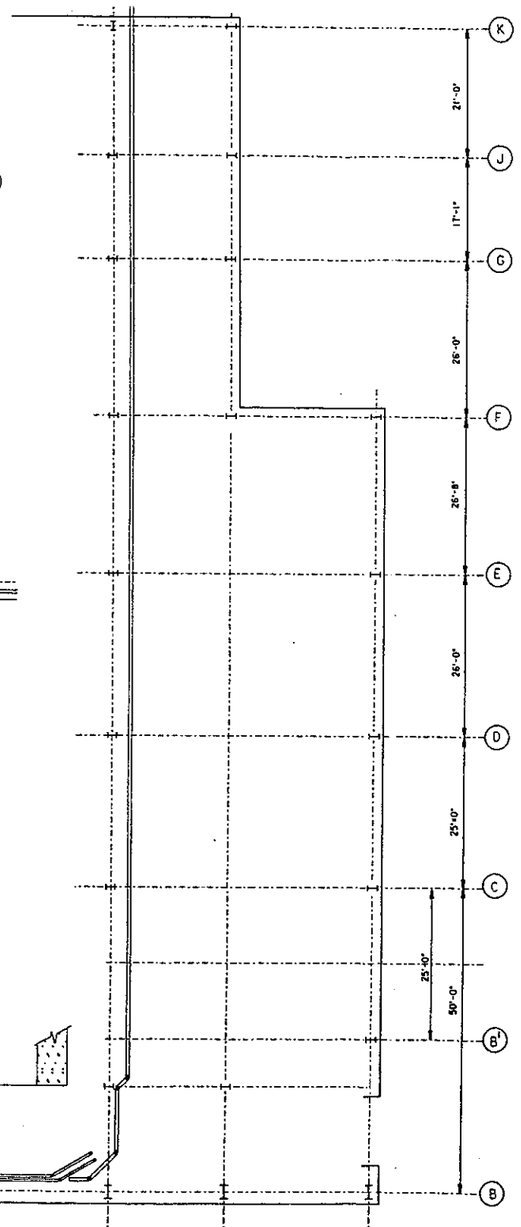
Bechtel
Bechtel Corporation San Francisco Regional Office
Pennelec LAPU

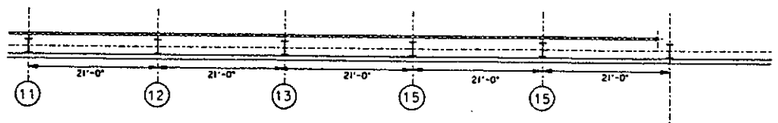
TITLE: C2D/FGD DEMONSTRATION PROJECT
AIR COMPRESSOR INSTALLATION
PLAN @ EL.1077'-0"

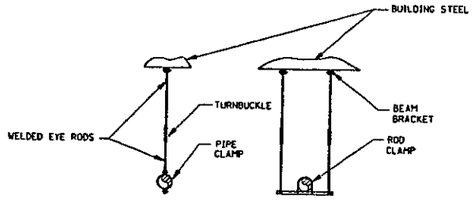
21176-1001 | SK-110 | 1





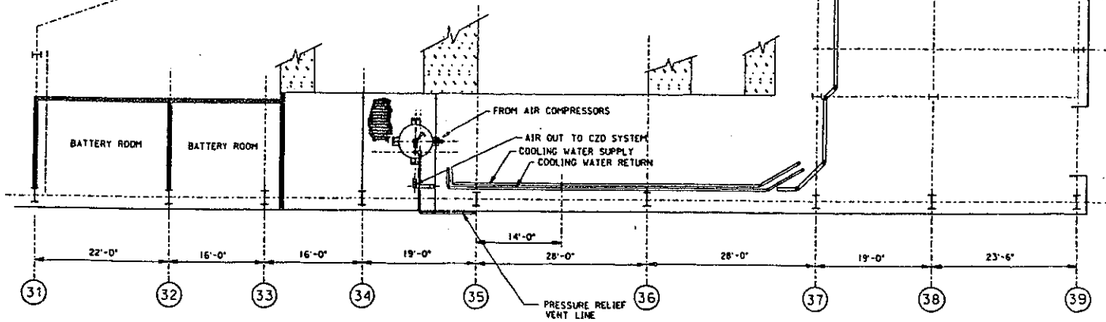






TYPICAL HANGER DETAILS

SCALE ½"=1'-0"



NOTES:

1. FOR DETAILS AND DIMENSIONS SEE DRAWING SK-121

SCALE ⅛"=1'-0"

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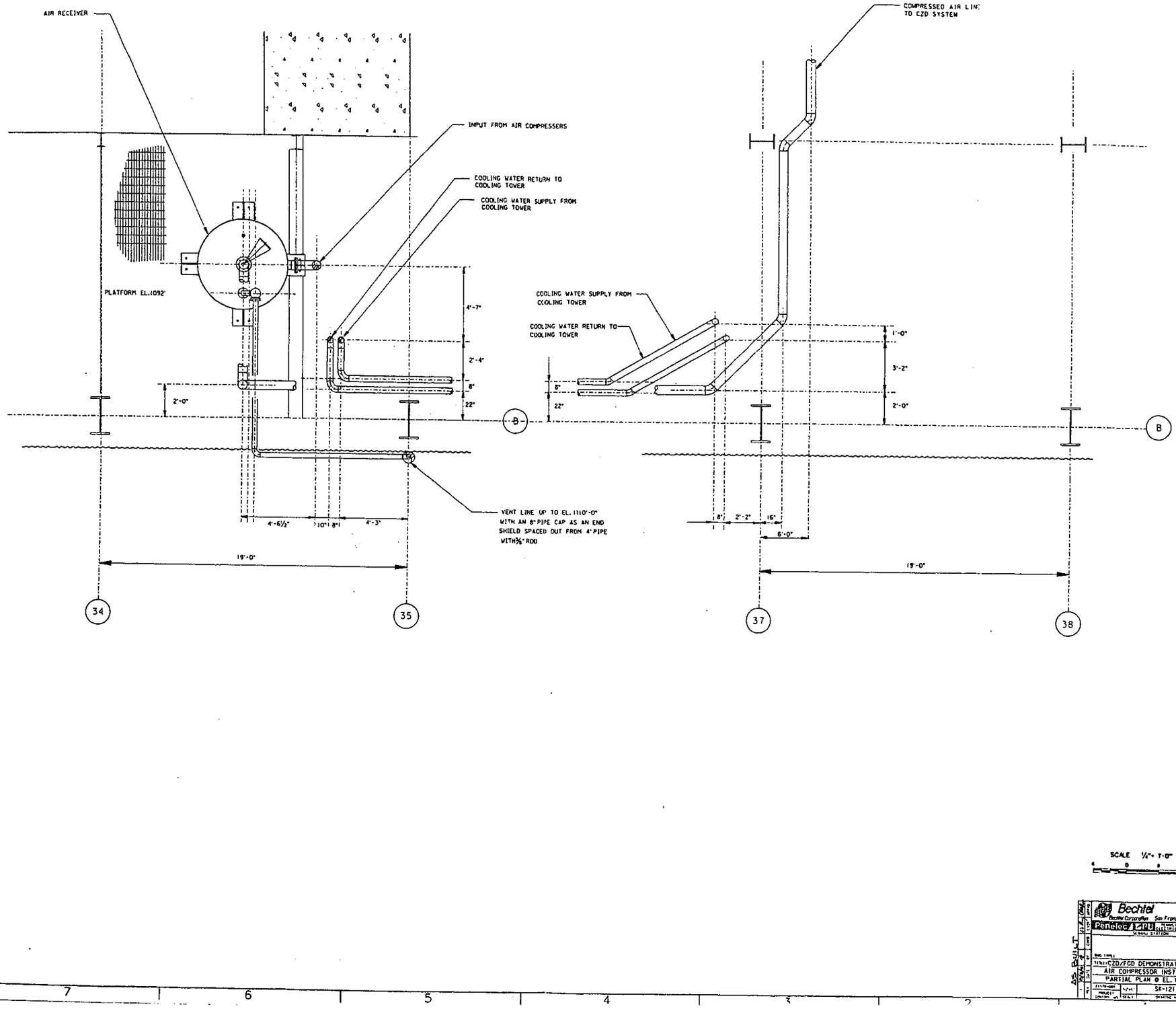
Bechtel Corporation San Francisco Regional Offices
Pandale LCPU

AS BUILT

CZD/FGD DEMONSTRATION PROJECT
AIR COMPRESSOR INSTALLATION
PLAN @ EL.1052'-0"
SK-120

SIZE E



SCALE ¼"= 1'-0"

0 4 8 FT

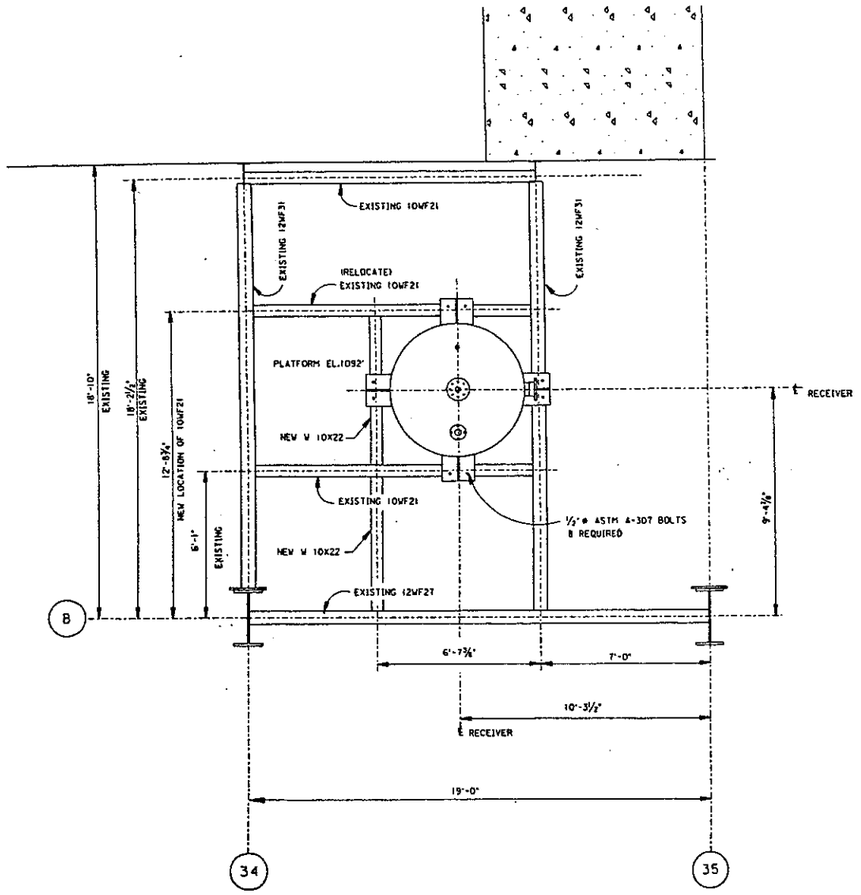
AS BUILT

Bechtel
Bechtel Corporation San Francisco Regional Office

Penelec LRU

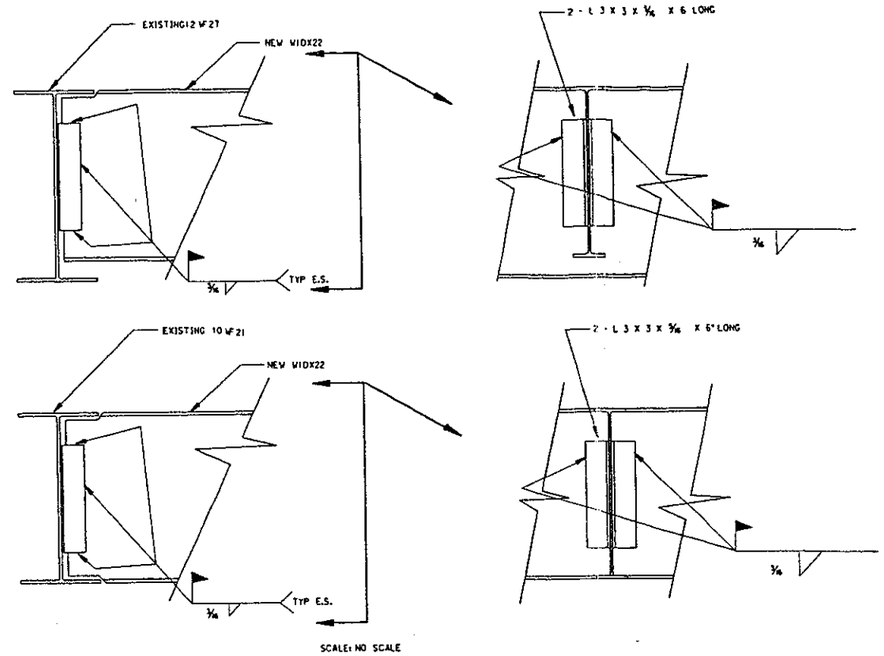
CZD/FGD DEMONSTRATION PROJECT
AIR COMPRESSOR INSTALLATION
PARTIAL PLAN @ EL. 1092'-0"

SK-121



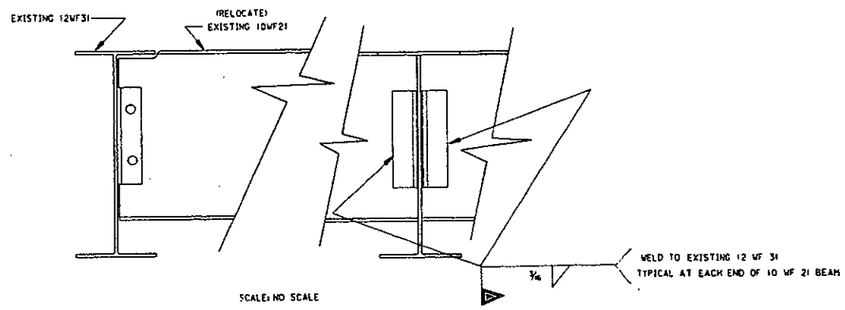
PLATFORM PLAN EL. 1092'-0"

T.O.S. (- 1½")



SCALE: NO SCALE

ADDITIONAL BEAMS INSTALLATION DETAIL



SCALE: NO SCALE

MOVING OF EXISTING BEAM ATTACHMENT DETAIL

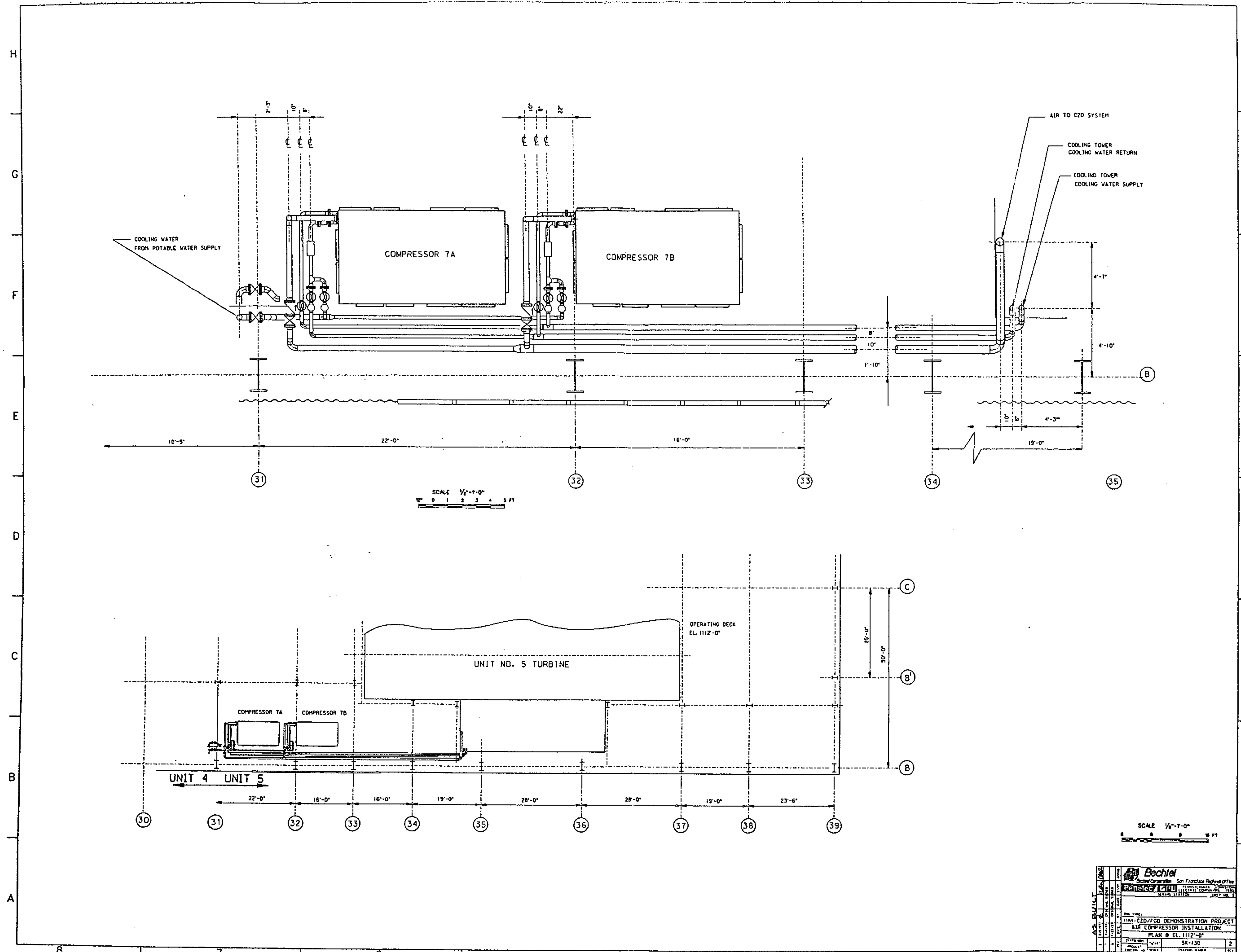
SCALE ½"=1'-0"

Bechtel Power Corporation San Francisco Regional Office

Panama 4 PU

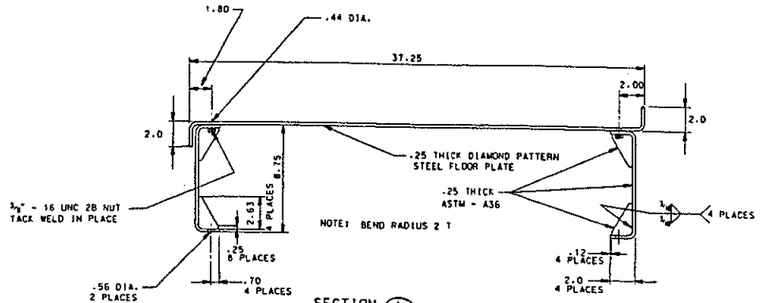
SUBJECT: CZD/FGD DEMONSTRATION PROJECT
AIR COMPRESSOR INSTALLATION
AIR RCVR SUPPORT STEEL

SK-122 | 0



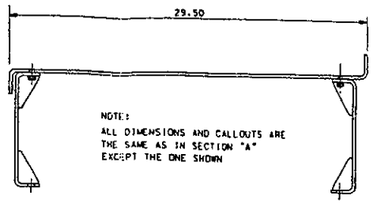
COOLING WATER FROM POTABLE WATER SUPPLY
COMPRESSOR 7A
COMPRESSOR 7B
AIR TO C2D SYSTEM
COOLING TOWER COOLING WATER RETURN
COOLING TOWER COOLING WATER SUPPLY
10'-9"
22'-0"
16'-0"
19'-0"
4'-7"
4'-10"
4'-3"
1'-10"
SCALE 1/8"=1'-0"
OPERATING DECK EL. 1112'-0"
UNIT NO. 5 TURBINE
COMPRESSOR 7A
COMPRESSOR 7B
UNIT 4 UNIT 5
25'-0"
50'-0"
22'-0"
16'-0"
16'-0"
19'-0"
28'-0"
28'-0"
19'-0"
23'-6"
SCALE 1/8"=1'-0"
AS BUILT
Bechtel
Bechtel Corporation San Francisco Regional Office
Penelec/GPU
SEWARD STATION
UNIT NO. 5
C2D/FGD DEMONSTRATION PROJECT
AIR COMPRESSOR INSTALLATION
PLAN @ EL. 1112'-0"
SK-130
2

SIZE E



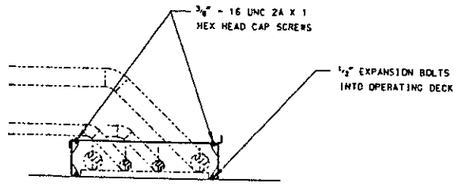
SECTION A

SCALE 3" = 1'-0"



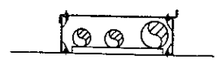
SECTION B

SCALE 3" = 1'-0"



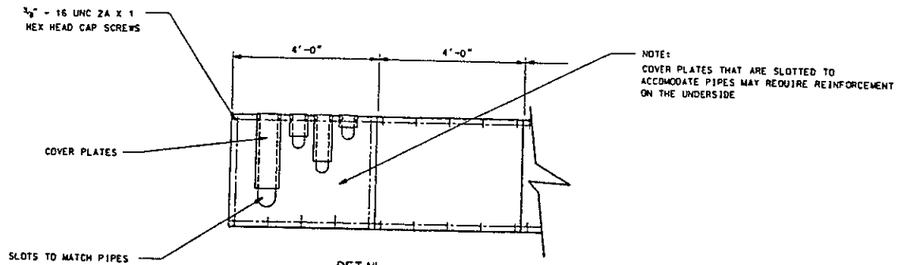
SECTION A

SCALE 1" = 1'-0"



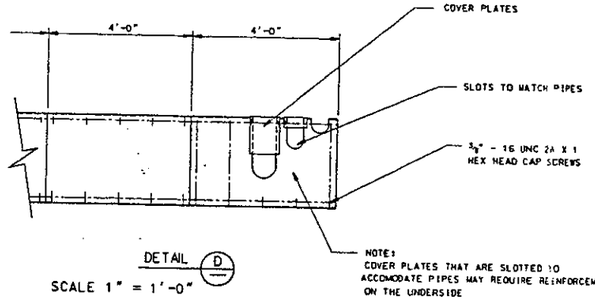
SECTION B

SCALE 1" = 1'-0"



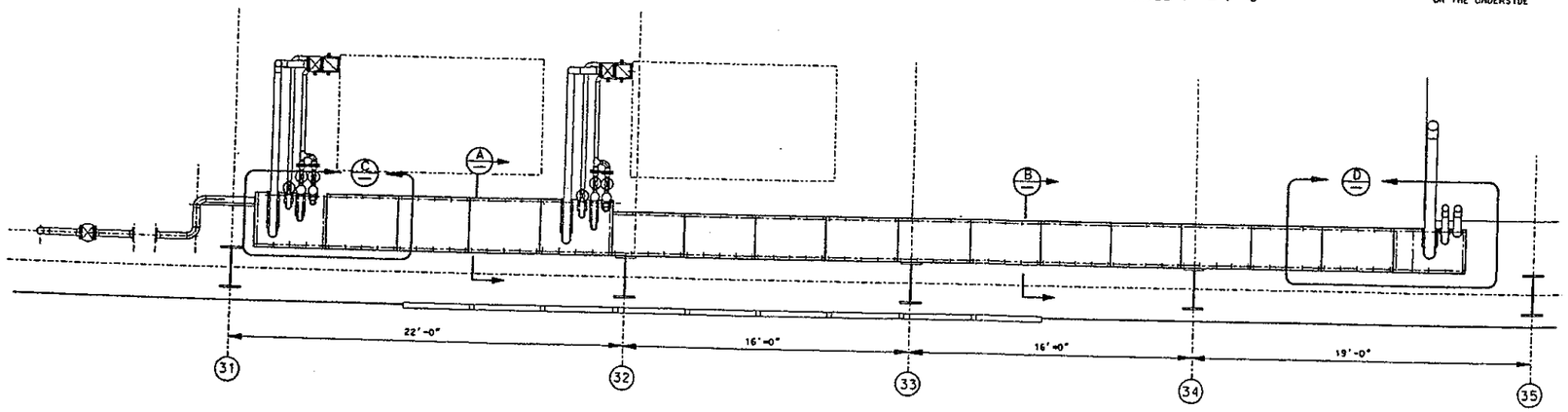
DETAIL C

SCALE 1" = 1'-0"



DETAIL D

SCALE 1" = 1'-0"



PARTIAL PLAN AT EL. 1112'

SCALE: 3/8" = 1'-0"

NOTE:

1. FOR LIST OF MATERIAL SEE SK-131-1

SCALE 3"-1'-0"

SCALE 1"-1'-0"

SCALE 1/8"-1'-0"

Bechtel

Bechtel Corporation San Francisco Regional Office

Pericles / API

ELECTRIC COMPONENT SUBSTATION UNIT NO. 1

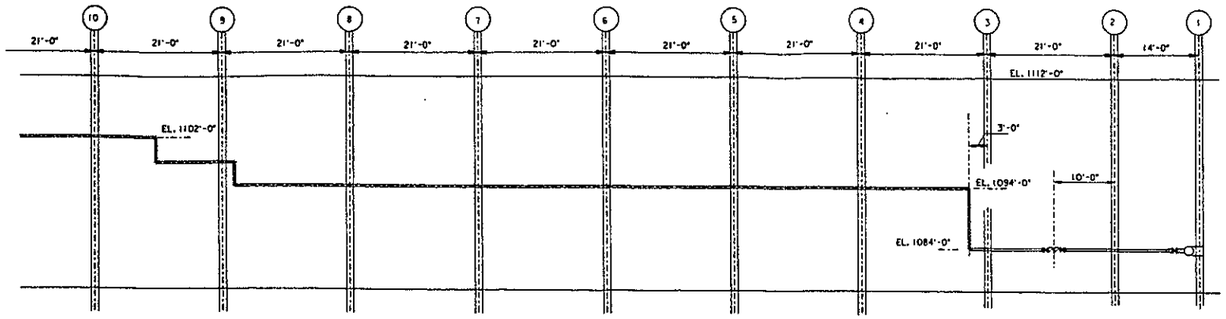
C2D/FGD DEMONSTRATION PROJECT

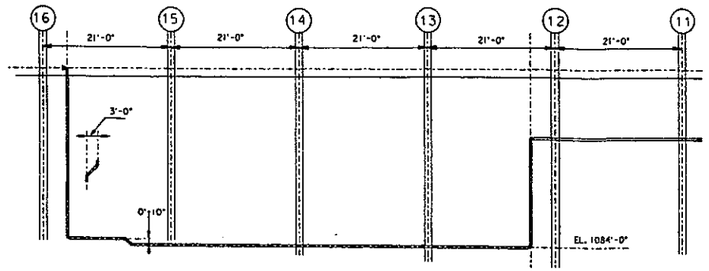
AIR COMPRESSOR INSTALLATION

PIPE COVERING PLATES

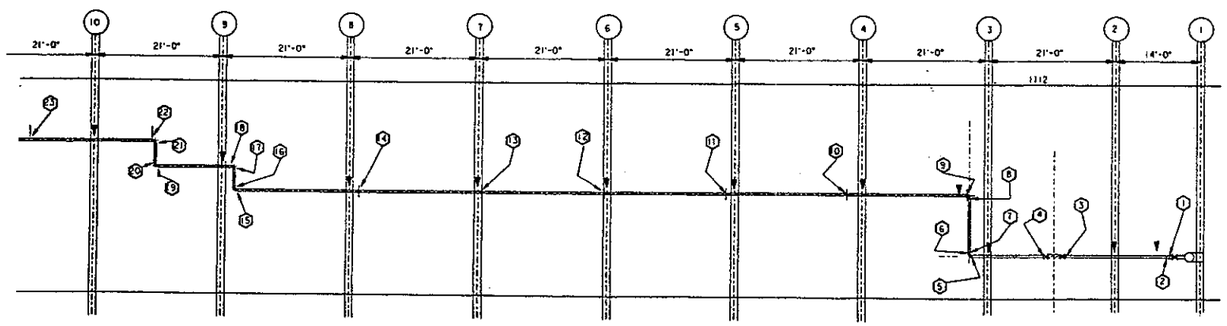
SK-131

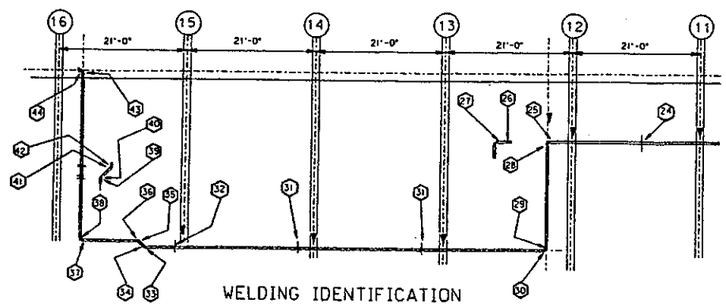
1





PIPE ROUTING



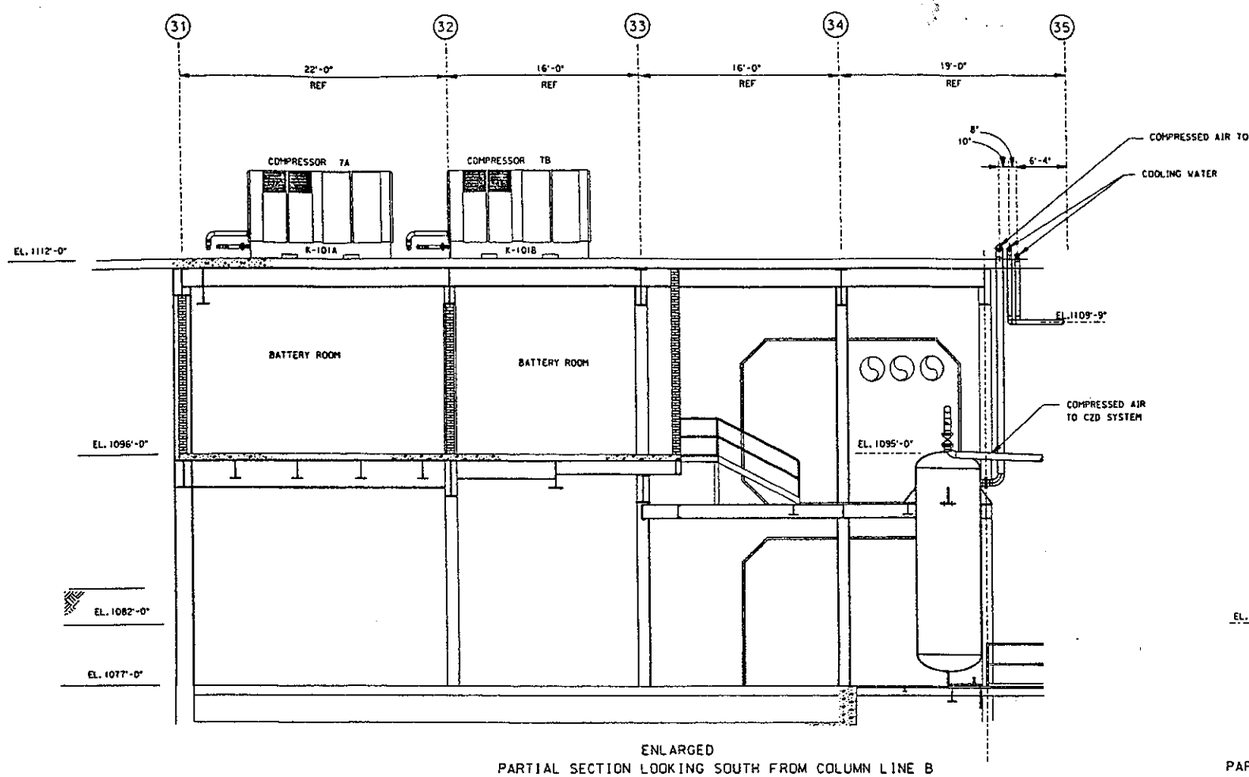


WELDING IDENTIFICATION

SCALE 1/8"-1'-0"

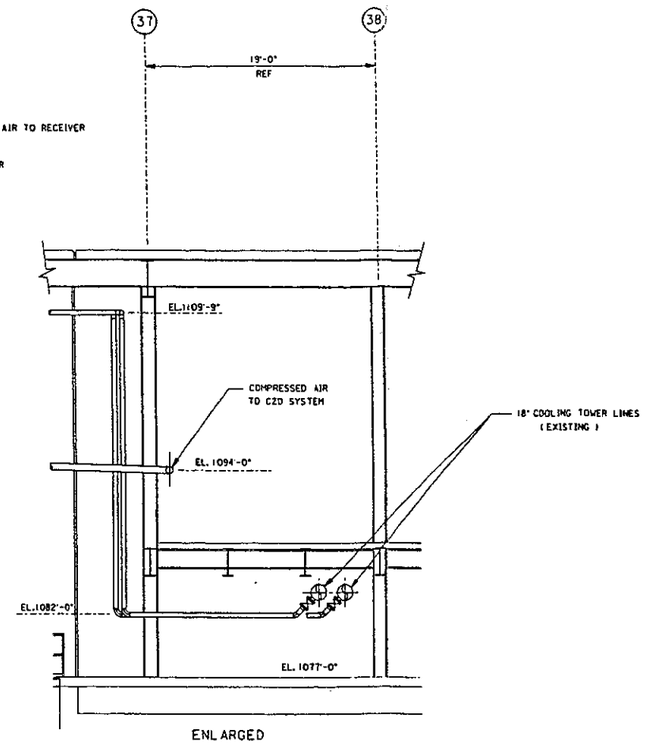
Bechtel
Bechtel Corporation San Francisco Regional Office
Pantelec CPU

CZD/FGD DEMONSTRATION PROJECT
AIR COMPRESSOR INSTALLATION
HIGH PRESSURE PIPING ELEVATION
SK-132



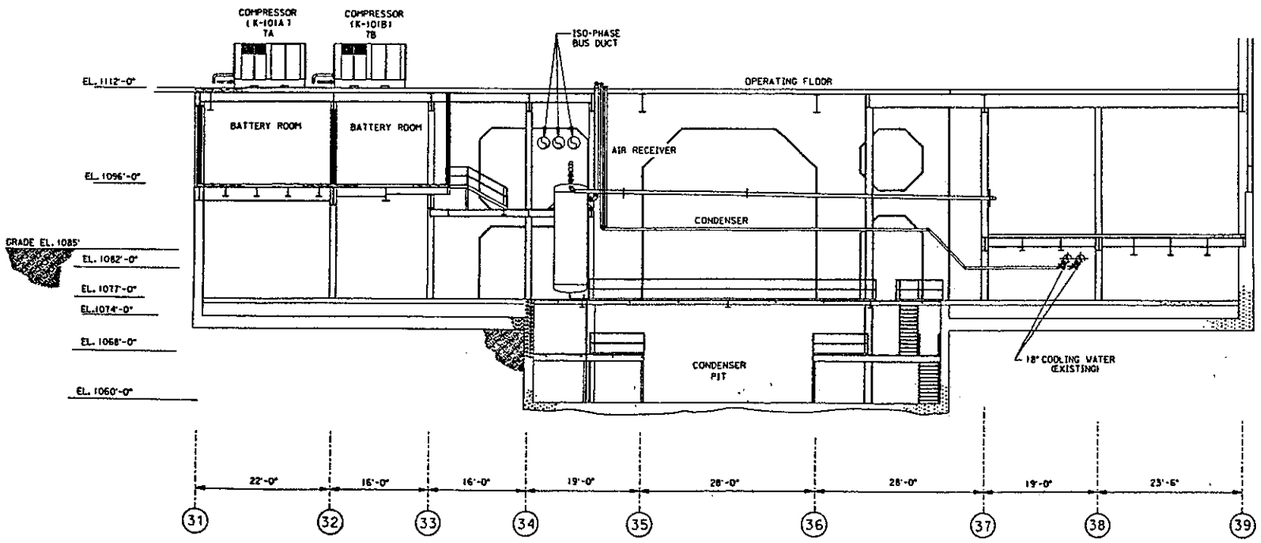
ENLARGED
PARTIAL SECTION LOOKING SOUTH FROM COLUMN LINE B

SCALE 1/4"= 1'-0"
4 0 4 8 FT



ENLARGED
PARTIAL SECTION LOOKING SOUTH FROM COLUMN LINE B

SCALE 1/4"= 1'-0"
4 0 4 8 FT



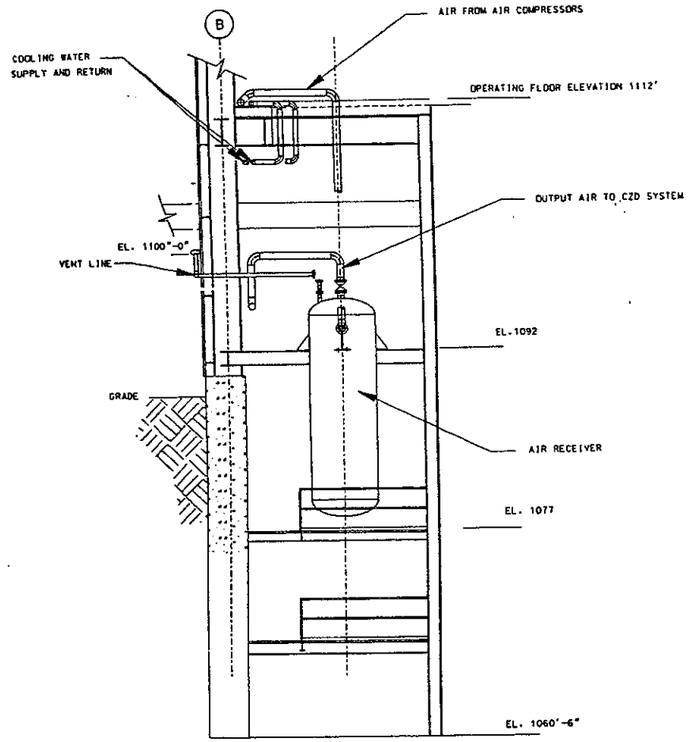
SECTION LOOKING SOUTH FROM COLUMN LINE B

SCALE 1/8"=1'-0"
8 0 8 16 FT

Bechtel
Bechtel Corporation San Francisco Regional Offices
Pendleton Electric Company
Navajo Station Units 1&2, 3

TITLE: CZD/FGD DEMONSTRATION PROJECT
AIR COMPRESSOR INSTALLATION
E-W SECTION LOOKING FROM "B"

DRAWING NUMBER: SK-210



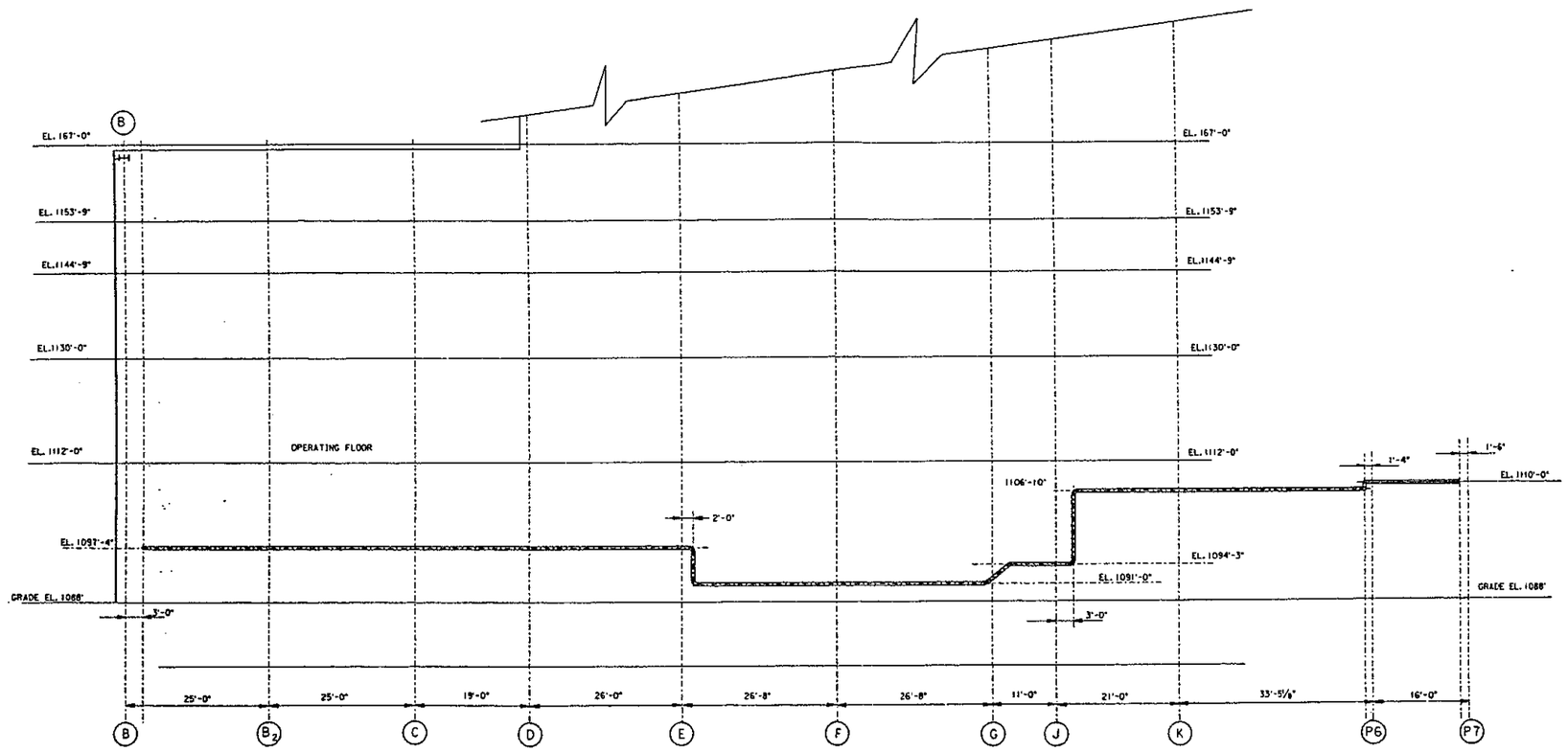
PARTIAL SECTION AT COLUMN LINE 35
LOOKING EAST
SHOWING THE AIR RECEIVER

SCALE 1/4"= 1'-0"
0 2 4 8 FT

Bechtel
Bechtel Corporation San Francisco Regional Office
Pennsylvania Electric Company
Seward Station Unit No. 5

CZD/FGD DEMONSTRATION PROJECT
AIR COMPRESSOR INSTALLATION
PARTIAL SECTION LOOKING FROM "35"

P110-001	1/4"=1'	SK-211	1
PROJECT CONTROL NO.	SCALE	DRAWING NUMBER	REV.

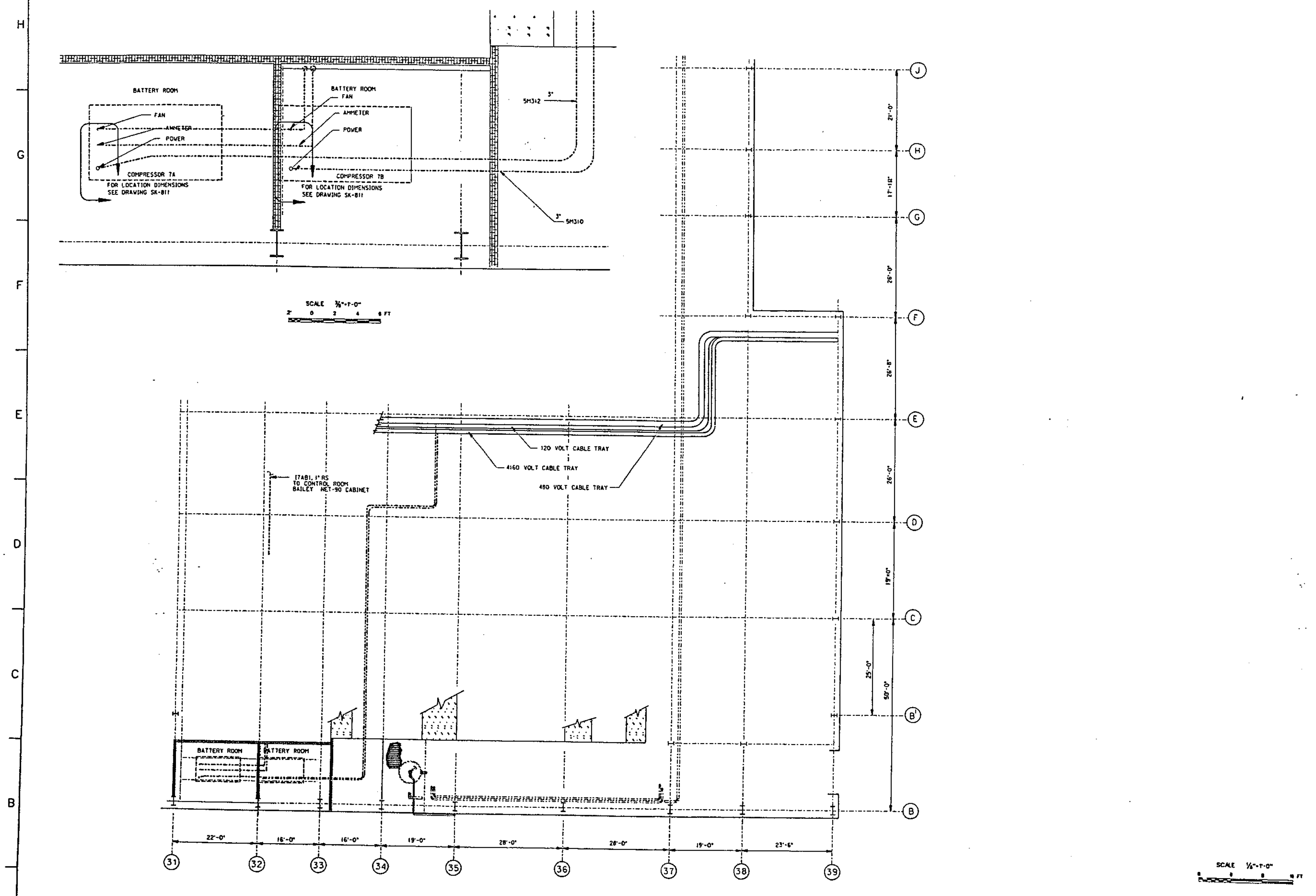


SECTION LOOKING EAST AT COLUMN ROW 37

SCALE 1/8"-1'-0"

Bechtel
Bechtel Corporation San Francisco Regional Offices
Pensacola APH

CZD/FGD DEMONSTRATION PROJECT
AIR COMPRESSOR INSTALLATION
N-S SECT. LOOKING AT COL. ROW 37
SK-220 2

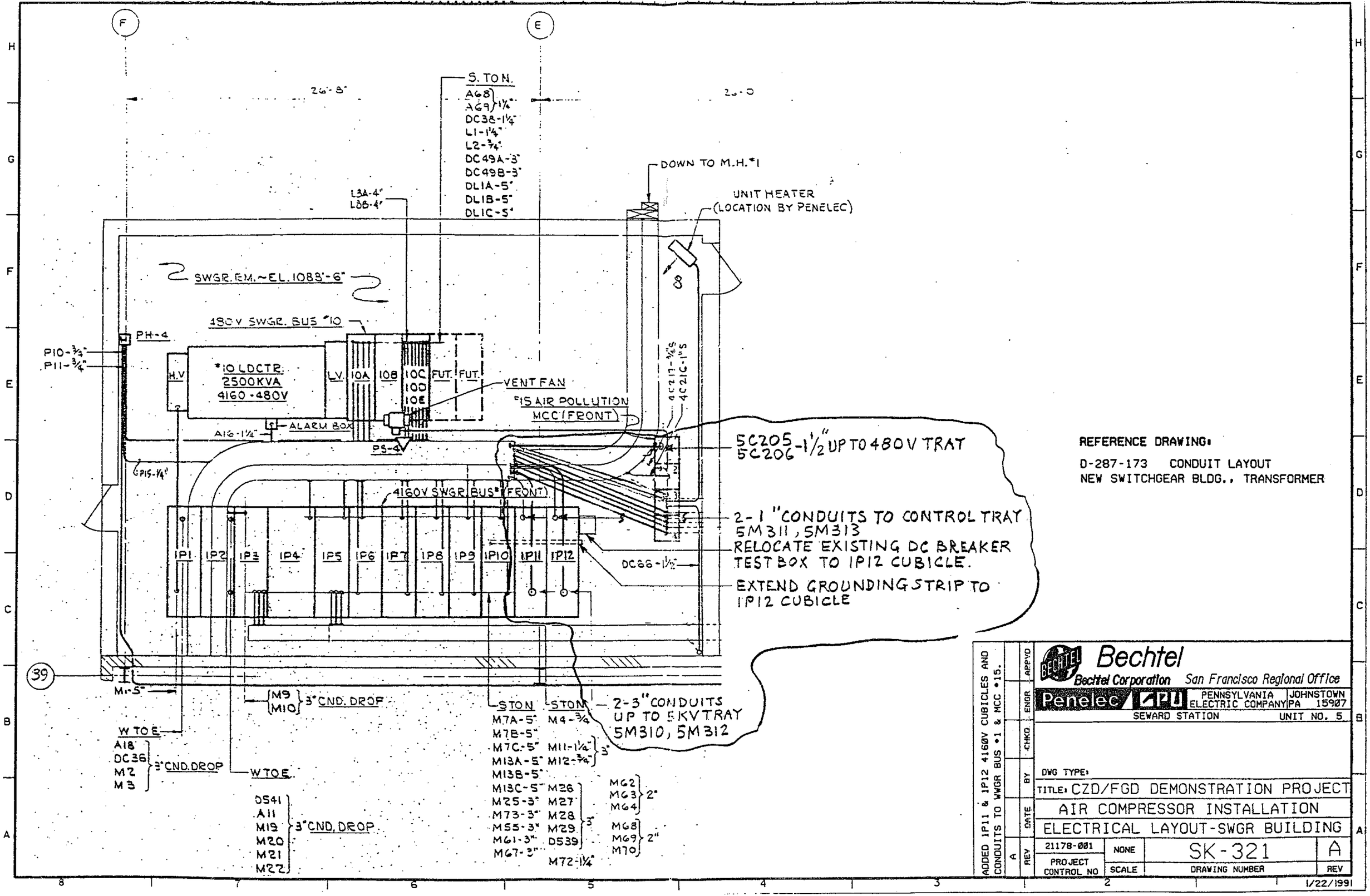


Bechtel
Bechtel Corporation San Francisco Regional Office
Penelec / GPU
SEWARD STATION UNIT NO. 5

CZD/FGD DEMONSTRATION PROJECT
AIR COMPRESSOR INSTALLATION
ELECTRICAL ROUTING

AS BUILT

SK-320 2



REFERENCE DRAWING:

D-287-173 CONDUIT LAYOUT
NEW SWITCHGEAR BLDG., TRANSFORMER

ADDED 1P11 & 1P12 4160V CUBICLES AND CONDUITS TO SWGR BUS #1 & MCC #15.

REV	DATE	BY	CHKD	ENGR	APPVD
A					

Bechtel
Bechtel Corporation San Francisco Regional Office

Penelec / PU PENNSYLVANIA ELECTRIC COMPANY | JOHNSTOWN PA 15907

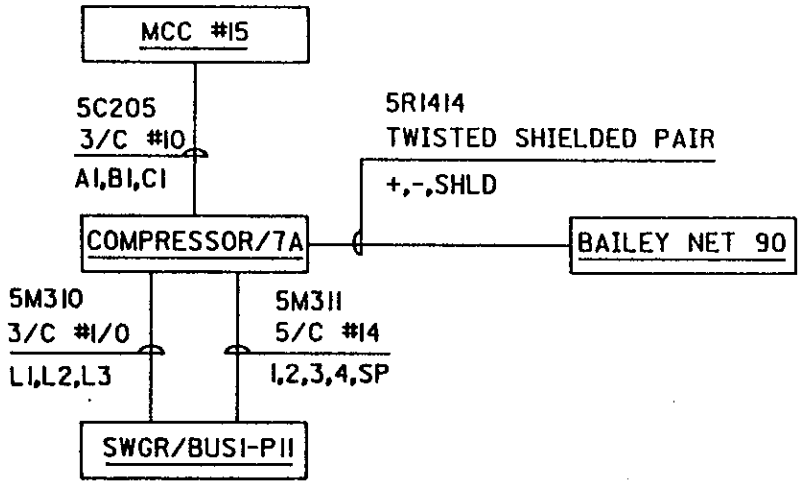
SEWARD STATION UNIT NO. 5

DWG TYPE:

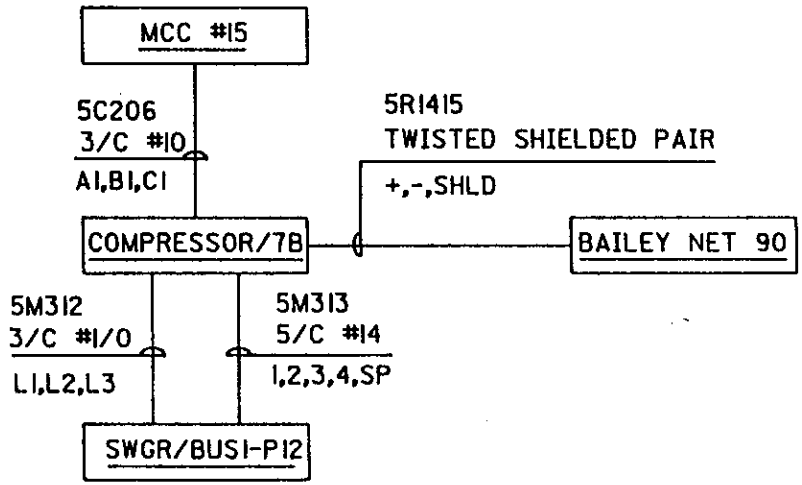
TITLE: CZD/FGD DEMONSTRATION PROJECT
AIR COMPRESSOR INSTALLATION
ELECTRICAL LAYOUT-SWGR BUILDING

PROJECT CONTROL NO	SCALE	DRAWING NUMBER	REV
21178-001	NONE	SK-321	A

1/22/1991



CZD SYSTEM AIR COMPRESSOR 7A



CZD SYSTEM AIR COMPRESSOR 7B

NOTES

1. SEE VENDOR DRAWINGS FOR SCHEMATIC DIAGRAM.

REFERENCE DRAWINGS

ISSUED FOR BID.

REV	DATE	BY	CHKD	ENGR	APPVD
0		MT			

Bechtel
Bechtel Corporation San Francisco Regional Office

Pennsylvania Electric Company | Johnstown, PA 15907
SEWARD STATION UNIT NO. 5

DWG TYPE:

TITLE: CZD/FGD DEMONSTRATION PROJECT

BLOCK INTERCONNECTION DIAGRAM

COMPRESSORS 7A AND 7B

PROJECT CONTROL NO	SCALE	DRAWING NUMBER	REV
21178-001	NONE	SK-350	0

1/15/1991
SK350.DGN

CIRCUIT SCHEDULE

APPROVALS		

REV	DATE	BY	CHKD	ENGR	APPVD

SEWARD STATION UNIT NO. 5

DWG TYPE:

TITLE: CIRCUIT SCHEDULE

Bechtel Bechtel Corporation San Francisco Regional Office

Penelec GPU PENNSYLVANIA ELECTRIC COMPANY JOHNSTOWN PA 15907

21178-001	SK-370	0
PROJ. CONTROL NO	DRAWING NUMBER	REV.

ATTACHMENT 7.6
MULTI-CONDUCTOR / ALARM, CONTROL, & POWER

REV. 4

REV.	CONDUCTORS				CONDUIT		CIRCUIT NUMBER- 5C205
	NO. AND SIZE	LENGTH†	VOLTS	SUN	SIZE	LENGTH	CABLE ROUTING
	1-3-10	350'	600	CFC	1½"	125	/*/201, 202/5M311/16'
	NATURE OF CIRCUIT	480V POWER					
	FROM MCC #15 TO BE DESIGNATED BY STATION BRKR -				TO COMPRESSOR 7A		

	TERM. BLOCK	TERM. NUMBER	WIRE MARK	BASE COLOR	FIRST TRACER	SECOND TRACER		TERM. NUMBER	TERM. BLOCK	
	BREAKER		A1	BLACK	------	------		MV	A1	T1
			B1	WHITE	------	------		MV	B1	T2
	↓		C1	RED	------	------		MV	C1	T3
				GREEN	------	------				
				ORANGE	------	------				
				BLUE	------	------				
				WHITE	BLACK	------				
				RED	BLACK	------				
				GREEN	BLACK	------				
				ORANGE	BLACK	------				
				BLUE	BLACK	------				
				BLACK	WHITE	------				
				RED	WHITE	------				
				GREEN	WHITE	------				
				BLUE	WHITE	------				
				BLACK	RED	------				
				WHITE	RED	------				
				ORANGE	RED	------				
				BLUE	RED	------				
				RED	GREEN	------				
				ORANGE	GREEN	------				
				BLACK	WHITE	RED				
				WHITE	BLACK	RED				
				RED	BLACK	WHITE				

REFERENCE DWG.- FROM	REFERENCE DWG.- TO
MCC VENDOR	COMPRESSOR VENDOR

REMARKS INSTALL CABLES IN THE 480V SECTION OF 201 & 202 TRAYS.

ELEM. DIAG. SK-350

†-INCLUDES PROVISIONS FOR TERMINATING CONDUCTORS- NOT TO BE USED FOR CUTTING LENGTHS.

REV.			
0			

STATION SEWARD UNIT NO. (S) 5

C&D DEMO PROJECT

ELECT. CIRCUIT SCHEDULE

C=480V MCC

GENERATION DESIGN ENGINEERING

DRAFTING

MADE DATE

ENGINEERING APPROVALS

DISC.	ARCH	CIVIL	ELEC	MECH
ENGR. DATE				
SUPV./MGR DATE				

Penelec / GPU PENNSYLVANIA ELECTRIC COMPANY JOHNSTOWN PA 15907

21178-001	5C205	0
PROJ CONT NO.	CIRCUIT NUMBER	REV.

ATTACHMENT 7.6
MULTI-CONDUCTOR / ALARM, CONTROL, & POWER

REV. 4

REV.	CONDUCTORS				CONDUIT		CIRCUIT NUMBER- 5C206
	NO. AND SIZE	LENGTH†	VOLTS	B/M	SIZE	LENGTH	CABLE ROUTING
	1-3-10	350'	600	B-CFC	1 1/2"	125	/5C205/201,202/5M313/16'/
	NATURE OF CIRCUIT	480V POWER					
	FROM MCC #15 TO BE ASSIGNED BY STATION BRKR -						TO COMPRESSOR 7B

	TERM. BLOCK	TERM. NUMBER	WIRE MARK	BASE COLOR	FIRST TRACER	SECOND TRACER		TERM. NUMBER	TERM. BLOCK
	BREAKER		A1	BLACK	-----	-----		MV	A
	↓		B1	WHITE	-----	-----		MV	B
			C1	RED	-----	-----		MV	C
				GREEN	-----	-----			
				ORANGE	-----	-----			
				BLUE	-----	-----			
				WHITE	BLACK	-----			
				RED	BLACK	-----			
				GREEN	BLACK	-----			
				ORANGE	BLACK	-----			
				BLUE	BLACK	-----			
				BLACK	WHITE	-----			
				RED	WHITE	-----			
				GREEN	WHITE	-----			
				BLUE	WHITE	-----			
				BLACK	RED	-----			
				WHITE	RED	-----			
				ORANGE	RED	-----			
				BLUE	RED	-----			
				RED	GREEN	-----			
				ORANGE	GREEN	-----			
				BLACK	WHITE	RED			
				WHITE	BLACK	RED			
				RED	BLACK	WHITE			

REFERENCE DWG.- FROM	REFERENCE DWG.- TO
MCC VENDOR	COMPRESSOR VENDOR

REMARKS INSTALL CABLES IN THE 480V SECTION OF 201 & 202 TRAYS.

†-INCLUDES PROVISIONS FOR TERMINATING CONDUCTORS- NOT TO BE USED FOR CUTTING LENGTHS.

ELEM. DIAG. SK-350

REV.			
0			

STATION SEWARD
UNIT NO. (S) 5
CED DEMO PROJECT
ELECT. CIRCUIT SCHEDULE
C=480V MCC

GENERATION DESIGN ENGINEERING	MADE	DATE
DRAFTING		

ENGINEERING APPROVALS	DISC.	ARCH	CIVIL	ELEC	MECH
ENGR. DATE					
SUPV./MGR DATE					

Penelec / GPU PENNSYLVANIA ELECTRIC COMPANY JOHNSTOWN PA 15907

21178-001	5C206	0
PROJ. CONT. NO.	CIRCUIT NUMBER	REV

ATTACHMENT 7.6
MULTI-CONDUCTOR / ALARM, CONTROL, & POWER

REV. 4

REV.	CONDUCTORS				CONDUIT		CIRCUIT NUMBER- SM310
	NO. AND SIZE	LENGTH†	VOLTS	S/M	SIZE	LENGTH	CABLE ROUTING
	1-3-1/0 SHIELDED	350'	4160	M-CFC	3"	125	/*/103,104/*/16'/

NATURE OF CIRCUIT: POWER

FROM: SWITCHGEAR / BUS 1 BRKR P11

TO: COMPRESSOR 7A

TERM. BLOCK	TERM. NUMBER	WIRE MARK	BASE COLOR	FIRST TRACER	SECOND TRACER		TERM. NUMBER	TERM. BLOCK
BREAKER		L1	BLACK	-----	-----		T1	MOTOR
		L2	WHITE	-----	-----		T2	
		L3	RED	-----	-----		T3	
		SHIELD	GREEN	-----	-----	▷PP	GRND	
			ORANGE	-----	-----			
			BLUE	-----	-----			
			WHITE	BLACK	-----			
			RED	BLACK	-----			
			GREEN	BLACK	-----			
			ORANGE	BLACK	-----			
			BLUE	BLACK	-----			
			BLACK	WHITE	-----			
			RED	WHITE	-----			
			GREEN	WHITE	-----			
			BLUE	WHITE	-----			
			BLACK	RED	-----			
			WHITE	RED	-----			
			ORANGE	RED	-----			
			BLUE	RED	-----			
			RED	GREEN	-----			
			ORANGE	GREEN	-----			
			BLACK	WHITE	RED			
			WHITE	BLACK	RED			
			RED	BLACK	WHITE			

L1
L2
L3

REFERENCE DWG.- FROM: SWITCHGEAR VENDOR

REFERENCE DWG.- TO: COMPRESSOR VENDOR

REMARKS: USE STRESS TUBE KITS (RAYCHEM HVT-3-81-G) FOR TERMINATION OF CABLES AT THE SWGR AND COMPRESSORS.

NOTE: L1 USES CT1 CURRENT XFMR
L2 - CT2
L3 - CT3

ELEM. DIAG. SK-350

†-INCLUDES PROVISIONS FOR TERMINATING CONDUCTORS- NOT TO BE USED FOR CUTTING LENGTHS.

REV.			
0			

STATION: SEWARD — UNIT NO.(S): 5

CED DEMO PROJECT
ELECT. CIRCUIT SCHEDULE

M = 4160V POWER

GENERATION DESIGN ENGINEERING

DRAFTING — MADE — DATE

ENGINEERING APPROVALS

DISC.	ARCH	CIVIL	ELEC	MECH
ENGR. / DATE				
SUPV./MGR / DATE				

Penelec / GPU — PENNSYLVANIA ELECTRIC COMPANY — JOHNSTOWN PA 15907

PROJ. CONT. NO.	CIRCUIT NUMBER	REV.
21178-001	5M310	0

ATTACHMENT 7.6
MULTI-CONDUCTOR / ALARM, CONTROL, & POWER

REV. 4

REV.	CONDUCTORS				CONDUIT		CIRCUIT NUMBER- 5M312
	NO. AND SIZE	LENGTH†	VOLTS	Ø/W	SIZE	LENGTH	CABLE ROUTING
	1-3-1/0 SHIELDED	350'	4160	CFC	3"	125	/*/103,104/*/16'/
	NATURE OF CIRCUIT	POWER					
	FROM SWITCHGEAR / BUS 1 BRKR P12				TO COMPRESSOR 7B		

	TERM. BLOCK	TERM. NUMBER	WIRE MARK	BASE COLOR	FIRST TRACER	SECOND TRACER		TERM. NUMBER	TERM. BLOCK
	BREAKER		L1	BLACK	-----	-----		T1	MOTOR
			L2	WHITE	-----	-----		T2	
			L3	RED	-----	-----		T3	
			SHIELD	GREEN	-----	-----	DRD	GRND	⏚
				ORANGE	-----	-----			
				BLUE	-----	-----			
				WHITE	BLACK	-----			
				RED	BLACK	-----			
				GREEN	BLACK	-----			
				ORANGE	BLACK	-----			
				BLUE	BLACK	-----			
				BLACK	WHITE	-----			
				RED	WHITE	-----			
				GREEN	WHITE	-----			
				BLUE	WHITE	-----			
				BLACK	RED	-----			
				WHITE	RED	-----			
				ORANGE	RED	-----			
				BLUE	RED	-----			
				RED	GREEN	-----			
				ORANGE	GREEN	-----			
				BLACK	WHITE	RED			
				WHITE	BLACK	RED			
				RED	BLACK	WHITE			

REFERENCE DWG.- FROM	REFERENCE DWG.- TO
SWITCHGEAR VENDOR	COMPRESSOR VENDOR

REMARKS USE STRESS TUBE KITS (RAYCHEM HVT-3-81-G) FOR TERMINATION OF CABLES AT THE SWGR AND COMPRESSORS.

NOTE L1 USES CT1 CURRENT SENSE
L2 CT2
L3 CT3

†-INCLUDES PROVISIONS FOR TERMINATING CONDUCTORS- NOT TO BE USED FOR CUTTING LENGTHS.

ELEM. DIAG. SK-350

REV.				ENGINEERING APPROVALS				
0			GENERATION DESIGN ENGINEERING	DISC.	ARCH	CIVIL	ELEC	MECH
				ENGR. DATE				
STATION SEWARD		UNIT NO.(S) 5	DRAFTING	SUPV./MGR DATE				
CZD DEMO PROJECT			MADE DATE					
ELECT. CIRCUIT SCHEDULE			Penelec / GPU	PENNSYLVANIA ELECTRIC COMPANY			JOHNSTOWN PA 15907	
M = 4160V POWER			21178-001 PROJ. CONT. NO.	5M312 CIRCUIT NUMBER				0 REV

ATTACHMENT 7.7
PAIR SHIELDED / INSTRUMENTATION

REV. 4

REV.	CONDUCTORS				CONDUIT		CIRCUIT NUMBER- 5R1414
	NO. AND SIZE	LENGTH†	VOLTS	B/M	SIZE	LENGTH	CABLE ROUTING
	1-PR-18SH	550'	600	CFC	1" / 1 1/2"	20' / 500	/*/PB /**/16'/

NATURE OF CIRCUIT: INSTRUMENTATION

FROM: COMPRESSOR 7A AMMETER

TO: BAILEY NET 90 CABINET

TERM. BLOCK	TERM. NUMBER	WIRE MARK	PAIR NO.	FIRST TRACER	WIRE MARK	TERM. NUMBER	TERM. BLOCK
N°	H68	H68 + 116	1	BLACK	+	COIL IN BASE	
N°	H69	H69 - 117		WHITE	-	COIL IN BASE	
CUST GRD		PAIR DRAIN			PAIR DRAIN		
			2	BLACK			
		PAIR DRAIN		WHITE			
			3	BLACK			
		PAIR DRAIN		WHITE			
			4	BLACK			
		PAIR DRAIN		WHITE			
			5	BLACK			
		PAIR DRAIN		WHITE			
			6	BLACK			
		PAIR DRAIN		WHITE			
			7	BLACK			
		PAIR DRAIN		WHITE			
			8	BLACK			
		PAIR DRAIN		WHITE			
		CABLE DRAIN					

REFERENCE DWG.-FROM: COMPRESSOR VENDORE

REFERENCE DWG.-TO: BAILY NET 90 CABINET VENDOR

REMARKS

**5R1414, 5R1415

†-INCLUDES PROVISIONS FOR TERMINATING CONDUCTORS- NOT TO BE USED FOR CUTTING LENGTHS.

ELEM. DIAG. SK-350

REV.				ENGINEERING APPROVALS				
0				GENERATION DESIGN ENGINEERING	DISC.	ARCH	CIVIL	ELEC	MECH
					ENGR.				
				DRAFTING	DATE				
					SUPV./MGR				
				MADE	DATE	DATE			

STATION SEWARD — UNIT NO.(S) 5

CED DEMO PROJECT

ELECT. CIRCUIT SCHEDULE

R = INSTRUMENTATION

Penelec / GPU — PENNSYLVANIA ELECTRIC COMPANY — JOHNSTOWN PA 15907

21178-001	5R1414	0
PROJ. CONT. NO.	CIRCUIT NUMBER	REV.

ATTACHMENT 7.7
PAIR SHIELDED / INSTRUMENTATION

REV. 4

REV.	CONDUCTORS				CONDUIT		CIRCUIT NUMBER- 5R1415
	NO. AND SIZE	LENGTH†	VOLTS	S/N	SIZE	LENGTH	CABLE ROUTING
	1-PR-18SH	550'	600	CFC	1" / 1 1/2"	50' / 500	/*/PB /**/16'/
	NATURE OF CIRCUIT	INSTRUMENTATION					
	FROM	COMPRESSOR 7B AMMETER			TO	BAILEY NET 90 CABINET	

TERM. BLOCK	TERM. NUMBER	WIRE MARK	PAIR NO.	FIRST TRACER	WIRE MARK	TERM. NUMBER	TERM. BLOCK
U-1	[illegible]	[illegible] + 116	1	BLACK	+	COIL IN BASE	
U-1	[illegible]	[illegible] - 117		WHITE	-	COIL IN BASE	
CUST GRD		PAIR DRAIN			PAIR DRAIN		
			2	BLACK			
				WHITE			
		PAIR DRAIN					
			3	BLACK			
				WHITE			
		PAIR DRAIN					
			4	BLACK			
				WHITE			
		PAIR DRAIN					
			5	BLACK			
				WHITE			
		PAIR DRAIN					
			6	BLACK			
				WHITE			
		PAIR DRAIN					
			7	BLACK			
				WHITE			
		PAIR DRAIN					
			8	BLACK			
				WHITE			
		PAIR DRAIN					
		CABLE DRAIN					

REFERENCE DWG.-FROM	REFERENCE DWG.-TO
COMPRESSOR VENDORE	BAILY NET 90 CABINET VENDOR

REMARKS

**5R1414, 5R1415

ELEM. DIAG. SK-350

†-INCLUDES PROVISIONS FOR TERMINATING CONDUCTORS- NOT TO BE USED FOR CUTTING LENGTHS.

REV.			
0			

STATION SEWARD UNIT NO.(S) 5

CED DEMO PROJECT

ELECT. CIRCUIT SCHEDULE

R = INSTRUMENTATION

GENERATION DESIGN ENGINEERING	ENGINEERING APPROVALS				
	DISC.	ARCH	CIVIL	ELEC	MECH
	ENGR.				
DRAFTING	DATE				
MADE DATE	SUPV./MGR. DATE				

Penelec / GPU PENNSYLVANIA ELECTRIC COMPANY JOHNSTOWN PA. 15907

21178-001 PROJ. CONT. NO. | 5R1415 CIRCUIT NUMBER | 0 REV

ATTACHMENT 7.6
MULTI-CONDUCTOR / ALARM, CONTROL, & POWER

REV. 4

REV.	CONDUCTORS				CONDUIT		CIRCUIT NUMBER- 5M311
	NO. AND SIZE	LENGTH†	VOLTS	B/M	SIZE	LENGTH	CABLE ROUTING
	1-5-14	350'	600	CFC	1"	125	/*/201, 202/*/16'/
	NATURE OF CIRCUIT	CONTROL					
	FROM SWITCHGEAR / BUS 1 BRKR P11				TO COMPRESSOR 7A		

	TERM. BLOCK	TERM. NUMBER	WIRE MARK	BASE COLOR	FIRST TRACER	SECOND TRACER		TERM. NUMBER	TERM. BLOCK
	A2	11	1	BLACK	-----	-----	[illegible]	[illegible]	[illegible]
	A2	10	2	WHITE	-----	-----	- OPEN	[illegible]	[illegible]
	A1	3	3	RED	-----	-----	+ CLOSE		
	A1	5	4	GREEN	-----	-----	- CLOSE		
			SP	ORANGE	-----	-----			
				BLUE	-----	-----			
				WHITE	BLACK	-----			
				RED	BLACK	-----			
				GREEN	BLACK	-----			
				ORANGE	BLACK	-----			
				BLUE	BLACK	-----			
				BLACK	WHITE	-----			
				RED	WHITE	-----			
				GREEN	WHITE	-----			
				BLUE	WHITE	-----			
				BLACK	RED	-----			
				WHITE	RED	-----			
				ORANGE	RED	-----			
				BLUE	RED	-----			
				RED	GREEN	-----			
				ORANGE	GREEN	-----			
				BLACK	WHITE	RED			
				WHITE	BLACK	RED			
				RED	BLACK	WHITE			

REFERENCE DWG.- FROM	REFERENCE DWG.- TO
SWITCHGEAR VENDOR	COMPRESSOR VENDOR

REMARKS INSTALL CABLES IN THE CONTROL SECTION OF 201 & 202 TRAYS.

†-INCLUDES PROVISIONS FOR TERMINATING CONDUCTORS- NOT TO BE USED FOR CUTTING LENGTHS.

ELEM. DIAG. SK-350

REV.			GENERATION DESIGN ENGINEERING	ENGINEERING APPROVALS				
O				DISC.	ARCH	CIVIL	ELEC	MECH
				ENGR. DATE				
			DRAFTING	SUPV./MGR DATE				
			MADE DATE					

STATION SEWARD — UNIT NO. (S) 5

CED DEMO PROJECT

ELECT. CIRCUIT SCHEDULE

M = 4160 SWITCHGEAR

Penelec / GPU — PENNSYLVANIA ELECTRIC COMPANY — JOHNSTOWN PA. 15907

21178-001	5M311	O
PROJ. CONT. NO.	CIRCUIT NUMBER	REV.

ATTACHMENT 7.6
MULTI-CONDUCTOR / ALARM, CONTROL, & POWER

REV. 4

REV.	CONDUCTORS				CONDUIT		CIRCUIT NUMBER- 5M313
	NO. AND SIZE	LENGTH†	VOLTS	B/M	SIZE	LENGTH	CABLE ROUTING
	1-5-14	350'	600	B-CFC	1"	125	/*/201, 202/*/16'/

NATURE OF CIRCUIT: CONTROL

FROM: SWITCHGEAR / BUS 1 BRKR P12

TO: COMPRESSOR 7B

TERM. BLOCK	TERM. NUMBER	WIRE MARK	BASE COLOR	FIRST TRACER	SECOND TRACER		TERM. NUMBER	TERM. BLOCK
A2	11	1	BLACK	-----	-----	+ OPEN	8-6	TB-1
A2	10	2	WHITE	-----	-----	- OPEN	8-5	TB-1
A1	3	3	RED	-----	-----	+ CLOSE		
A1	5	4	GREEN	-----	-----	- CLOSE		
		SP	ORANGE	-----	-----			
			BLUE	-----	-----			
			WHITE	BLACK	-----			
			RED	BLACK	-----			
			GREEN	BLACK	-----			
			ORANGE	BLACK	-----			
			BLUE	BLACK	-----			
			BLACK	WHITE	-----			
			RED	WHITE	-----			
			GREEN	WHITE	-----			
			BLUE	WHITE	-----			
			BLACK	RED	-----			
			WHITE	RED	-----			
			ORANGE	RED	-----			
			BLUE	RED	-----			
			RED	GREEN	-----			
			ORANGE	GREEN	-----			
			BLACK	WHITE	RED			
			WHITE	BLACK	RED			
			RED	BLACK	WHITE			

REFERENCE DWG.- FROM: SWITCHGEAR VENDOR

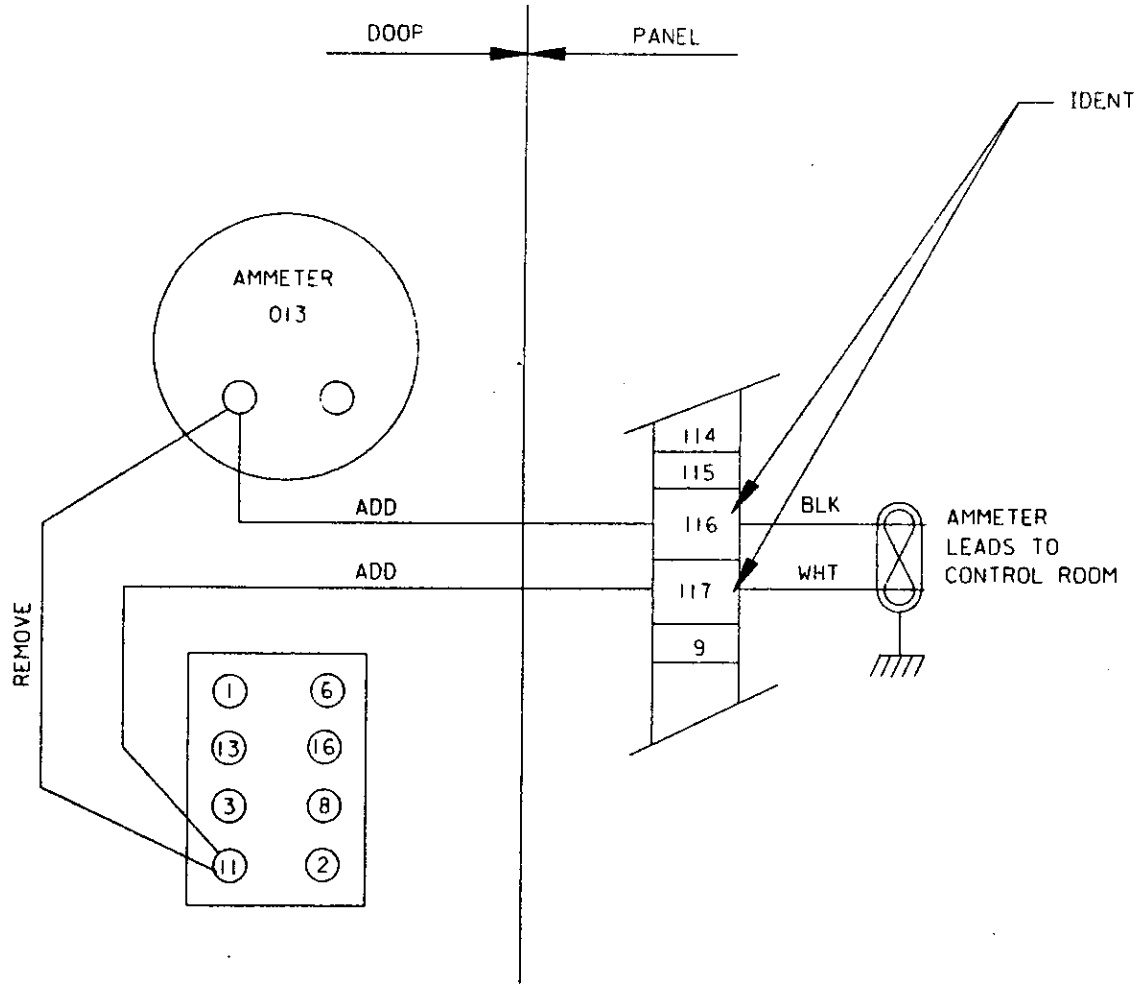
REFERENCE DWG.- TO: COMPRESSOR VENDOR

REMARKS: INSTALL CABLES IN THE CONTROL SECTION OF 201 & 202 TRAYS.

†-INCLUDES PROVISIONS FOR TERMINATING CONDUCTORS- NOT TO BE USED FOR CUTTING LENGTHS.

ELEM. DIAG. SK-350

REV.				ENGINEERING APPROVALS				
0			GENERATION DESIGN ENGINEERING	DISC.	ARCH	CIVIL	ELEC	MECH
				ENGR. DATE				
STATION: SEWARD		UNIT NO (S): 5	DRAFTING					
CED DEMO PROJECT				SUPV./MGR DATE				
ELECT. CIRCUIT SCHEDULE			MADE DATE					
M = 4160 SWITCHGEAR			Penelec / GPU	PENNSYLVANIA ELECTRIC COMPANY			JOHNSTOWN PA. 15907	
			21178-001 PROJ. CONT. NO.	5M313 CIRCUIT NUMBER				0 REV.



NOTES

1. THE ADDED WIRE SHALL BE OF THE SAME GUAGE AS THE REST OF THE PANEL.
2. THE ENDS OF THE WIRES SHALL BE IDENTIFIED WITH TERMINATION IDENTIFICATION IN THE SAME MANNER AS THE ORIGINAL WIRING
3. THE RELOCATION OF THE CUSTOMER GROUND CONNECTION MAY BE TO A LOCATION CONVIENT FOR TERMINATION OF THE SHIELD WIRE

Bechtel Corporation San Francisco Regional Office		SEWARD STATION UNIT NO. 5 PENNSYLVANIA ELECTRIC COMPANY		JOHNSTOWN PA 15907	
PROJECT CONTROL NO	TITLE:	DRAWING NUMBER	DATE:	SCALE:	REV
21178-002	AIR COMP AMMETER MOD	SK-380	5/10/91	NONE	0

380.DGN /May. 10, 1991 /05:4

SCALE RULES

SIZE E

AIR COMPRESSSOR - 7A
K-101A

AIR COMPRESSSOR - 7B
K-101B

AIR RECEIVER
3000 GAL

LEVEL INDICATOR
DETAILS LATER

SIGHT GLASS

DRIP PAN

DRIP PAN

BACKUP COOLING WATER (75 Lb)
LOW PRESSURE CITY WATER

DRAIN LINE TO SUMP

NORMAL COOLING WATER
LOW PRESSURE COOLING TOWER

AIR OUT TO
CZD SYSTEM

AIR RECEIVER
VENT TO BUILDING
EXTERIOR

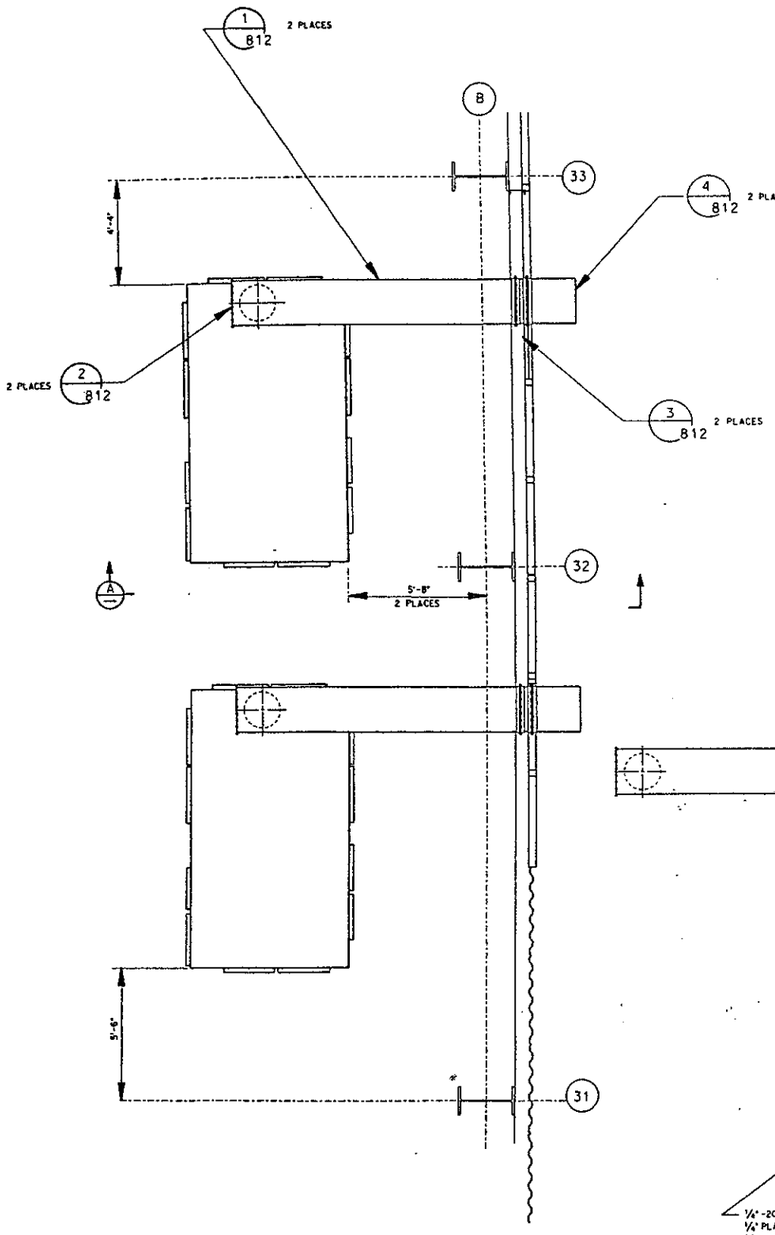
DRAIN TO
CONDENSER PIT

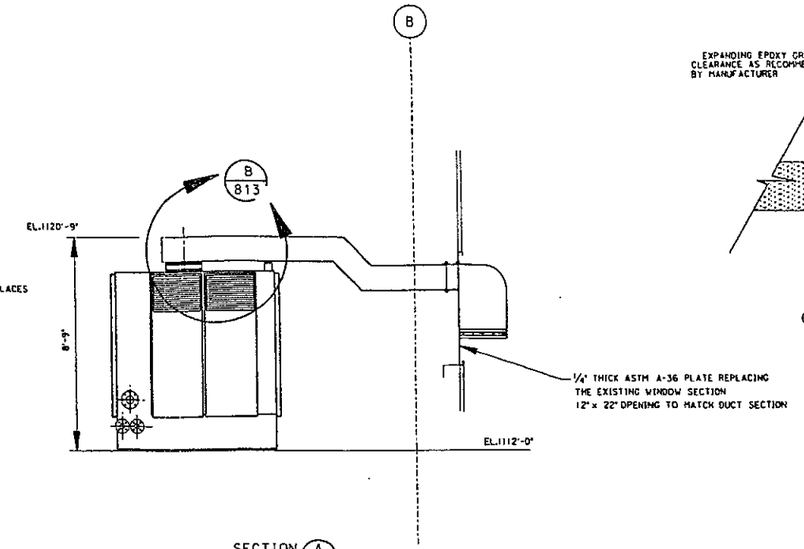
COOLING WATER RETURN
TO COOLING TOWER

DRAIN TO
CONDENSER PIT

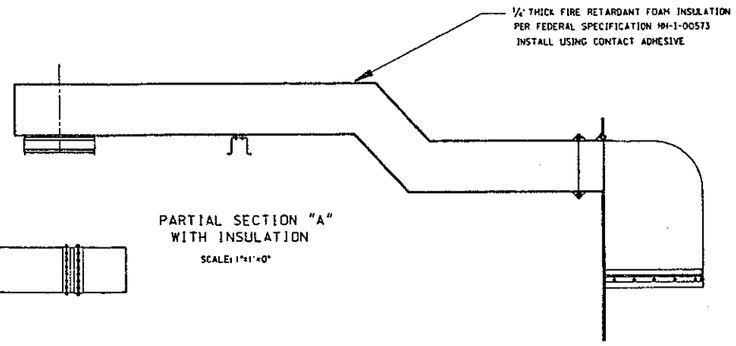
Bechtel
Bechtel Corporation San Francisco Power Division
Pleasant Hill, California

CZD/FGD DEMONSTRATION PROJECT
AIR COMPRESSOR INSTALLATION
P & I D
SK-500



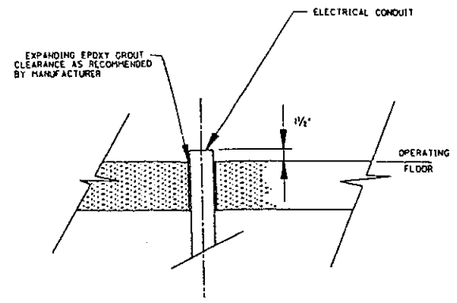


SECTION A

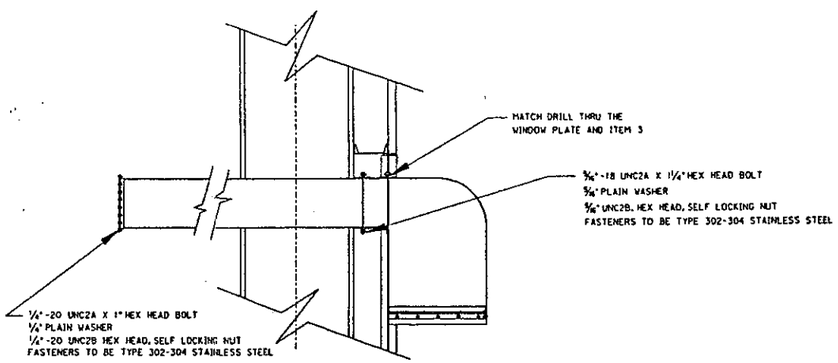


PARTIAL SECTION "A"
WITH INSULATION

SCALE: 1"=1'-0"



CONDUIT INSTALLATION
SCALE: NONE



ENLARGED
ASSEMBLY DETAIL

SCALE: 1"=1'-0"

NOTE:

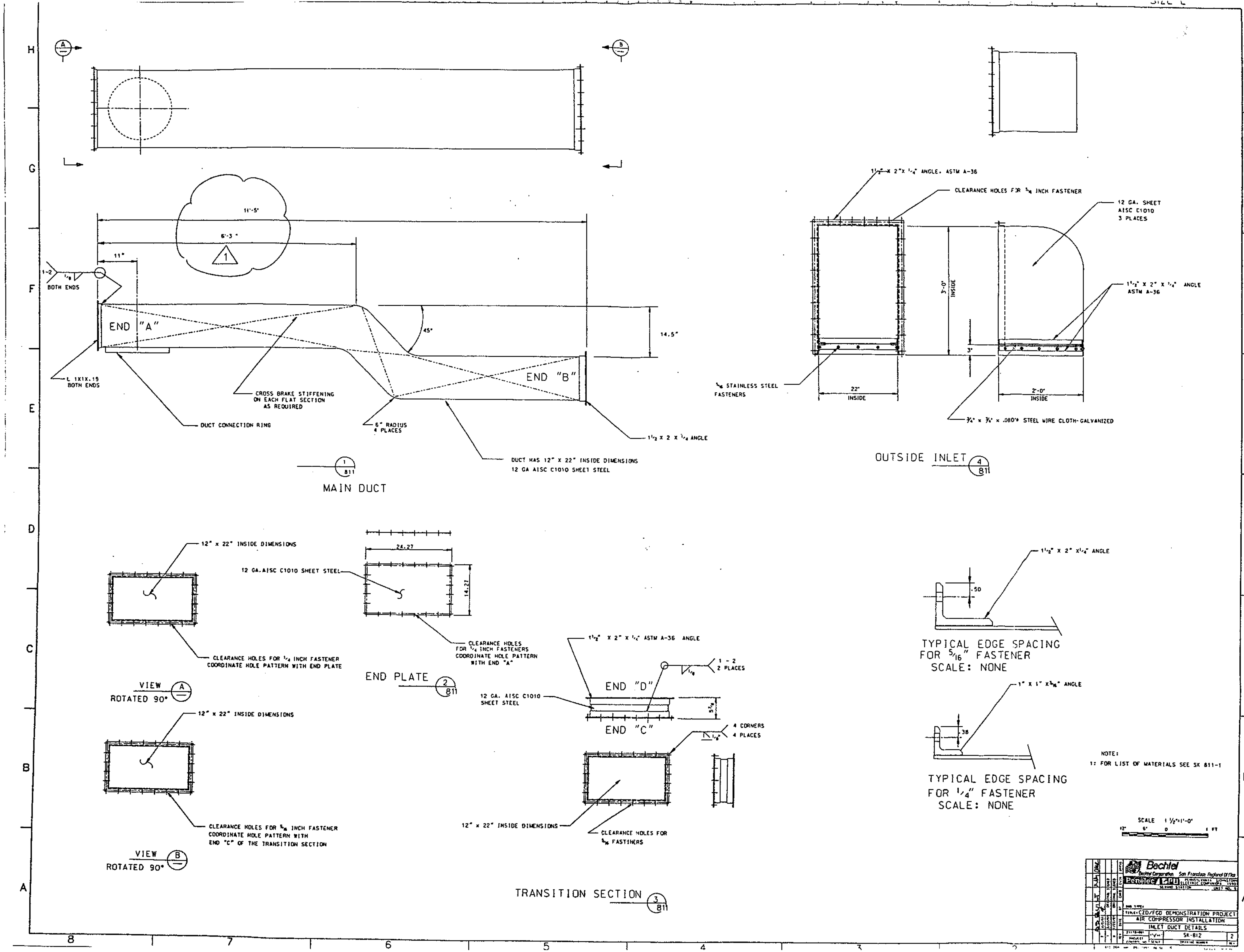
1. FOR LIST OF MATERIALS SEE DRAWING SK-811-1

SCALE 1" = 1'-0"

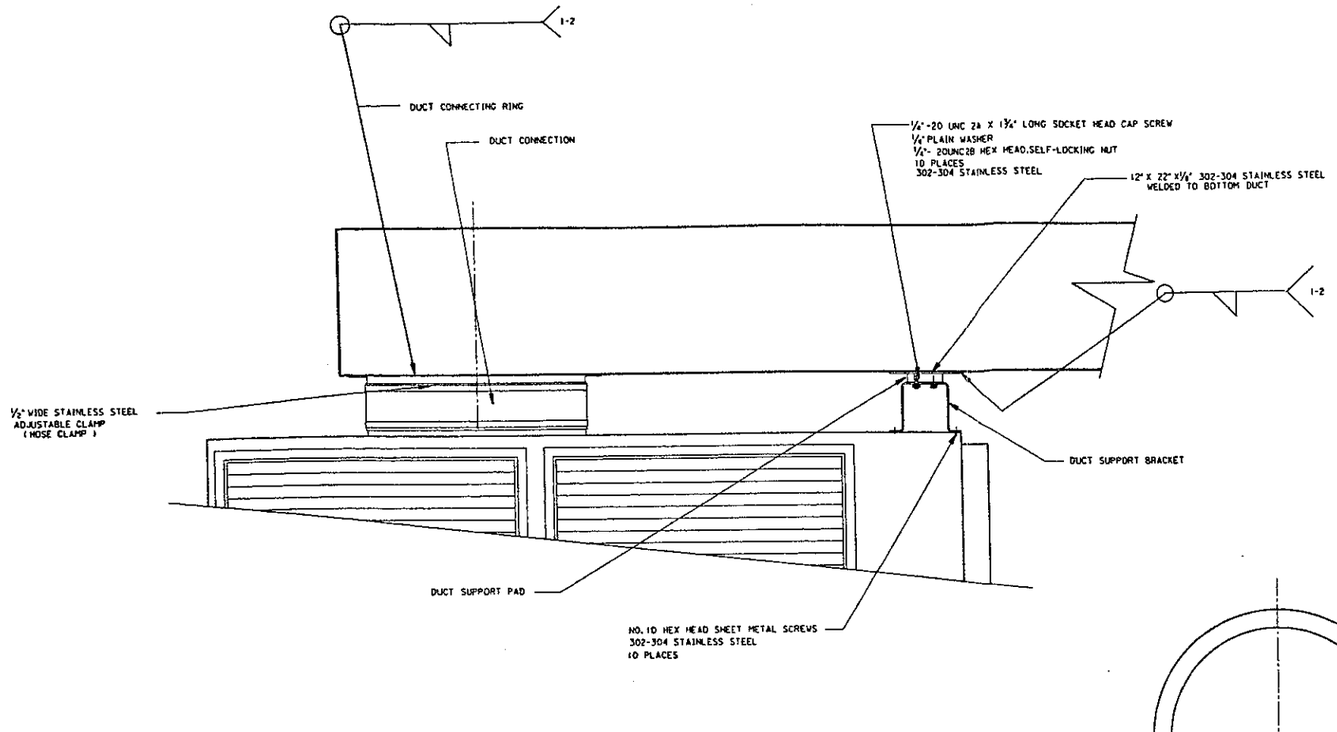
SCALE ½"=1'-0"

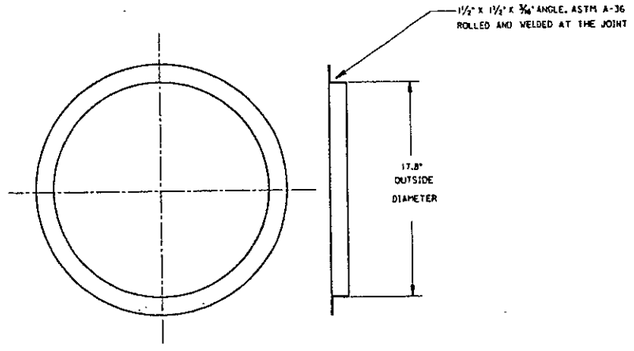
Bechtel
Bechtel Corporation San Francisco Regional Office
Pehelec APU

CZD/FGD DEMONSTRATION PROJECT
AIR COMPRESSOR INSTALLATION
COMP & DUCT REQUIREMENTS
SK-811 2

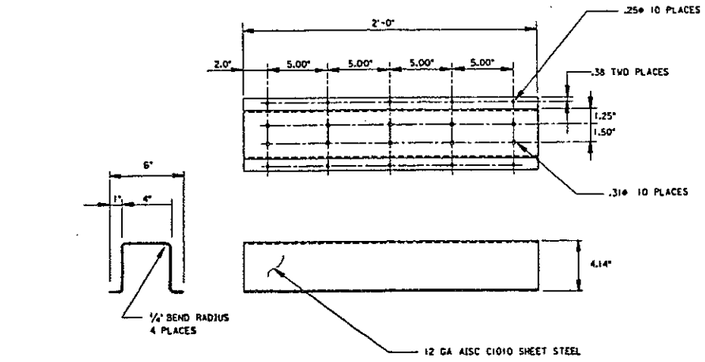


MAIN DUCT
11'-5"
6'-3"
11"
1-2 BOTH ENDS
END "A"
END "B"
45°
14.5"
L 1X1X.19 BOTH ENDS
CROSS BRAKE STIFFENING ON EACH FLAT SECTION AS REQUIRED
DUCT CONNECTION RING
6" RADIUS 4 PLACES
1½ X 2 X ¼ ANGLE
DUCT HAS 12" X 22" INSIDE DIMENSIONS
12 GA AISC C1010 SHEET STEEL
OUTSIDE INLET
1½" X 2" X ¼" ANGLE, ASTM A-36
CLEARANCE HOLES FOR 5/16 INCH FASTENER
12 GA. SHEET AISC C1010 3 PLACES
3'-0" INSIDE
1½" X 2" X ¼" ANGLE ASTM A-36
3"
5/16 STAINLESS STEEL FASTENERS
22" INSIDE
2'-0" INSIDE
¾" x ¾" x .080"Ø STEEL WIRE CLOTH-GALVANIZED
12" x 22" INSIDE DIMENSIONS
CLEARANCE HOLES FOR ¼ INCH FASTENER COORDINATE HOLE PATTERN WITH END PLATE
VIEW A ROTATED 90°
24.27
14.27
12 GA.AISC C1010 SHEET STEEL
CLEARANCE HOLES FOR ¼ INCH FASTENERS COORDINATE HOLE PATTERN WITH END "A"
END PLATE
12" x 22" INSIDE DIMENSIONS
CLEARANCE HOLES FOR 5/16 INCH FASTENER COORDINATE HOLE PATTERN WITH END "C" OF THE TRANSITION SECTION
VIEW B ROTATED 90°
1½" X 2" X ¼" ASTM A-36 ANGLE
1 - 2 2 PLACES
END "D"
END "C"
12 GA. AISC C1010 SHEET STEEL
4 CORNERS 4 PLACES
12" x 22" INSIDE DIMENSIONS
CLEARANCE HOLES FOR 5/16 FASTENERS
TRANSITION SECTION
1½" X 2" X¼" ANGLE
.50
TYPICAL EDGE SPACING FOR 5/16" FASTENER SCALE: NONE
1" X 1" X3/16" ANGLE
.38
TYPICAL EDGE SPACING FOR ¼" FASTENER SCALE: NONE
NOTE:
1: FOR LIST OF MATERIALS SEE SK 811-1
SCALE 1 ½"=1'-0"
12" 6" 0 1 FT
Bechtel
Bechtel Corporation San Francisco Regional Office
Penelec GPU
PENNSYLVANIA ELECTRIC COMPANY
SEWARD STATION
UNIT NO. 5
CZD/FGD DEMONSTRATION PROJECT
AIR COMPRESSOR INSTALLATION
INLET DUCT DETAILS
SK-812
2

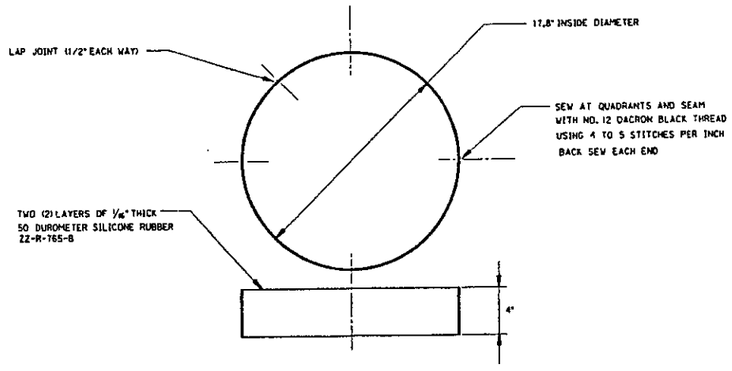




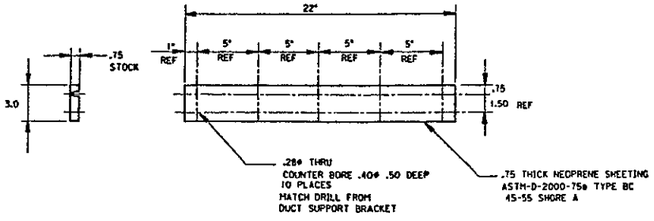
DUCT CONNECTION RING



DUCT SUPPORT BRACKET



DUCT CONNECTION



DUCT SUPPORT PAD

NOTE:

1. FOR LIST OF MATERIALS SEE DRAWING SK811-1

SCALE 3"-1'-0"

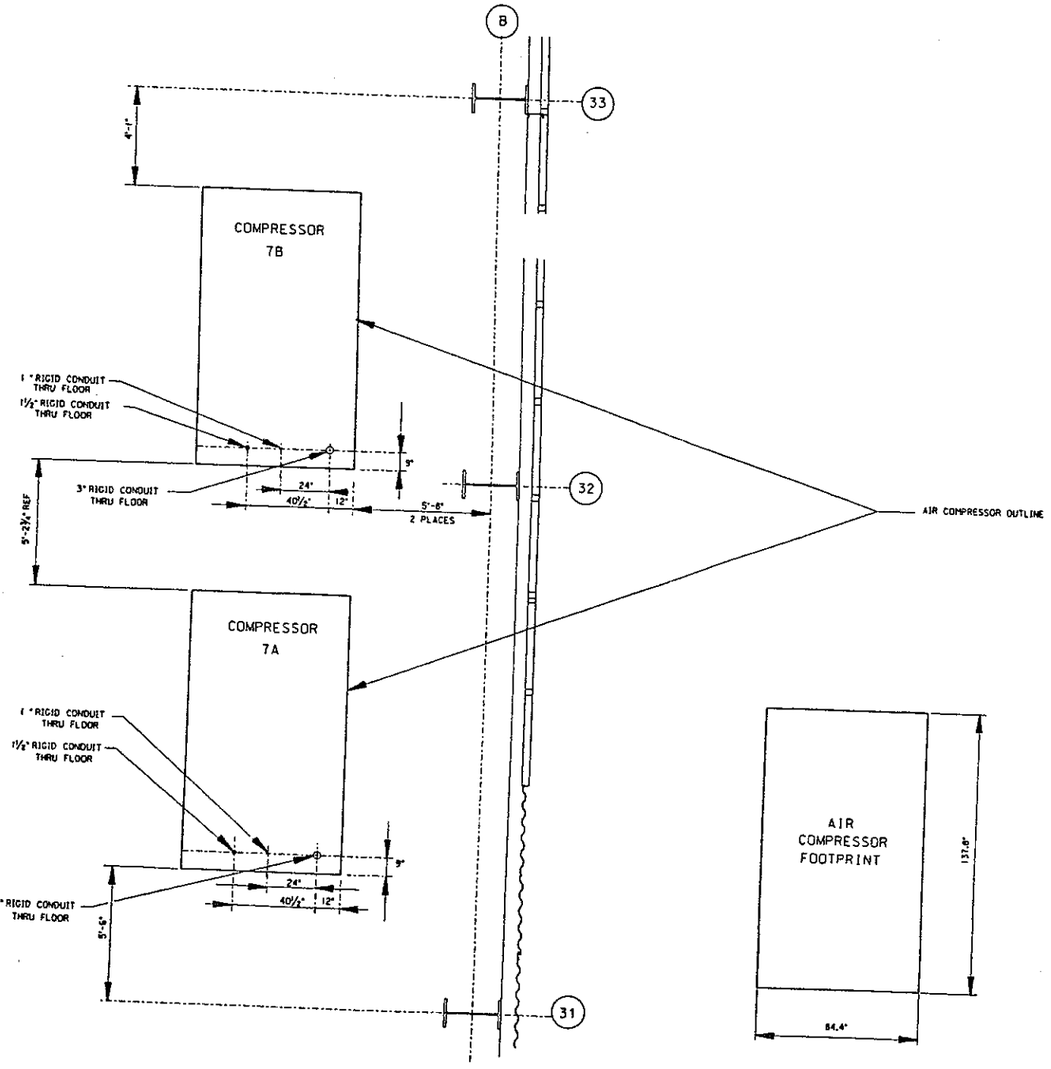
0 4" 8" 12 IN

Bechtel
Bechtel Corporation San Francisco Regional Office
Pittsburg Power Company
Pittsburg Station Unit No. 5

CZD/FGD DEMONSTRATION PROJECT
AIR COMPRESSOR INSTALLATION
INLET DUCT DETAILS

SK-813

SIZE E



NOTE:

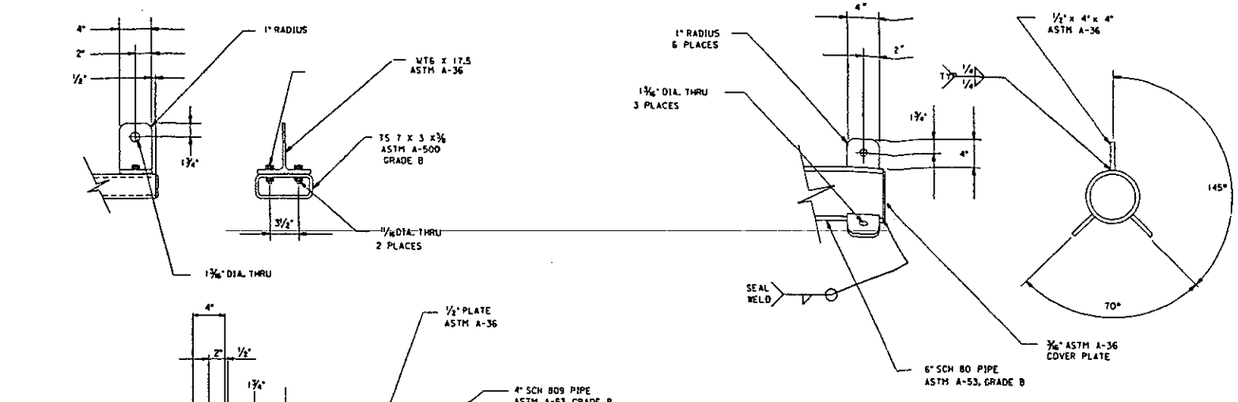
1. THIS DRAWING IS INTENDED TO SHOW THE LOCATION OF THE AIR COMPRESSORS AND THEIR RESPECTIVE FLOOR PENETRATIONS.
2. ALL DIMENSIONS ARE BASIC

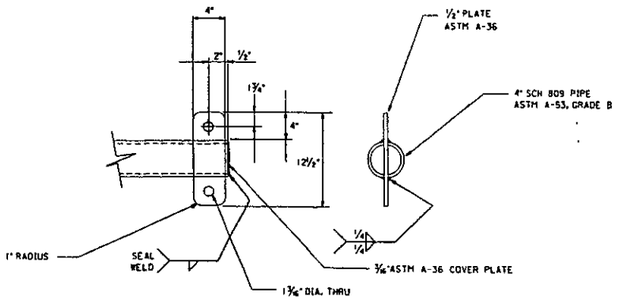
SCALE ½"=1'-0"

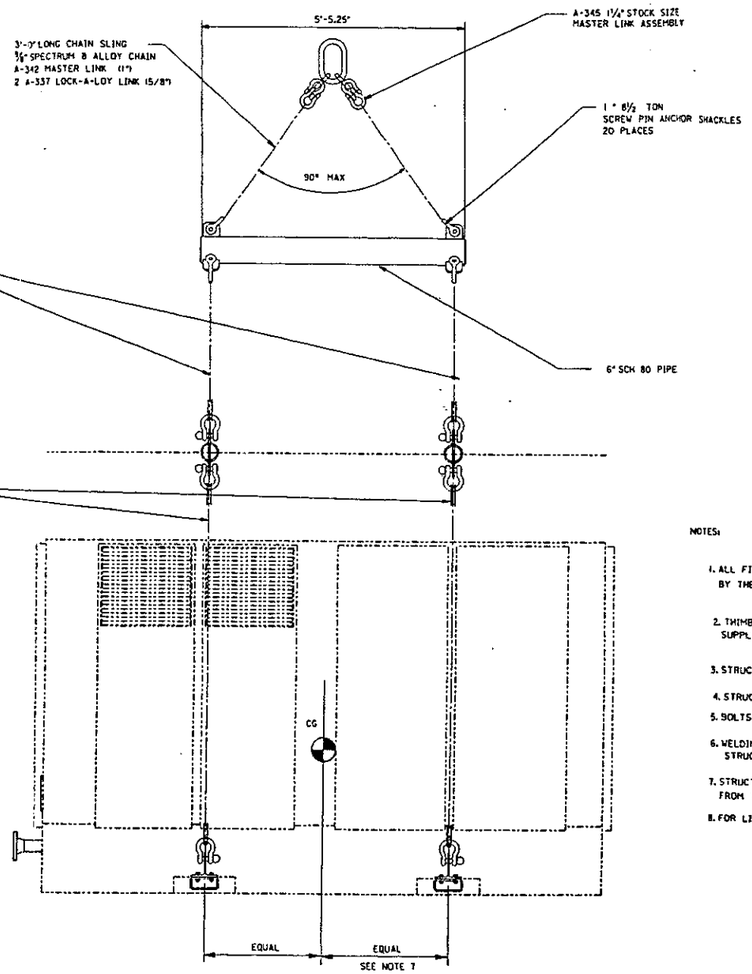
Bechtel
Bechtel Corporation San Francisco Regional Office
Pennsylvania Electric Company
Seward Station
Unit No. 5

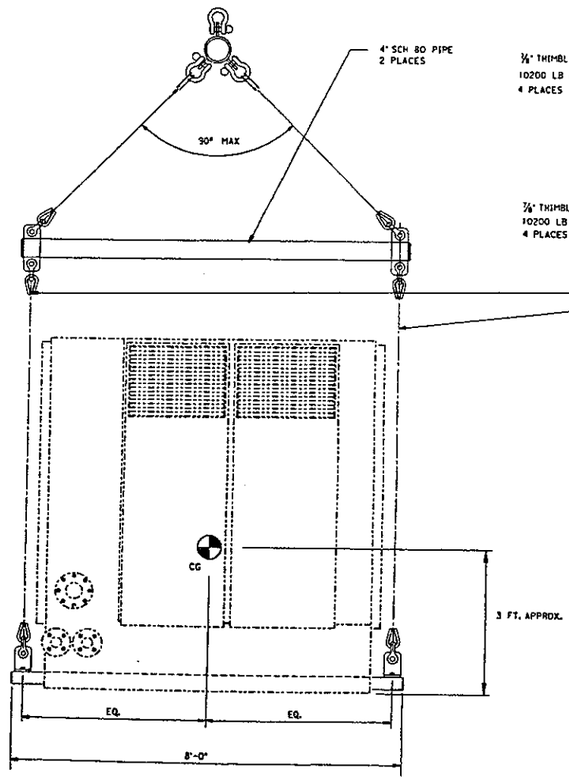
CID/FGD DEMONSTRATION PROJECT
AIR COMPRESSOR INSTALLATION
FLOOR AREA ALLOCATION

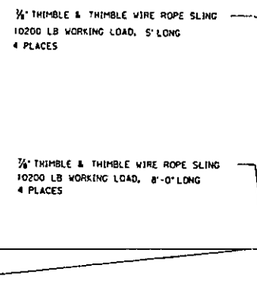
SK-B14











NOTES:

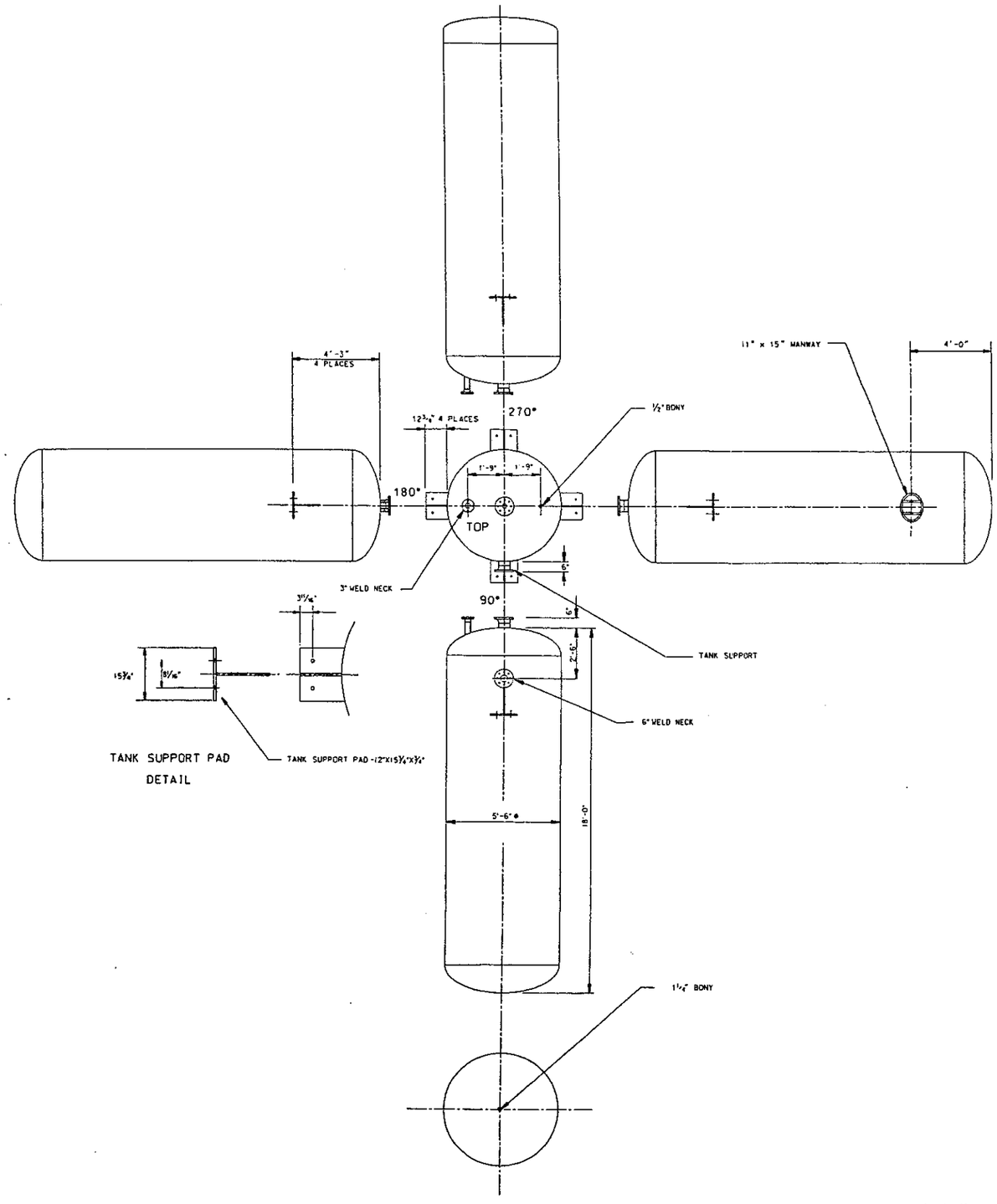
1. ALL FITTINGS SHALL BE CROSBY PRODUCTS MANUFACTURED BY THE CROSBY GROUP UNLESS NOTED OTHERVISE.
2. THIMBLE AND THIMBLE WIRE ROPE SLING SHALL BE SUPPLIED BY Mc MASTER-CARR SUPPLLY COMPANY.
3. STRUCTURAL STEEL AND PLATES SHALL CONFORM TO ASTM A-36
4. STRUCTURAL TUBE SHALL BE ASTM A-500, GRADE B.
5. BOLTS SHSLL CONFORM TO ASTM A-307
6. WELDING SHALL BE IN ACCORDANCE WITH AWS D1.1-90 STRUCTURAL WELDING CODE, USING E70 ELECTRODES
7. STRUCTURAL TUBE MEMBER SHALL BE LOCATED AT EQUAL DISTANCE FROM THE C.G. OF THE AIR COMPRESSOR.
8. FOR LIST OF MATERIALS SEE SK-816-1

SCALE 1"= 1'-0"

Bechtel
Bechtel Corporation San Francisco Regional Office
Pehelec Inc.

CZD/FGD DEMONSTRATION PROJECT
AIR COMPRESSOR INSTALLATION
LIFTING SLING

21170-005 | SK-816 | 0

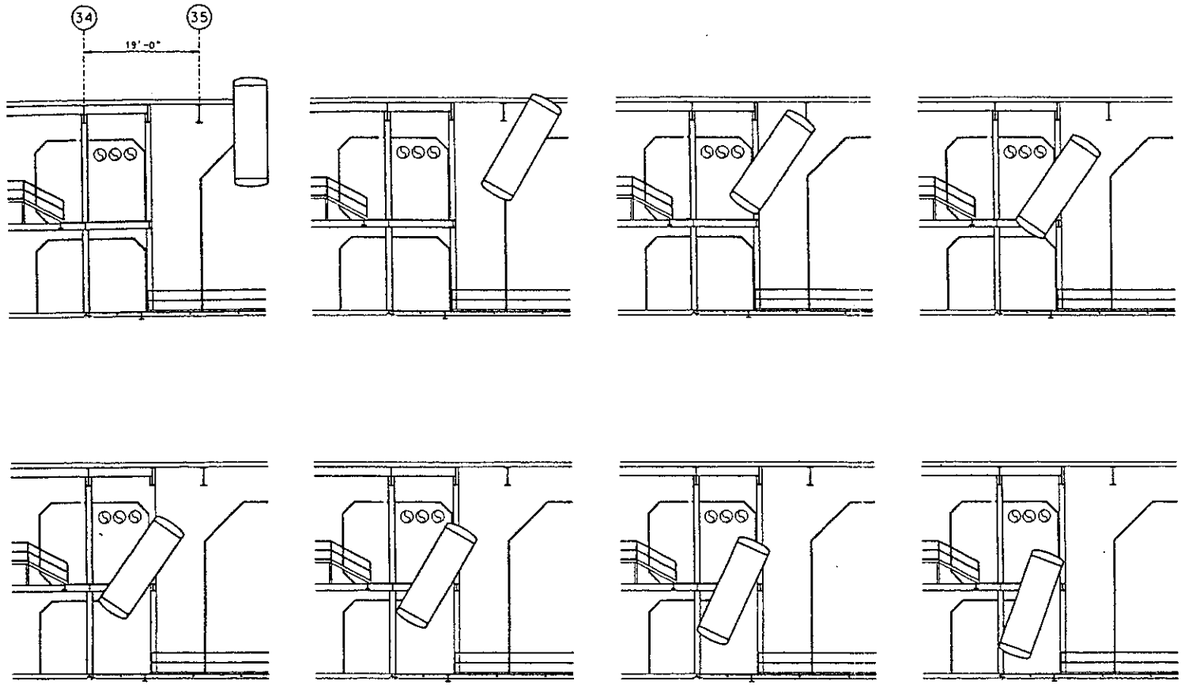


SCALE ½"=1'-0"

Bechtel
Bechtel Corporation San Francisco Regional Office
Pensacola CFBU

PENSACOLA CFB/FGD DEMONSTRATION PROJECT
AIR RECIEVER
REQUIREMENTS DRAWING

21170-001	1/2"=1'-0"	SK-820	0



PARTIAL SECTION LOOKING SOUTH FROM COL. LINE B
BETWEEN COL LINES 34 AND 35

NOTE:
1. IT IS THE INTENT OF THIS DRAWING TO DEPICT THE APPROXIMATE MOVEMENT OF THE AIR RECIEVER INTO ITS OPERATING POSITION, IT DOESNOT PORTRAY ANY PROTECTIVE MEASURES THAT MUST BE TAKEN TO GUARD AGAINST INADVERTANT DAMAGE TO ADJACENT EQUIPMENT

SCALE 1/8"-1'-0"

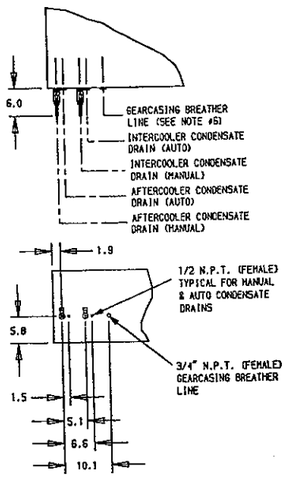
Bechtel
Bechtel Corporation San Francisco Regional Office
Pen&Elec LP&L

EZD/FGD DEMONSTRATION PROJECT
AIR RECEIVER INSTALLATION

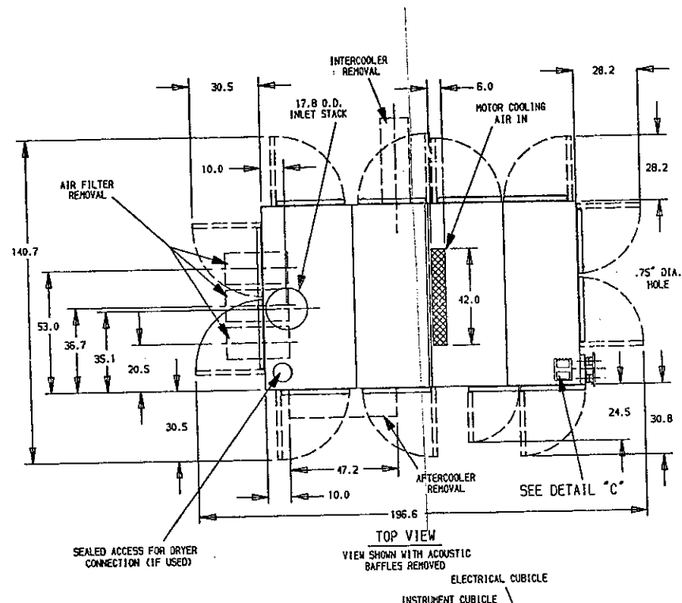
SK-821 | 0

CONT ON SH SH NO

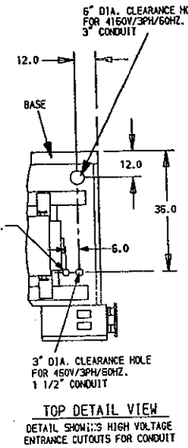
ZONE	LTR	REVISION DESCRIPTION	DATE	APP'D
	A	ECO #15520 PAR	3/21/91	MEM



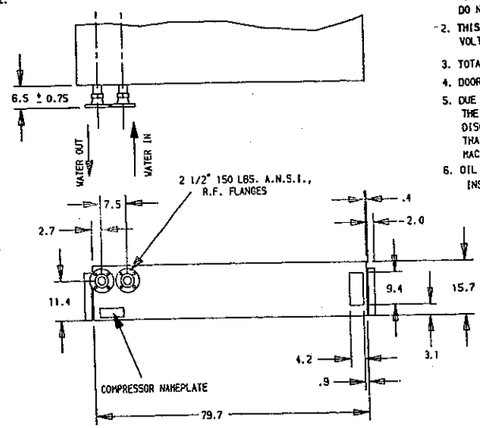
DETAIL "B"
SCALE 1"=2"



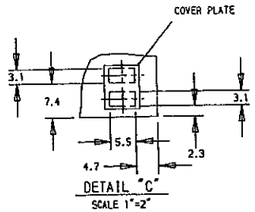
TOP VIEW
VIEW SHOWN WITH ACOUSTIC BAFFLES REMOVED



TOP DETAIL VIEW
DETAIL SHOWING HIGH VOLTAGE ENTRANCE CUTOUTS FOR CONDUIT



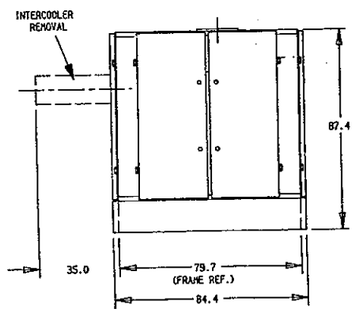
DETAIL "A"
SCALE 1"=1 1/2"



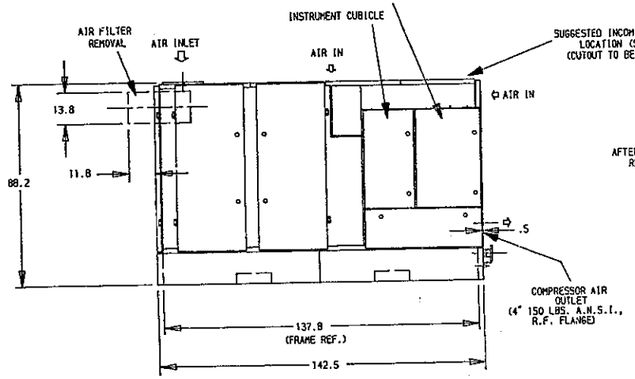
DETAIL "C"
SCALE 1"=2"

NOTES:

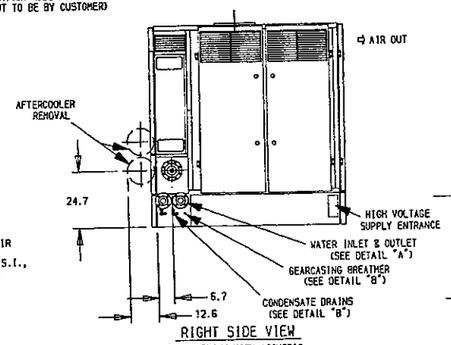
1. CONDENSATE DRAINS ARE PROVIDED WITH FEMALE CONNECTIONS FOR CUSTOMER HOOK-UP. NO SHUT-OFFS ARE TO BE PLACED ON AUTOMATIC CONDENSATE DRAIN LINES. (DO NOT RUN DRAIN LINES DIRECTLY TO AN OPEN DRAIN, DO NOT INTERCONNECT)
2. THIS ENTRANCE IS FOR VOLTAGE BELOW 600V. HIGH VOLTAGE MOTORS REQUIRE SEPARATE CONDUIT ENTRANCE.
3. TOTAL WEIGHT = 15,000 LBS.
4. DOORS LIFT OFF MACHINE FOR MAINTENANCE.
5. DUE TO FLEXIBLE CONNECTION ON AIR DISCHARGE PIPING, THE AIR CONNECTION DIMENSIONS LOCATING THE DISCHARGE MAY VARY SLIGHTLY. IT IS RECOMMENDED THAT THE DISCHARGE PIPING BE INSTALLED AFTER THE MACHINE IS IN PLACE.
6. OIL SUMP BREATHER CONNECTION, SEE INSTALLATION INSTRUCTIONS FOR SERVICING.



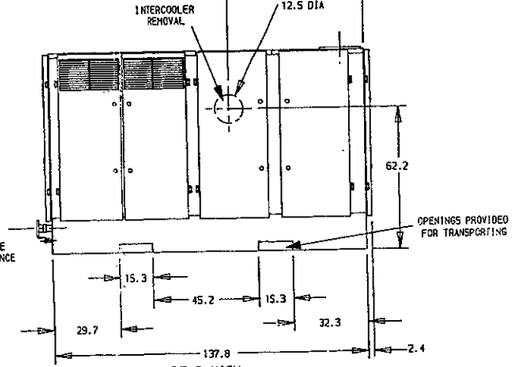
LEFT SIDE VIEW
VIEW SHOWN WITH ACOUSTIC BAFFLES



FRONT VIEW
VIEW SHOWN WITH ACOUSTIC BAFFLES



RIGHT SIDE VIEW
VIEW SHOWN WITH ACOUSTIC BAFFLES



REAR VIEW
VIEW SHOWN WITH ACOUSTIC BAFFLES REMOVED

MEDUSA Rev. 6.04 CAD Drawing
CAD produced drawing originals shall be stored electrically and be accessible by the drawing number. No manually made changes are allowed on this drawing.

- ☐ PRELIMINARY-NOT FOR CONSTRUCTION
- ☐ FOR APPROVAL-RETURN WITHIN 10 DAYS TO AVOID SHIPMENT DELAY
- ☐ CERTIFIED FOR CONSTRUCTION-ANY CHANGES AFFECT PRICE AND DELIVERY
- ☐ FOR INFORMATION ONLY

BY _____ DATE _____

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON
DECIMALS: XXX ± XX ±
FRACTIONS ±
ANGLES ± ALL SURFACES BREAK SHARP CORNERS AND REMOVE BURRS
SCALE .036 WT. ACT CALC

Atlas Copco
ATLAS COPCO COMPTEC INC.
20 School Road, Voorheesville, New York 12186

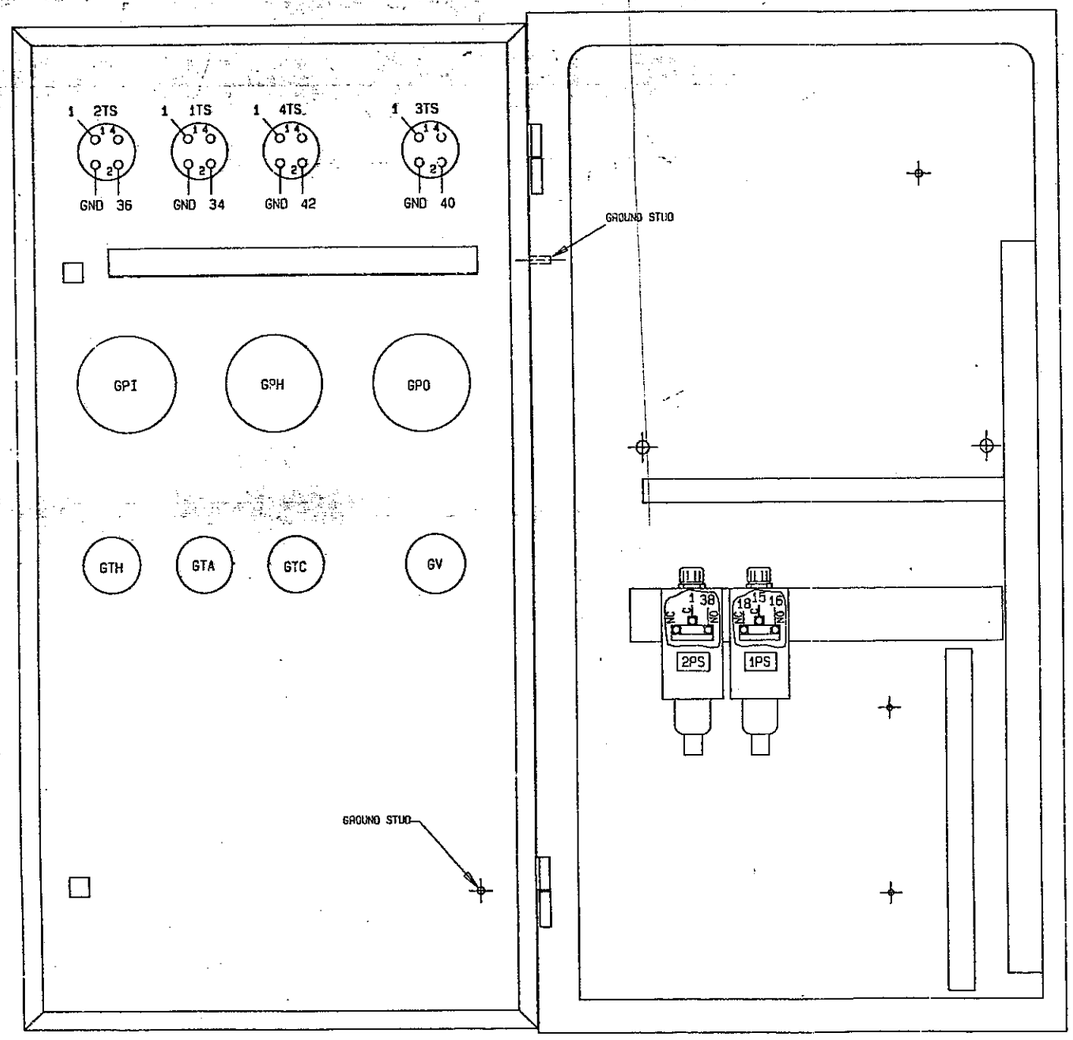
DWN BY	DCK	2-13-91
CHKD		
DES ENG		
PROJ ENG	MEM	2-14-91
MFG		
ISSUED	TT	2-15-91

GENERAL ARRANGEMENT
ZRS-PN, MH, MCM, HVA

D | 1310735667 | A
DRAWING NUMBER SH. 1 OF 1 | REV.

CONT ON SH SH NO

ZONE	LTR	REVISION DESCRIPTION	DATE	APP'D
	A	ECO #1264BZ DCK	1-13-89	



INSTRUMENT CUBICLE (ITEM 001) DOOR OPEN

NOTES:

1. UNLESS SPECFIED, ALL WIRING MUST BE SINGLE CONDUCTOR, STRANDED 600V CABLE, 105 DEGREE C RATED, NOT LESS THAN NO. 14 AWG., MTW INSULATION, RED. WIRE MARKED #2 MUST BE WHITE INSULATION.
2. PARTS LEGEND:
   - GPI - INTERCOOLER PRESSURE GAGE
   - GPH - DISCHARGE PRESSURE GAGE
   - GPO - OIL PRESSURE GAGE
   - GTA - A.C. WATER OUTLET TEMPERATURE GAGE
   - GTC - COMPRESSOR WATER OUTLET TEMPERATURE GAGE
   - GTH - AIR OUTLET TEMPERATURE GAGE
   - GV - AIR FILTER VACUUM GAGE
   - PS - PRESSURE SWITCH
   - TS - TEMPERATURE SWITCH

SEPARATE B\M ISSUED
BALLOON CALLOUTS ON CUSTOMER DRAWINGS ARE FOR MANUFACTURING REFERENCE ONLY

CAD FILE NAME: ZA737101.01A

PURCHASER
USER
P.O.# ITEM
CUST.IDENT/TAG#
A.C.C.SO#
☐ PRELIMINARY-NOT FOR CONSTRUCTION
☐ FOR APPROVAL-RETURN WITHIN 10 DAYS TO AVOID SHIPMENT DELAY
☐ CERTIFIED FOR CONSTRUCTION-ANY CHANGES EFFECTS PRICE AND DELIVERY
☐ FOR INFORMATION ONLY
BY DATE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS .XXX ± .XX ±
FRACTIONS ±
ANGLES ± ALL SURFACES ✓
BREAK SHARP CORNERS AND REMOVE BURRS
SCALE 1"=1 W/ ACT CALC
PLOT SCALE = .3"=1
OVERLAY = 1, 4.5

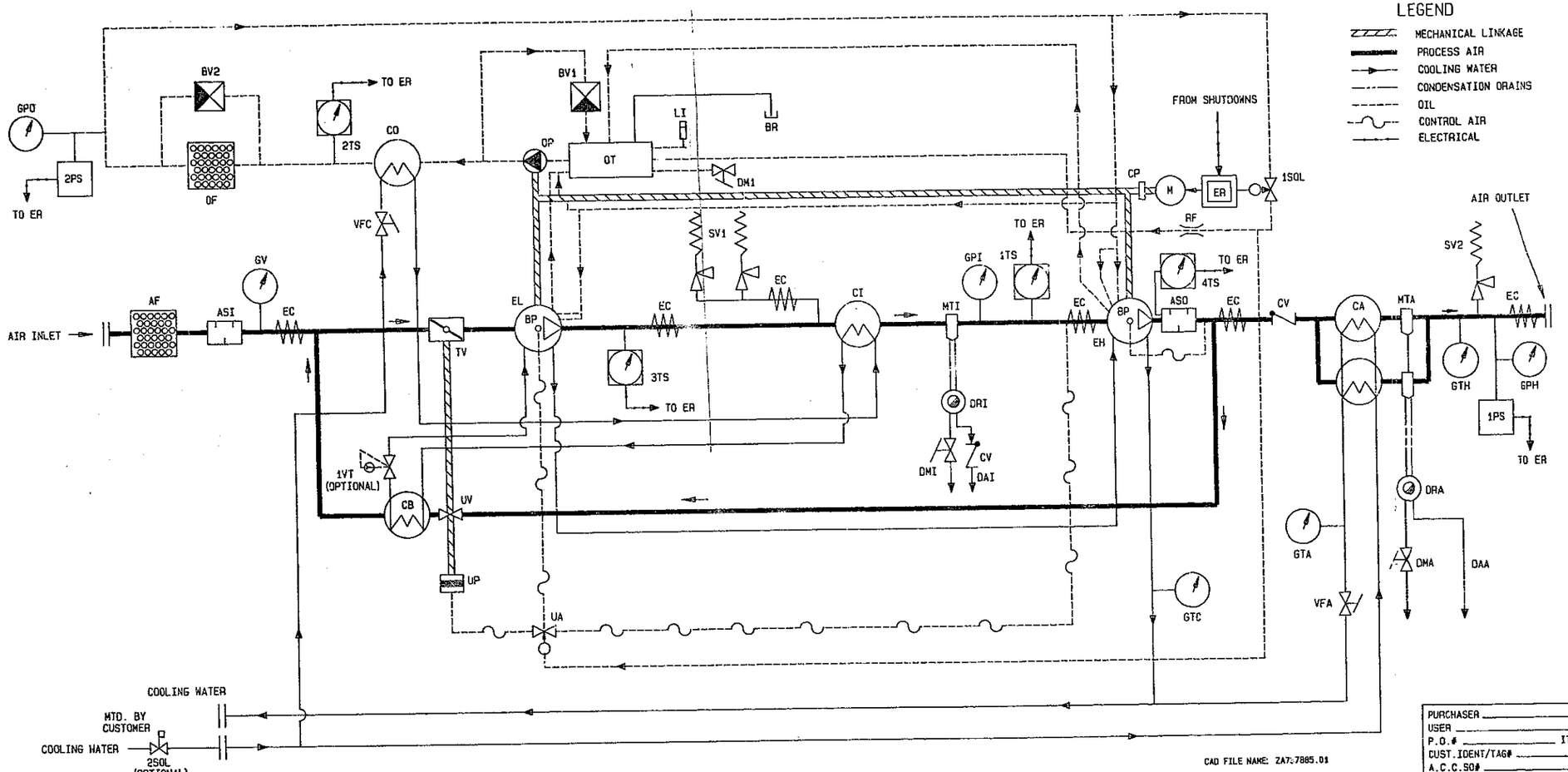
Atlas Copco
ATLAS COPCO
20 School Road, Voorheesville, New York 12186

DWN BY	DCK 1-13-89	INSTRUMENT CUBICLE ASSY ZR-PN
CHKD	MNR 9-15-88	
DES ENG	RN 9-15-88	
PROJ ENG	KWS 9-15-88	1310737101 A
MFG	TF 11/10/89	
ISSUED	TF 9-15-88	DRAWING NUMBER SH. 1 OF 1 REV.

BRUNING 5x951-1

ZONE	LTR	REVISION DESCRIPTION	DATE	APP'D

CONT ON SH SH NO



AF = AIR FILTER
ASI = AIR INTAKE SILENCER
ASO = AIR OUTLET SILENCER
BP = BALANCING PISTON
BR = BREATHER
BV1 = BY-PASS VALVE OIL PUMP
BV2 = BY-PASS VALVE OIL FILTER
CA = AFTERCOOLER
CB = BLEED-OFF COOLER
CI = INTERCOOLER
CO = OIL COOLER
CP = COUPLING

CV = CHECK VALVE
DAA = AUTO DRAIN OUTLET AFTERCOOLER TRAP
DAI = AUTO DRAIN OUTLET INTERCOOLER TRAP
DMA = DRAIN VALVE AFTERCOOLER TRAP SEPARATOR (MANUAL)
DMI = DRAIN VALVE INTERCOOLER TRAP SEPARATOR (MANUAL)
DM1 = DRAIN VALVE OIL SUMP
DRA = MOISTURE TRAP AFTERCOOLER (AUTO.)
DRI = MOISTURE TRAP INTERCOOLER (AUTO.)
EC = EXPANSION COMPENSATOR
EH = HP COMPRESSOR ELEMENT
EL = LP COMPRESSOR ELEMENT
ER = CONTROL CIRCUIT
GPH = DISCHARGE PRESSURE GAUGE

GPI = INTERCOOLER PRESSURE GAUGE
GPO = OIL PRESSURE GAUGE
GTA = AFTERCOOLER COOLING WATER OUTLET TEMP. GAUGE
GTC = COMPRESSOR COOLING WATER OUTLET TEMP. GAUSE
GTH = AIR OUTLET TEMP. GAUGE
GV = AIR FILTER VACUUM GAUGE
LI = OIL LEVEL GAUGE
M = MOTOR
MTA = MOISTURE SEPARATOR, AFTERCOOLER
MTI = MOISTURE SEPARATOR, INTERCOOLER
OF = OIL FILTER

OP = OIL PUMP
OT = OIL SUMP
RF = FLOW RESTRICTOR OIL RETURN
1SOL = LOADING SOLENOID VALVE
2SOL = WATER SOLENOID VALVE (OPTIONAL)
SV1 = INTERCOOLER SAFETY VALVE
SV2 = HP SAFETY VALVE
TV = THROTTLE VALVE
UA = UNLOADER CYLINDER
UP = UNLOADER PISTON
UV = UNLOADER VALVE
VFA = REGULATOR VALVE AFTERCOOLER COOLING WATER (MANUAL)

VFC = REGULATOR VALVE COMPRESSOR COOLING WATER (MANUAL)
1PS = AIR PRESSURE SWITCH
2PS = OIL PRESSURE SWITCH
1TS = AIR TEMP. HP INLET SHUT-DOWN
2TS = OIL TEMP. SHUT-DOWN
3TS = AIR TEMP. LP OUTLET SHUT-DOWN
4TS = AIR TEMP. HP OUTLET SHUT-DOWN
1VT = THERMOSTATIC WATER VALVE (OPTIONAL)

CAD FILE NAME: ZA7:7885.01

PURCHASER
USER
P.O.# ITEM
CUST.IDENT/TAG#
A.C.C.SO#
☐ PRELIMINARY-NOT FOR CONSTRUCTION
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☐ CERTIFIED FOR CONSTRUCTION-ANY CHANGES AFFECT PRICE AND DELIVERY
☐ FOR INFORMATION ONLY
BY DATE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON
DECIMALS FRACTIONS
.XXX ± ±
.XX ±
ANGLES ± ALL SURFACES
BREAK SHARP CORNERS AND REMOVE BURRS
SCALE NONE WT. ACT CALC
PLOT SCALE: .07=1
OVERLAY: 1, 4, 5

ATLAS COPCO
20 School Road, Voorheesville, New York 12186

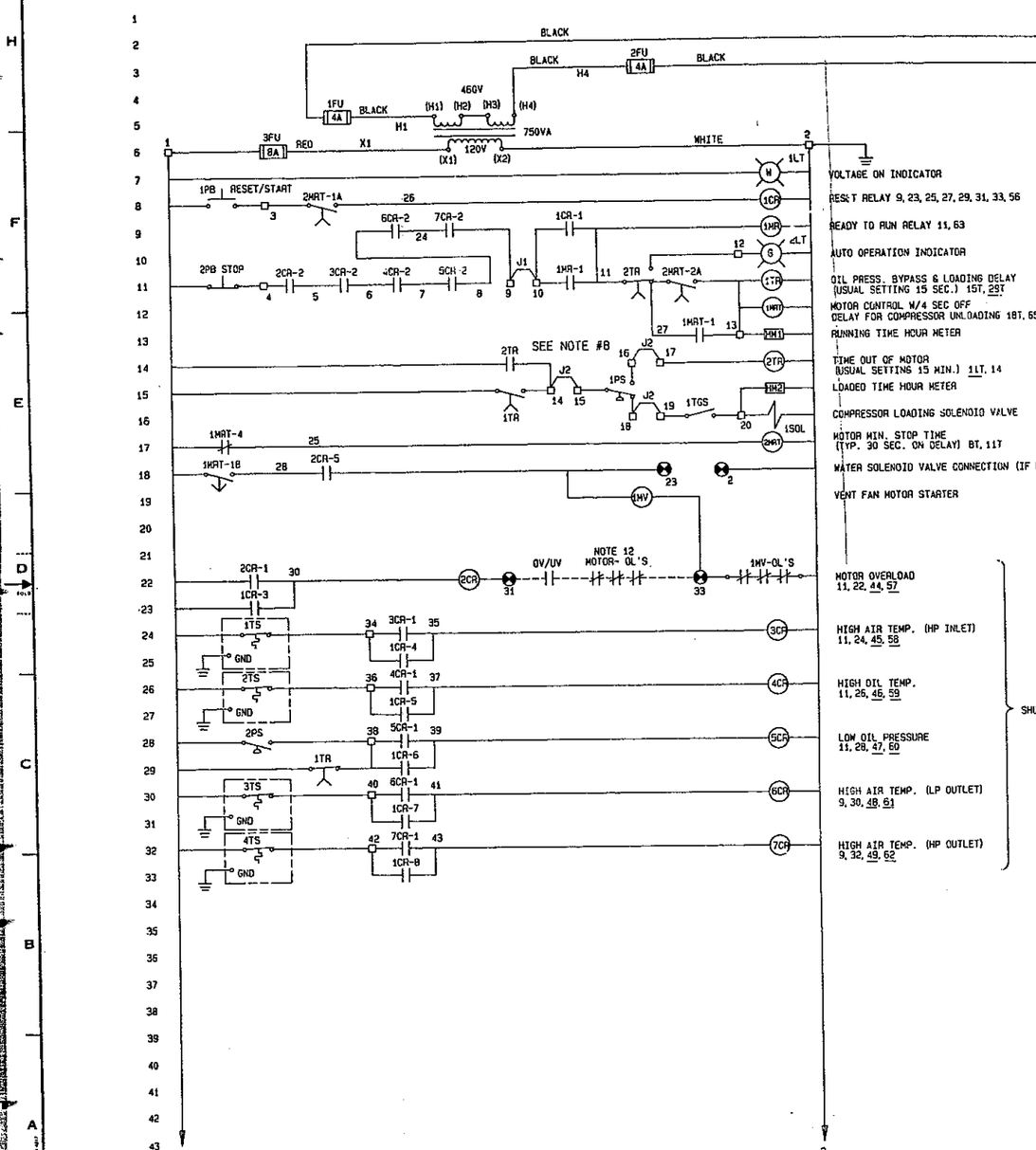
DWN BY TWR 12/20/88
CHKD
DES ENG
PROJ ENG 11-30-88
MFG
ISSUED 12-29-88

FLOW DIAGRAM
ZR5-PN
1310737885
DRAWING NUMBER SH. 1 OF 1 REV.

BRUNING 55551-1

CONT ON SH SH NO

ZONE	LTR	REVISION DESCRIPTION	DATE	APP'D
	A	ECO 15520 MGV	3/2/91	MEM



NOTES:

1. ALL RED, WHITE, & GREEN WIRING MUST BE SINGLE CONDUCTOR, STRANDED 600V CABLE, 105 DEGREE C RATED. NOT LESS THAN 14 AWG., WITH INSULATION. BLACK WIRING MUST BE 12AWG, GROUND WIRE GREEN INSULATION.
2. ----- = DENOTES WIRING BY OTHERS.
3. □ = DENOTES TERMINAL BLOCK IN COMPRESSOR CONTROL PANEL.
4. VENT FAN MOTOR H.P.: ZR3-1 H.P. ZR4-1.5 H.P. ZR5-1.5 H.P. ZR6-1.5 H.P.
5. CONTROL DEVICES LOCATED IN INSTRUMENT CUBICLE
   PRESSURE SWITCH: 1PS, 2PS
   TEMPERATURE SWITCH: 1TS, 2TS, 3TS, 4TS
6. SWITCH SET POINTS:

1TS	↓	145 DEGREE F (62 DEGREE C)
2TS	↓	175 DEGREE F (80 DEGREE C)
3TS	↓	425 DEGREE F (220 DEGREE C)
4TS	↓	425 DEGREE F (220 DEGREE C)
1PS		FIELD SET
2PS	↓	20 PSIG (1.4 BAR)

   ↓ SWITCH SET TO ACTIVATE ON INCREASING CONDITION.
   ↓ SWITCH SET TO ACTIVATE ON DECREASING CONDITION.
8. JUMPERS:
   J1 REMOVE WHEN CONNECTING ADDITIONAL SHUT-DOWNS IN FIELD.
   J2 REMOVE WHEN CONNECTING SEQUENCING PANEL IN FIELD.
9. BRANCH CIRCUIT PROTECTOR MUST BE PROVIDED BY INSTALLER.
10. ⊗ = DENOTES TERMINAL BLOCK (CUSTOMER CONNECTION) IN COMPRESSOR CONTROL PANEL.
11. TO EXTERNAL MOTOR STARTER COIL CIRCUIT WHEN SUPPLIED BY CUSTOMER, OTHERWISE AUX. CONTACT.
12. MOTOR STARTER OVERLOADS & FAULT CONTACTS FROM CUSTOMER MOUNTED MOTOR STARTER.

PURCHASER _____
USER _____
P.O.# _____ ITEM _____
CUST.IDENT/TAG# _____
A.C.C.SO# _____
□ PRELIMINARY-NOT FOR CONSTRUCTION
□ FOR APPROVAL-RETURN WITHIN 10 DAYS TO AVOID SHIPMENT DELAY
□ CERTIFIED FOR CONSTRUCTION-ANY CHANGES EFFECTS PRICE AND DELIVERY
□ FOR INFORMATION ONLY
BY _____ DATE _____

CAD FILE NAME: ZD000595.01A

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON
DECIMALS XXX ± XX ± FRACTIONS ±
ANGLES ± ALL SURFACES ✓
BREAK SHARP CORNERS AND REMOVE BURRS
SCALE NONE WT. ACT CALC
PLOT SCALE: .85=1

Atlas Copco
ATLAS COPCO COMPTEC INC.
29 School Road, Voorheesville, New York 12186

DWN BY	JCK 2-12-91
CHKD	
DES ENG	
PROJ ENG	
MFG	
ISSUED	

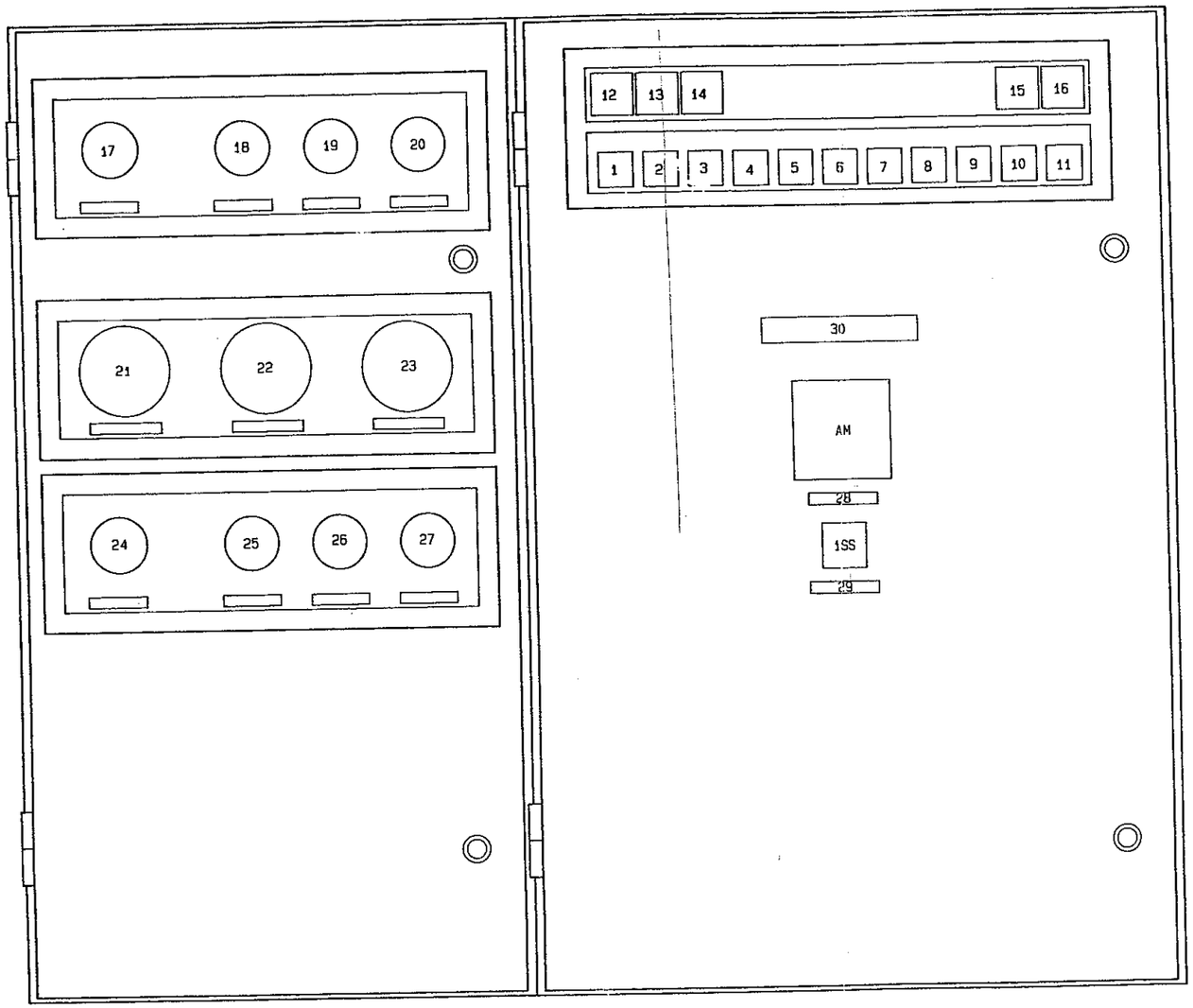
CONTROL SCHEMATIC ZR VFS, NOS, AMM, CT

1311000595 A

DRAWING NUMBER SH. 1 OF 1 REV.

CONT ON SH SH NO

ZONE	LTR	REVISION DESCRIPTION	DATE	APP'D



LEGEND

1. VOLTAGE ON (1LT) (W)
2. AUTO OPERATION (2LT) (G)
3. OIL PRESSURE (6LT) (A)
4. OIL TEMP. (5LT) (A)
5. MOTOR OVERLOAD (3LT) (A)
6. TEMP. L.P. OUTLET (7LT) (A)
7. TEMP. H.P. INLET (4LT) (A)
8. TEMP. H.P. OUTLET (8LT) (A)
9. BLANK
10. BLANK
11. MD ON (IF USED)
12. RUNNING TIME (HM1)
13. UNLOAD/NORMAL (1TGS)
14. LOADING TIME (HM2)
15. RESET-START (1PB) (BLACK)
16. STOP (2PB) (RED)
17. AIR TEMPERATURE L.P. OUTLET (3TS)
18. AIR TEMPERATURE H.P. OUTLET (4TS)
19. AIR TEMPERATURE H.P. INLET (1TS)
20. OIL TEMPERATURE (2TS)
21. OIL PRESSURE (6PO)
22. DISCHARGE PRESSURE (GPH)
23. INTERCOOLER PRESSURE (GPI)
24. FILTER INDICATOR (GV)
25. WATER TEMPERATURE COMPRESSOR (GTC)
26. WATER TEMPERATURE AFTERCOOLER (GTA)
27. AIR TEMPERATURE OUTLET (GTH)
28. AMMETER (AM)
29. PHASE SELECTOR SWITCH (1SS)
30. RESTART DELAY OF 30 SEC. MAY OCCUR

CAD FILE NAME: ZD000748.01

PURCHASER _____
USER _____
P.O.# _____ ITEM _____
CUST.IDENT/TAG# _____
A.C.C.SO# _____
☐ PRELIMINARY-NOT FOR CONSTRUCTION
☐ FOR APPROVAL-RETURN WITHIN 10 DAYS TO AVOID SHIPMENT DELAY
☐ CERTIFIED FOR CONSTRUCTION-ANY CHANGES EFFECTS PRICE AND DELIVERY
☐ FOR INFORMATION ONLY
BY _____ DATE _____

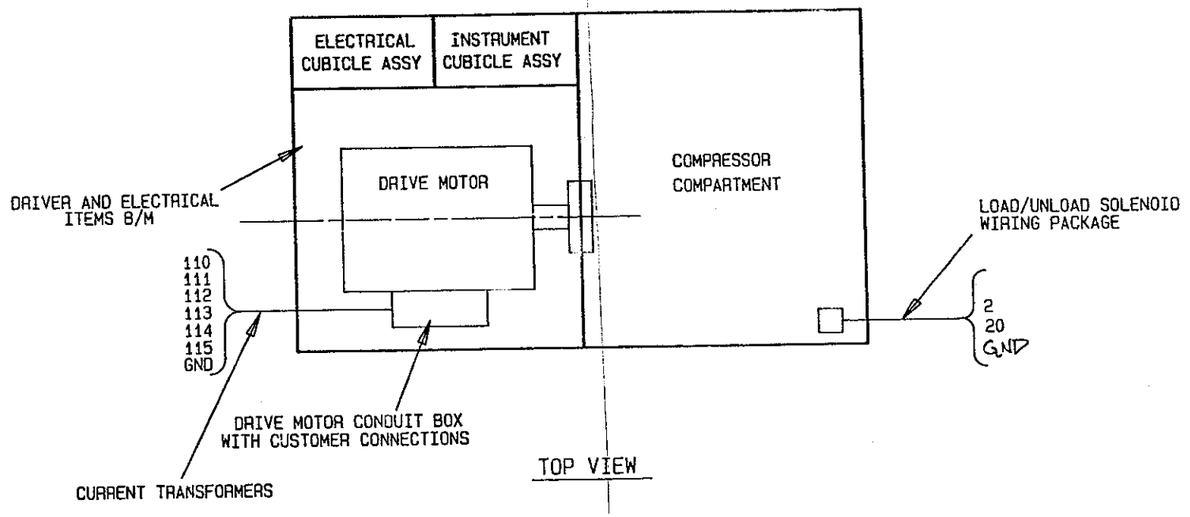
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON
DECIMALS XXX ± XX ±
FRACTIONS ±
ANGLES ± ALL SURFACES ✓
BREAK SHARP CORNERS AND REMOVE BURRS
SCALE 3/8=1 | WT. ACT CALC
PLOT SCALE: 1=1
OVERLAY: 1,4,5

Atlas Copco
ATLAS COPCO COMPTEC INC.
20 School Road, Voorheesville, New York 12186

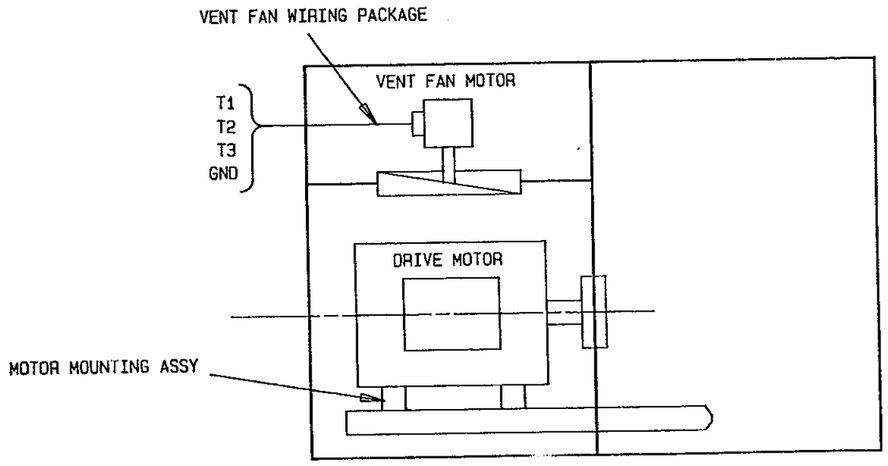
DWN BY DCK 2-11-91	CONTROL FACE LAYOUT ZR-PN AMM CT
CHKD	
DES ENG	
PROJ ENG MEK 2-14-91	1311000748
MFG	
ISSUED JF 3-15-91	DRAWING NUMBER SH. 1 OF 1 REV.

CONT ON SH SH NO.

ZONE	LTR	REVISION DESCRIPTION	DATE	APP'D



TOP VIEW



SIDE VIEW

PURCHASER _____
USER _____
P.O.# _____ ITEM _____
CUST.IDENT/TAG# _____
A.C.C.SO# _____
☐ PRELIMINARY-NOT FOR CONSTRUCTION
☐ FOR APPROVAL-RETURN WITHIN 10 DAYS TO AVOID SHIPMENT DELAY
☐ CERTIFIED FOR CONSTRUCTION-ANY CHANGES EFFECTS PRICE AND DELIVERY
☐ FOR INFORMATION ONLY
BY _____ DATE _____

CAD FILE NAME: ZD001245.01

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON
DECIMALS FRACTIONS
.XXX ± ±
.XX ±
ANGLES ± ALL SURFACES ✓
BREAK SHARP CORNERS AND REMOVE BURRS

SCALE NONE | WT. ACT CALC

PLOT SCALE: 1=1
OVERLAY: 1, 4, 5

Atlas Copco **ATLAS COPCO COMPTEC INC.**
20 School Road, Voorheesville, New York 12186

DWN BY DCK 2-11-91
CHKD
DES ENG
PROJ ENG MEM 2-14-91
MFG
ISSUED TT 2-15-91

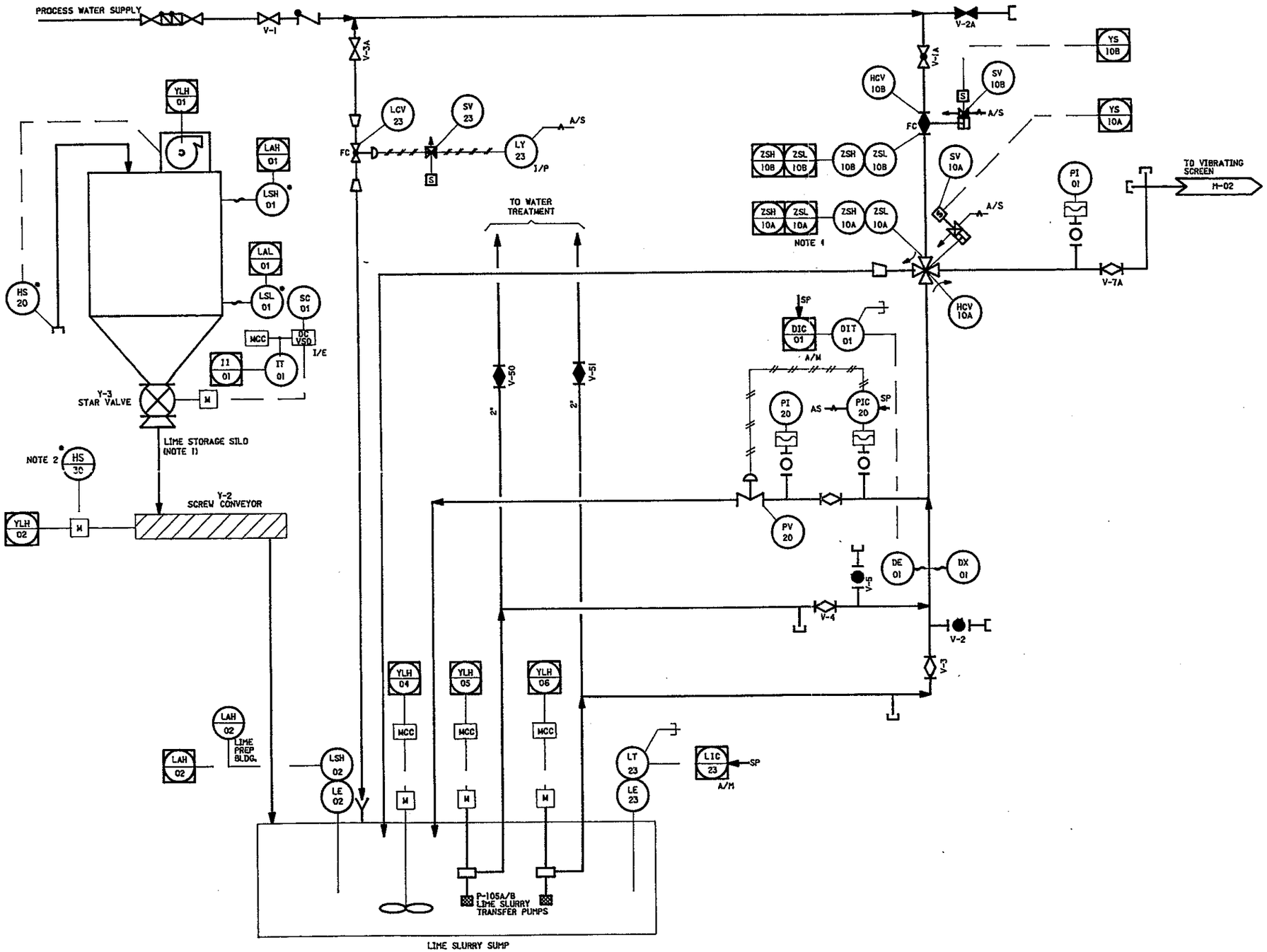
EQUIPMENT ORIENTATION DRAWING Z-PN VFS, NOS, AMM, CT

1311001245

DRAWING NUMBER SH. 1 OF 1 REV.

NOTES:

1. FOR FURTHER INFORMATION ON SILO EQUIPMENT AND INSTRUMENTATION REFER TO KOPPERS DWG. M1102, LIME STORAGE SILO CONTROL PANEL.
2. INSTRUMENTATION MARKED WITH AN ASTERISK (*) IS EXISTING.
3. REFER TO DRAWING M-03 FOR SEQUENCE OF OPERATION.



2	REV	21178-003	NONE	M-01	2
	DATE	PROJECT CONTROL NO	SCALE	DRAWING NUMBER	REV
	BY				
	CHKD				
	ENGR				
	APPVD				

Bechtel Bechtel Corporation San Francisco Regional Office

Penelec GPU PENNSYLVANIA ELECTRIC COMPANY JOHNSTOWN PA 15907

SEWARD STATION UNIT NO. 5

OWG TYPE:

TITLE: CZD/FGD DEMONSTRATION PROJECT

LIME SLURRY PREPARATION

PIPING & INSTRUMENT DIAGRAM

22034 "D"SIZE

M01.DGN /Mar. 3,1993 /06:59

M01DGN

NOTES:

1. T-101 OR T-102 WILL BE IN SERVICE AT ANY ONE TIME. FLEX HOSE WILL BE CONNECTED AND DISCONNECTED ACCORDINGLY.
2. THE APPROPIATE LEVEL SIGNAL MUST BE SWITCHED TO LC-25 WHEN T-101 AND T-102 ARE ROTATED INSERVICE.
3. GRITS TANKS ARE EMPTIED, AS REQUIRED, TO MAINTAIN SEWARD PLANT CLEARWELL pH.

PROCESS WATER M-03

FROM LIME SLURRY SUMP M-01

SV 25 · LY 25 · I/P · A/S · PI 25 · LV 25 · V-7 · FC · LC 25 · SP

FOR SCREEN WASHING HOSE CONNECTION · V-8 · V-9

GRITS SLUICING WATER

SEAL WATER TO LIME SLURRY FEED PUMPS THIS DWG

1" WASH DOWN V-29

1" WASH DOWN V-30

1" WASH DOWN V-31

RECIRCULATION FROM LANCE DIST. HEADER BYPASS M-03 · V-55

TO LIME INJECTION AT TOP OF DUCT M-03

V-10 · V-11

YLH 14 · M

VS-101 VIBRATING SCREEN · T-105

DEGRITTED LIME

HS 25 (NOTE 2)

LI 25A · YLH 09 · LT 25A · LE 25A · MCC

LI 25B · LT 25B · LE 25B · YLH 10 · MCC

V-28 · 1"ø FLUSH WATER HOSE CONNECTION · V-27 · PI 28

"Y" STRAINER WITH 40 MESH SCREEN

TO DRAIN · PI 05 · V-26 · 1"ø FLUSH WATER HOSE CONNECTION

O/F · SAMPLING VALVE V-18 · TI 25A · Y-101 · V-21 · T-101 SLURRY FEED TANK · V-20 · DRAIN · FLUSH V-19

O/F · SAMPLING VALVE V-22 · TI 25B · Y-102 · V-25 · T-102 SLURRY FEED TANK · V-24 · DRAIN · FLUSH V-23

YLH 07 · MCC · M · O/F · SAMPLING VALVE V-12 · Y-104 · V-14 · T-104 GRITS TANK · V-13

YLH 08 · MCC · M · O/F · SAMPLING VALVE V-15 · Y-103 · V-17 · T-103 GRITS TANK · V-16

(NOTE 3) · ASH SLUICING SEWER

MCC · YLH 11 · STR · P-102A LIME SLURRY FEED PUMP · V-32

FCV 102A · V-35 · SEAL WATER THIS DWG · FCV 102B · V-34

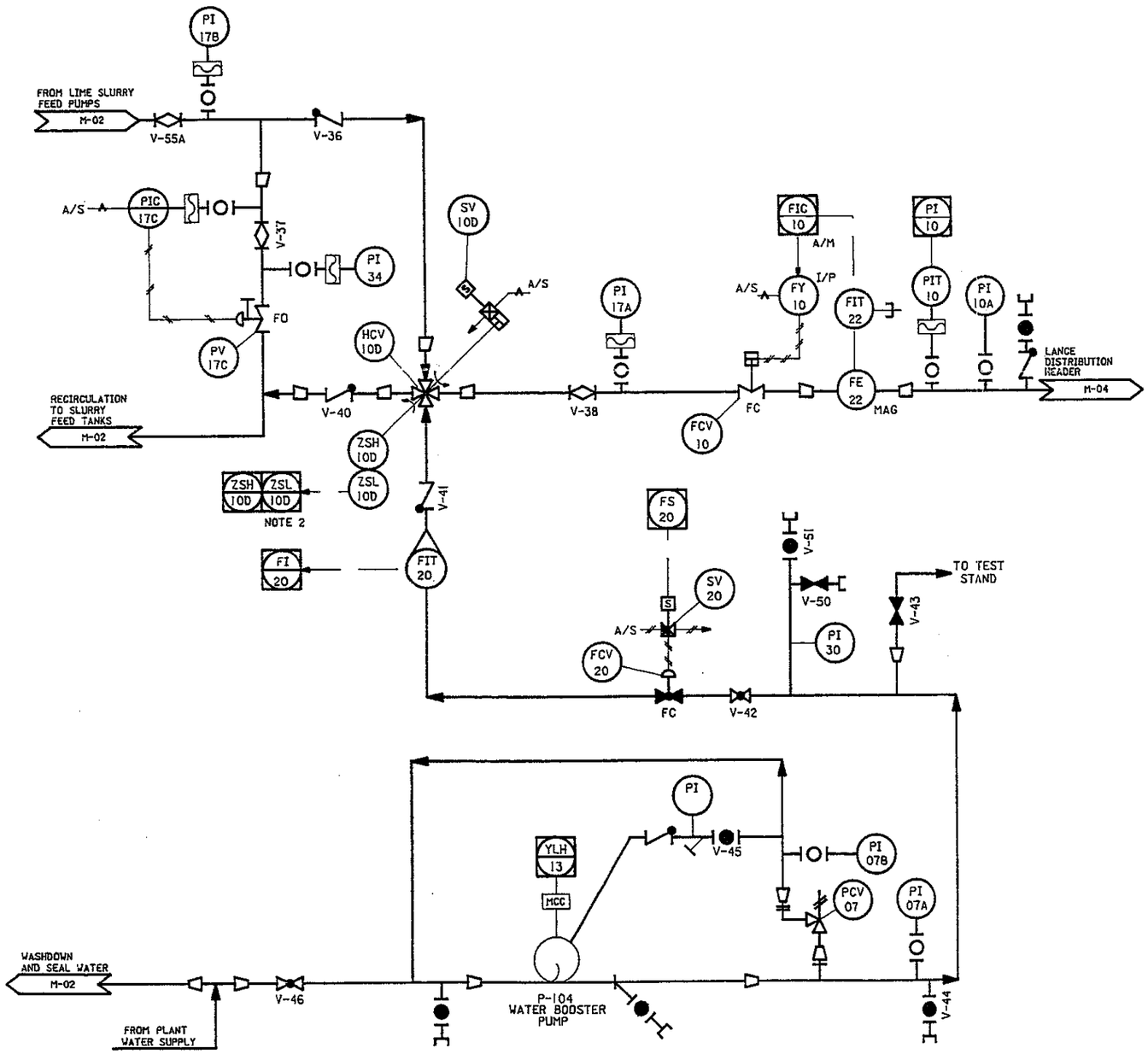
YLH 12 · STR · V-33 · P-102B LIME SLURRY FEED PUMP

APPVD	Bechtel Corporation San Francisco Regional Office				
ENGR	Penelec GPU PENNSYLVANIA ELECTRIC COMPANY JOHNSTOWN PA 15907				
CHKD	SEWARD STATION UNIT NO. 5				
BY	DWG TYPE:				
DATE	TITLE: CZD/FGD DEMONSTRATION PROJECT				
	LIME SLURRY FEED				
	PIPING AND INSTRUMENT DIAGRAM				
REV 2	21178-003	NONE	M-02	2	
	PROJECT CONTROL NO	SCALE	DRAWING NUMBER	REV	

22X34 'D' SIZE

M02.DGN

M02.DGN /Mar. 2, 1993 /08:00



M03.DGN

A. "READY/STANDBY" LOGIC

THE "READY/STANDBY" LOGIC ALLOWS CONTROL ROOM OPERATORS TO AUTOMATICALLY DELIVER WATER INSTEAD OF LIME SLURRY INTO THE DUCT. THE INTERLOCK LOGIC PROVIDES FOR:

1.) SWITCHING BETWEEN LIME SURRY AND WATER TO THE LANCE DISTRIBUTION HEADER.

2.) CONTRIOL OF LIME SLURRY OR WATER FLOW TO LANCE HEADER BY FLOW CONTROL OR CASCADED TO DUCT TEMPERATURE CONTROL.

3.) CLEARING OUT LIME SLURRY FILLED PIPE SPOOLS.

NOTES:

1. DCS SOFTWARE LOGIC PERFORMS THE SEQUENCE OF OPERATIONS SHOWN ON THIS DRAWING.
2. HCV-10B "OPEN" (ZSH-10D) IS "WATER TO LANCE DISTRIBUTION HEADER". HCV-10D "CLOSED" (ZSL-10D) IS LIME SLURRY TO LANCE DISTRIBURTION HEADER".

A.1 "READY" STATE (HS-10A & B CLOSED): LIME SLURRY TO LANCE HEADER

TAG ID	CONTACT STATE	COMMENTS
YS-10A	CLOSED	HCV-10A SUPPLYING SLURRY TO VIBRATING SCREEN
YS-10B	OPEN	HCV-10B CLOSED
YS-10D	CLOSED	LIME SLURRY TO LANCE HEADER
YS-10E	CLOSED	LV-25 CONTROLLED BY LC-25
FS-20	OPEN	FCV-20 CLOSED
FIC-10		OPERATOR SELECTABLE: 0 TO 60 GPM LIME SLURRY

A.2 "READY" TO "STANDBY" TRANSITION (HS-10A OR HS-10B OPENS)

TABLE - 1

TAG ID	"READY" STATE T=0	TIME DELAY (TD)	"STANDBY" STATE T=TD → ∞	COMMENTS
YS-10A	OPEN		→	LIME SLURRY RECIRC. TO LIME SLURRY SUMP
YS-10B	CLOSED	60 SEC	OPEN	WATER FLUSH FOR PIPE SPOOL VIBRATING SCREEN (HCV-10B OPEN)
YS-10D	OPEN		→	WATER TO LANCE HEADER
YS-10E	OPEN		→	LV-25 FORCED OPEN
FS-20	CLOSED		→	FCV-20 FORCED OPEN
FIC-10	OPERATOR SELECTABLE		→	0 TO 60 GPM LIME SLURRY

A.3 "STANDBY" TO "READY" STATE TRANSITION (HS-10A AND HS-10B CLOSES)

TABLE - 2

TAG ID	"STANDBY" STATE T=0	TIME DELAY (TD)	"READY" STATE T=TD → ∞	COMMENTS
YS-10A	CLOSED		→	LIME SLURRY TO VIBRATING SCREEN
YS-10B	CLOSED	30 SEC	OPEN	WATER FLUSH OF LIME SLURRY RECIRC. PIPE SPOOL TO LIME SLURRY SUMP
YS-10D	CLOSED		→	LIME SLURRY TO LANCE HEADER
YS-10E	CLOSED		→	LV-25 CONTROLLED BY LC-25
FS-20	CLOSED	30 SEC	OPEN	WATER FLUSH OF SLURRY RECIRC. PIPE SPOOL TO FD TANK
FIC-10	OPERATOR SELECTABLE		→	0 TO 60 GPM LIME SLURRY

B. AUTOMATIC SHUTDOWN LOGIC

THE AUTOMATIC SHUTDOWN LOGIC PROTECTS THE GAS DUCTING FROM SLURRY BUILDUPS DUE TO ABNORMALLY LOW C SECTION TEMPERATURES (SUCH AS EMERGENCY BOILER SHUTDOWN) OR LOSS OF ATOMIZING AIR PRESSURE. LOGIC PROVIDES FOR CLEANING OUT LIME SLURRY FILLED PIPE SPOOLS WITH WATER BEFORE SHUTDOWN AND RESTART AFTER ABNORMAL CONDITION IS CLEARED.

B.1 NOMINAL-TO-LOW ATOMIZING AIR (PSL-19 OPENS) OR T-12C ≤ 135°F AND "READY" STATE.

TABLE - 1

TAG ID	STATE 1 T=0	TIME DELAY (TD)	STATE 2 T=TD → ∞	COMMENTS
YS-10A	OPEN		→	RECIRULATE LIME SLURRY
YS-10B	CLOSED	60 SEC	OPEN	FLUSH WATER TO VIBRATING SCREEN
YS-10D	OPEN		→	RECIRULATE LIME SLURRY/ WATER TO LANCE HEADER
YS-10E	OPEN		→	LV-25 FORCED OPEN
FS-20	CLOSED	60 SEC	OPEN	FLUSH WATER TO LANCE HEADER
FIC-10	OPERATOR SELECTABLE	60 SEC	0 GPM	FLOW TO LANCE HEADER STOPPED AFTER WATER FLUSH

B.2 LOW-TO-NOMINAL ATOMIZING AIR (PSL-19 CLOSES) AND T-12C > 135°F AND "READY" STATE.

TABLE - 2

TAG ID	STATE$_1$ T=0	TIME DELAY (TD)	STATE$_2$ T=TD → ∞	COMMENTS
YS-10A	CLOSED		→	LIME SLURRY TO VIBRATING SCREEN
YS-10B	CLOSED	30 SEC	OPEN	FLUSH WATER TO RECIRC. PIPE SPOOL
YS-10D	CLOSED		→	LIME SLURRY TO LANCE HEADER
YS-10E	CLOSED		→	LV-25 CONTROLLED BY LC-25
FS-20	CLOSED	30 SEC	OPEN	WATER FLUSH OF SLURRY PIPE SPOOL TO FD TANK
FIC-10	OPERATOR SELECTABLE		→	0 TO 60 GPM LIME SLURRY

B.3 NOMINAL-TO-LOW ATOMIZING AIR (PSL-19 OPEN) OR T-12C ≤ 135°F AND "STANDBY" STATE.

TABLE - 3

TAG ID	STATE$_1$ T=0	TIME DELAY (TD)	STATE$_2$ T=TD → ∞	COMMENTS
YS-10A	OPEN		→	OPEN BY STANDBY LOGIC
YS-10B	NO CHANGE		→	STATE CHANGE BY STANDBY LOGIC
YS-10D	NO CHANGE		→	STATE CHANGE BY STANDBY LOGIC
YS-10E	NO CHANGE		→	STATE CHANGE BY STANDBY LOGIC
FS-20	CLOSED	30 SEC	OPEN	FLUSH WATER TO LANCE HEADER
FIC-10	OPERATOR SELECTABLE	30 SEC	0 GPM	FLOW TO LANCE HEADER STOPPED AFTER WATER FLUSH

Bechtel Bechtel Corporation San Francisco Regional Office

Penelec GPU PENNSYLVANIA ELECTRIC COMPANY JOHNSTOWN PA 15907

SEWARD STATION UNIT NO. 5

APPVD | ENGR | CHKD | BY | DATE | REV 2

DWG TYPE:

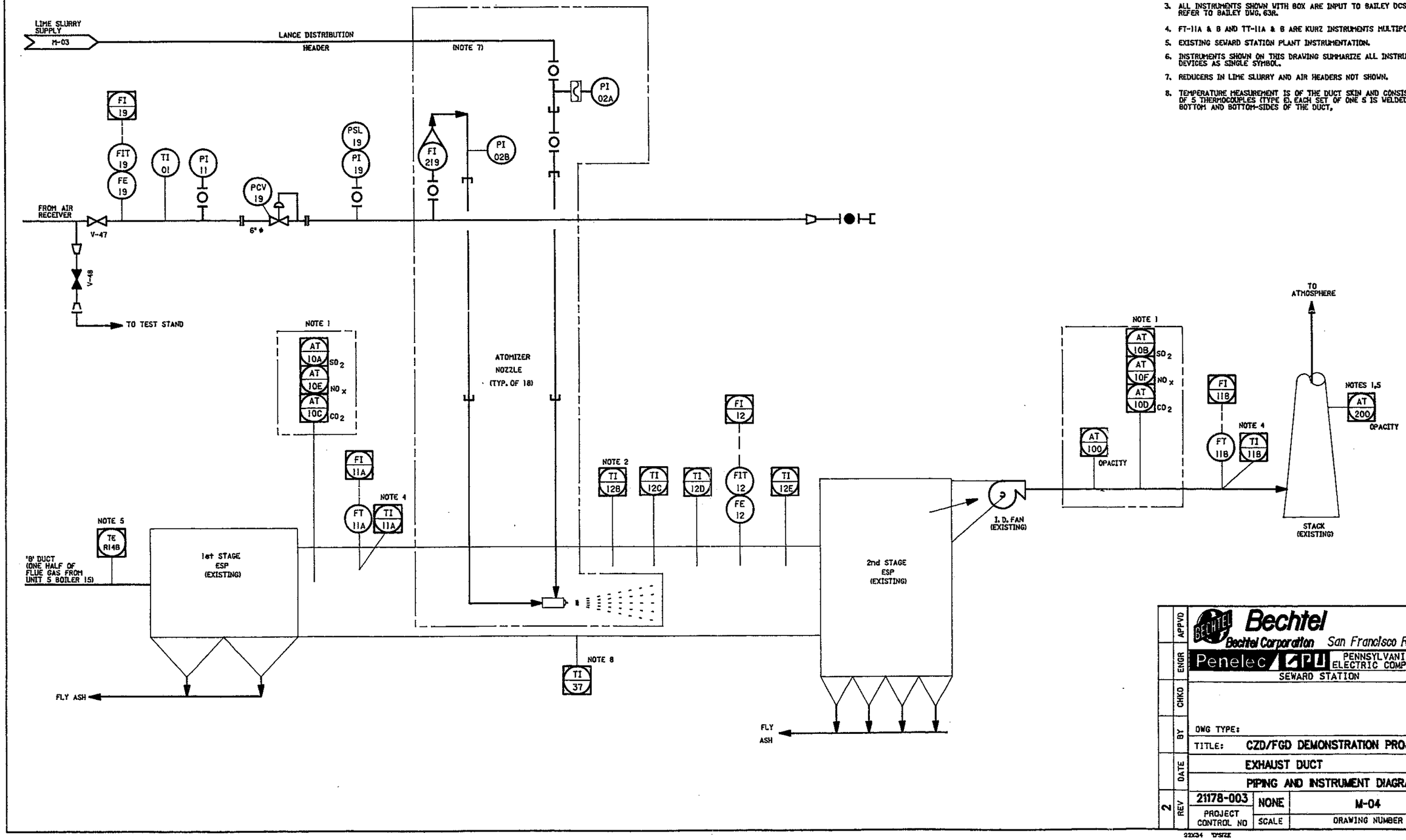
TITLE: CZD/FGD DEMONSTRATION PROJECT

LIME INJECTION SYSTEM

PIPING AND INSTRUMENT DIAGRAM

21178-003	NONE	M-03	2
PROJECT CONTROL NO	SCALE	DRAWING NUMBER	REV

22X34 "D" SIZE



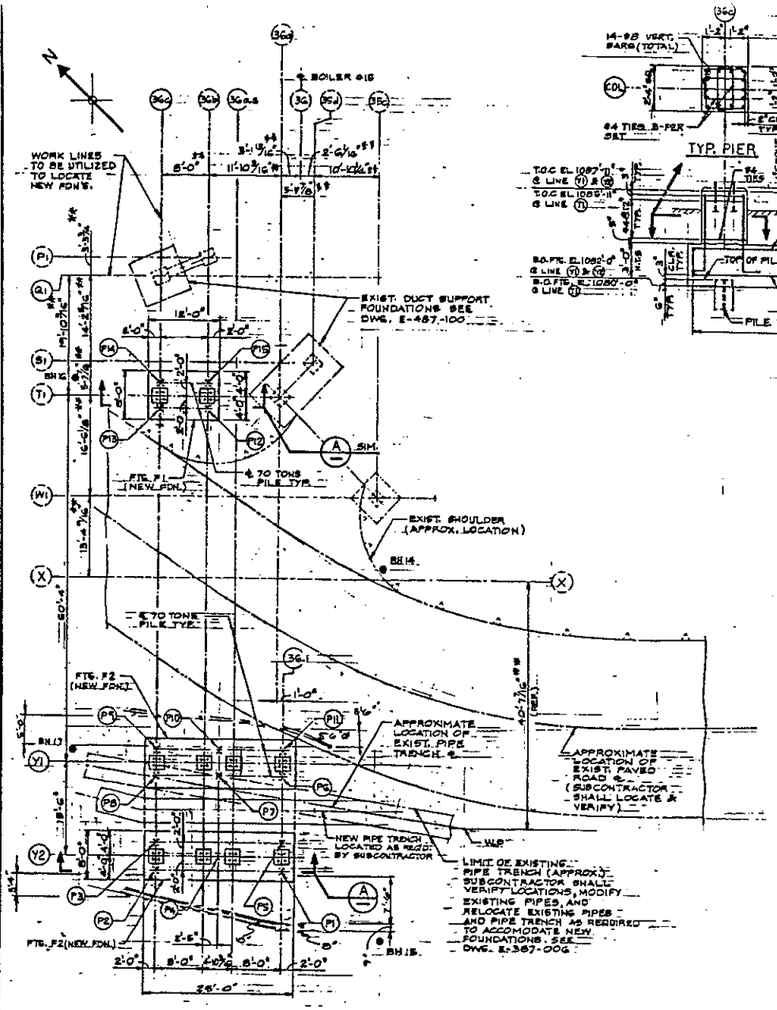
NOTES:

1. INSTRUMENTATION IS MAINTAINED BY PENELEC'S ENVIRONMENTAL GROUP.
2. TEMPERATURE MEASUREMENTS TI-12B, TI-12C, TI-12D AND TI-12E ARE 4 SETS OF 24 THERMOCOUPLES (TYPE E) NUMBERED TE-1281 TO TE-1286, TE-1281 TO TE-12816, TE-1282 TO TE-12826 AND TE-1283 TO TE-12836 (TYPICAL NUMBERING FOR 12C, 12D AND 12E).
   - THERMOCOUPLE INPUTS FROM EACH SET ARE COMPUTED FOR THE AVERAGE TEMPERATURE BASED ON ONLY THE OPERATING THERMOCOUPLES AS DETERMINED BY THE INDIVIDUAL INPUT SIGNAL.
   - DURING NORMAL OPERATION, THERMOCOUPLE SET 128 WILL NOT BE INSTALLED.
3. ALL INSTRUMENTS SHOWN WITH BOX ARE INPUT TO BAILEY DCS. REFER TO BAILEY DWG. 63R.
4. FT-11A & B AND TT-11A & B ARE KURZ INSTRUMENTS MULTIPOINT PROBES.
5. EXISTING SEWARD STATION PLANT INSTRUMENTATION.
6. INSTRUMENTS SHOWN ON THIS DRAWING SUMMARIZE ALL INSTRUMENT DEVICES AS SINGLE SYMBOL.
7. REDUCERS IN LIME SLURRY AND AIR HEADERS NOT SHOWN.
8. TEMPERATURE MEASUREMENT IS OF THE DUCT SKIN AND CONSIST OF 4 SETS OF 5 THERMOCOUPLES (TYPE E). EACH SET OF ONE 5 IS WELDED TO THE BOTTOM AND BOTTOM-SIDES OF THE DUCT.

APPVD	Bechtel Corporation — San Francisco Regional Office		
ENGR	Penelec / GPU — PENNSYLVANIA ELECTRIC COMPANY, JOHNSTOWN PA 15907		
CHKD	SEWARD STATION	UNIT NO. 5	
BY	DWG TYPE:		
DATE	TITLE: CZD/FGD DEMONSTRATION PROJECT		
	EXHAUST DUCT		
	PIPING AND INSTRUMENT DIAGRAM		
2 REV	21178-003 PROJECT CONTROL NO	NONE SCALE	M-04 DRAWING NUMBER	2 REV

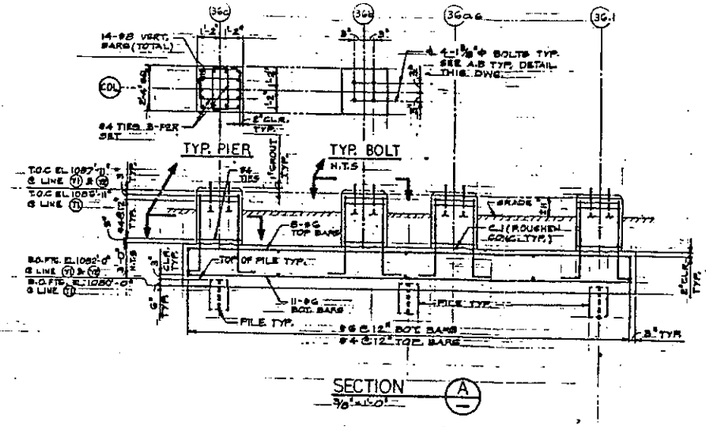
22X34 'D' SIZE

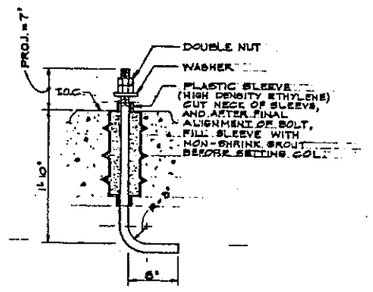
M04.DGN



FOUNDATION PLAN

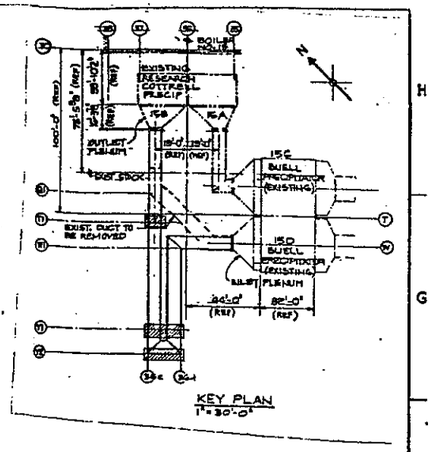
1/8"=1'-0"





A.B. TYPICAL DETAIL

1½"=1'-0"



LEGEND:

- ● BH NO. APPROXIMATE LOCATION OF EXISTING BORE HOLE (REFER TO APPENDIX "D" OF SPEC. E-110040-01)
- (P#) PILE IDENTIFICATION NUMBER

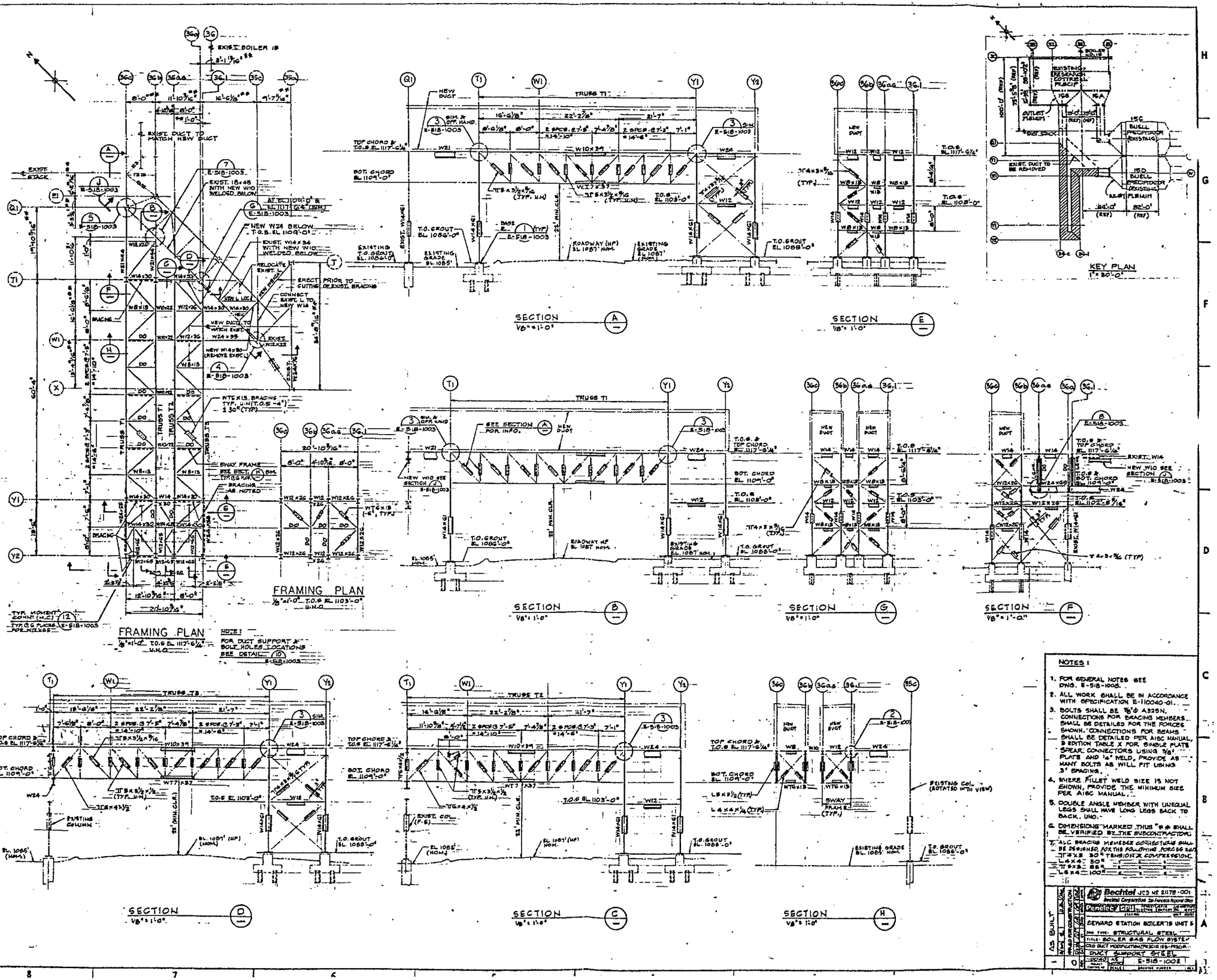
NOTES:

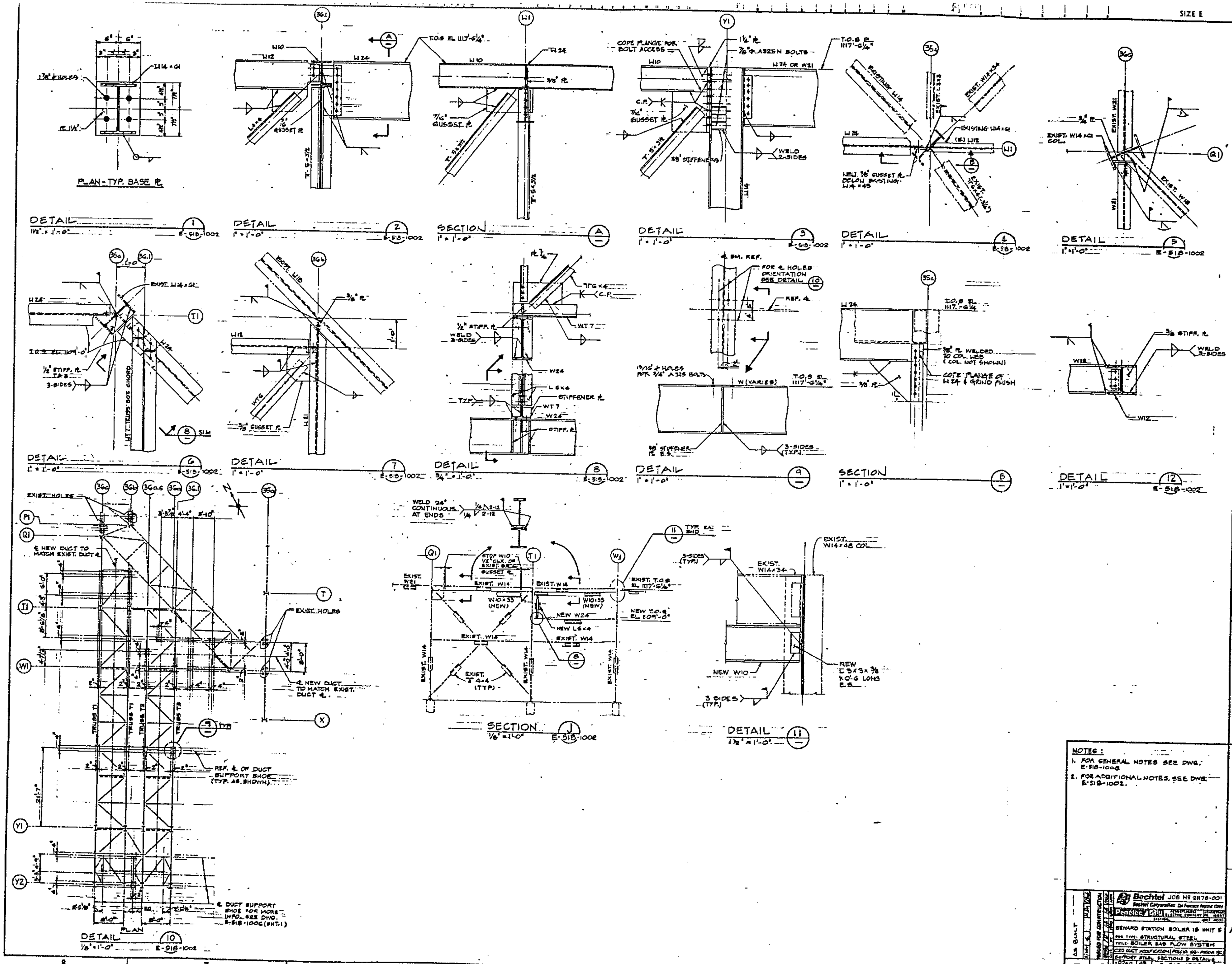
1. FOR GENERAL NOTES: SEE DWG. E-518-1008
2. ALL WORK SHOWN ON THIS DRAWING SHALL BE PER SPEC. E-110040-01.
3. DIMENSIONS NOTED THUS "###" SHALL BE VERIFIED BY THE SUBCONTRACTOR.
4. PILE SIZE SHALL BE PER SECTION XI OF SPEC. E-110040-01. PILES SHALL BE END BEARING ON BEDROCK. LENGTH OF PILES REQUIRED SHALL BE DETERMINED BY THE SUBCONTRACTOR.

0	110040	AS NOTED	E-408-1002	1	
	PROJECT CONTROL NO.	SCALE	DRAWING NUMBER	REV.	

Bechtel JOB NO 21178-001
Bechtel Corporation San Francisco Power Office
Consolidated Edison SYSTEM ELECTRIC ENGINEER
STEWARD STATION BOILER 15 UNIT 5
SUB. SYS.: STRUCTURAL CONCRETE
TITLE: BOILER GAS FLOW SYSTEM
ESD DUCT MODIFICATIONS (FROM 15B-PRECIP.)
FOUNDATIONS

AS BUILT
MARK | DATE | BY | DESCRIPTION
ISSUED FOR CONSTRUCTION
APPROVED FOR CONSTRUCTION


FRAMING PLAN
1/8"=1'-0" T.O.S EL. 1103'-0" U.N.O.
FRAMING PLAN
1/8"=1'-0" T.O.S EL. 1117'-6 1/4" U.N.O.
NOTE:
FOR DUCT SUPPORT & BOLT HOLES LOCATIONS SEE DETAIL 10 E-518-1003
SECTION A 1/8"=1'-0"
SECTION B 1/8"=1'-0"
SECTION C 1/8"=1'-0"
SECTION D 1/8"=1'-0"
SECTION E 1/8"=1'-0"
SECTION G 1/8"=1'-0"
SECTION H 1/8"=1'-0"
SECTION F 1/8"=1'-0"
KEY PLAN
1"=30'-0"
NOTES:
1. FOR GENERAL NOTES SEE DWG. E-518-1003.
2. ALL WORK SHALL BE IN ACCORDANCE WITH SPECIFICATION E-110040-01.
3. BOLTS SHALL BE 7/8"ø A325N. CONNECTIONS FOR BRACING MEMBERS SHALL BE DETAILED FOR THE FORCES SHOWN. CONNECTIONS FOR BEAMS SHALL BE DETAILED PER AISC MANUAL, 9 EDITION TABLE X FOR SINGLE PLATE SHEAR CONNECTORS USING 5/8" PLATE AND 1/4" WELD, PROVIDE AS MANY BOLTS AS WILL FIT USING 3" SPACING.
4. WHERE FILLET WELD SIZE IS NOT SHOWN, PROVIDE THE MINIMUM SIZE PER AISC MANUAL.
5. DOUBLE ANGLE MEMBER WITH UNEQUAL LEGS SHALL HAVE LONG LEGS BACK TO BACK, UNO.
6. DIMENSIONS MARKED THUS "6#" SHALL BE VERIFIED BY THE SUBCONTRACTOR.
7. ALL BRACING MEMBER CONNECTIONS SHALL BE DESIGNED FOR THE FOLLOWING FORCES IN KIPS
L 4x4 x 5/16 30# TENSION OR COMPRESSION
L 5x3 1/2 x 5/16 35#
L 6x4 x 5/16 40#
L 6x4 x 7/16 100#
Bechtel JOB NO 21178-001
Bechtel Corporation San Francisco Power Office
DESIGNED DRAWN CHECKED APPROVED
SEWARD STATION BOILER #5 UNIT 5
SHEET TYPE: STRUCTURAL STEEL
TITLE: BOILER GAS FLOW SYSTEM
COLD DUCT MODIFICATION (PROJECT 185-PROJ#)
DUCT SUPPORT STEEL
DRAWING NO. E-518-1002
AS BUILT
ISSUED FOR CONSTRUCTION
0 1

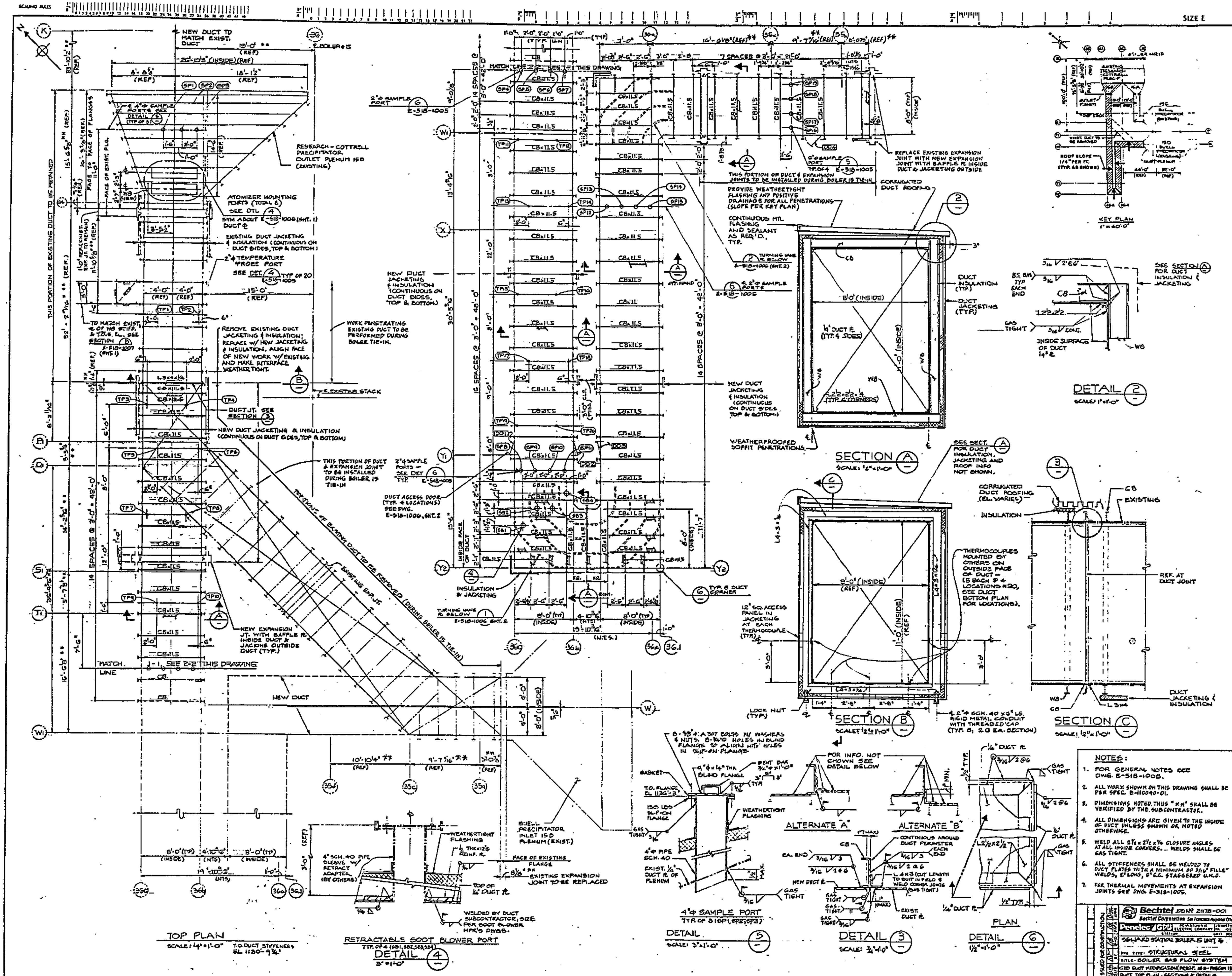


NOTES :

1. FOR GENERAL NOTES SEE DWG. E-518-1008
2. FOR ADDITIONAL NOTES, SEE DWG. E-518-1002.

Bechtel JOB NO 21178-001
Bechtel Corporation San Francisco Regional Office
Penelec GPU Pennsylvania Electric Company
SEWARD STATION BOILER 15 UNIT 5
DWG TYPE: STRUCTURAL STEEL
TITLE: BOILER GAS FLOW SYSTEM
C20 DUCT MODIFICATION
SUPPORT STEEL SECTIONS & DETAILS
E-518-1003

AS BUILT
ISSUED FOR CONSTRUCTION

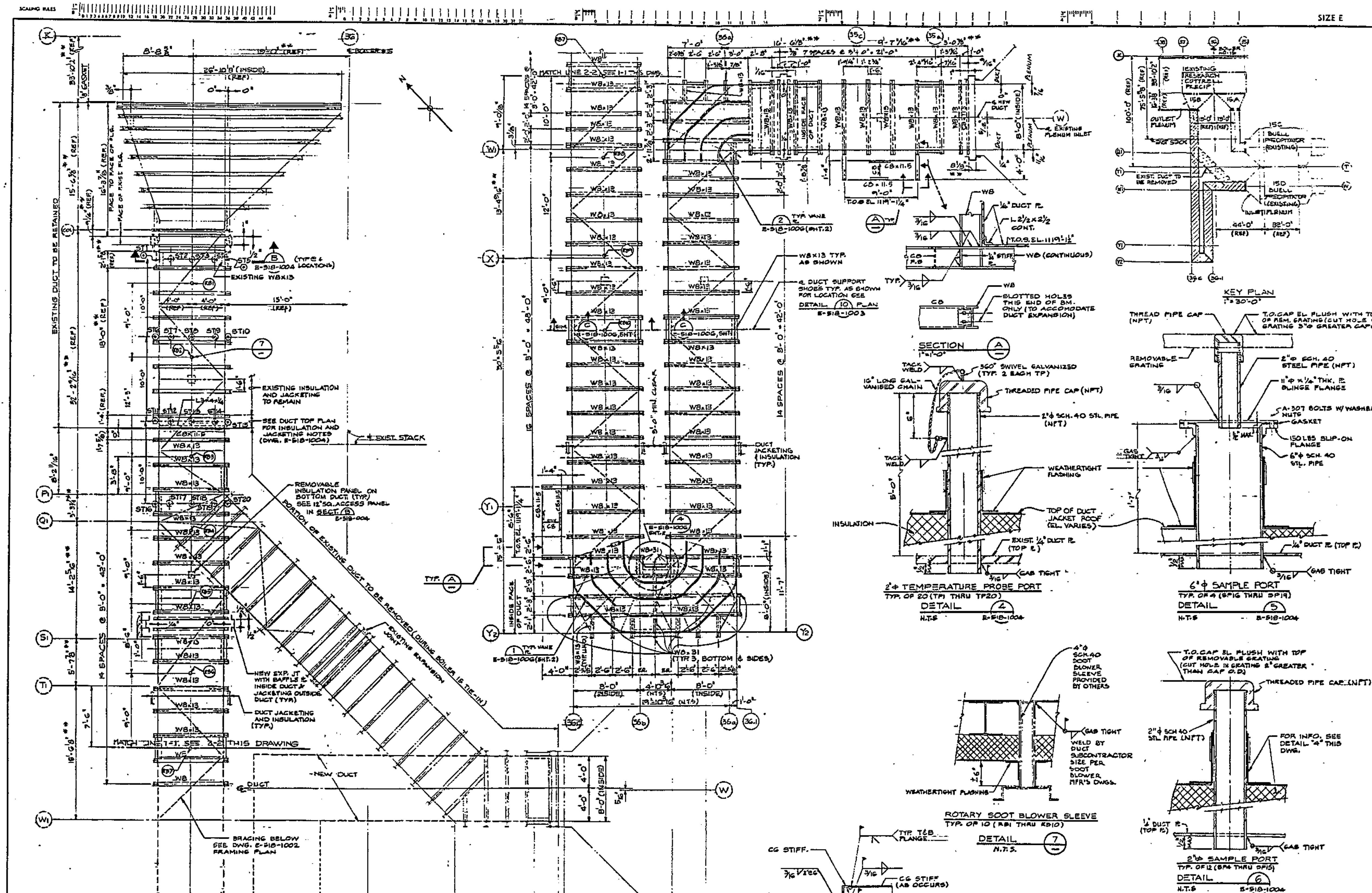


NOTES:

1. FOR GENERAL NOTES SEE DWG. E-518-1008.
2. ALL WORK SHOWN ON THIS DRAWING SHALL BE PER SPEC. E-110040-01.
3. DIMENSIONS NOTED THUS "**" SHALL BE VERIFIED BY THE SUBCONTRACTOR.
4. ALL DIMENSIONS ARE GIVEN TO THE INSIDE OF DUCT UNLESS SHOWN OR NOTED OTHERWISE.
5. WELD ALL 2 1/2 x 2 1/2 x 1/4 CLOSURE ANGLES AT ALL INSIDE CORNERS.... WELDS SHALL BE GAS TIGHT.
6. ALL STIFFENERS SHALL BE WELDED TO DUCT PLATES WITH A MINIMUM OF 3/16" FILLET WELDS, 2" LONG, 6" C.C. STAGGERED U.N.O.
7. FOR THERMAL MOVEMENTS AT EXPANSION JOINTS SEE DWG. E-518-1005.

ISSUED FOR CONSTRUCTION

Bechtel JOB Nº 21178-001
Bechtel Corporation San Francisco Regional Office
Penelec / GPU PENNSYLVANIA ELECTRIC COMPANY JOHNSTOWN PA.
STATION: SEWARD STATION BOILER 15 UNIT 5
DWG TYPE: STRUCTURAL STEEL
TITLE: BOILER GAS FLOW SYSTEM
DUCT MODIFICATION (PRECIP. 15B - PRECIP. 15D)
DUCT TOP PLAN, SECTIONS & DETAILS
SCALE: AS NOTED
DRAWING NUMBER: E-518-1004 REV 0

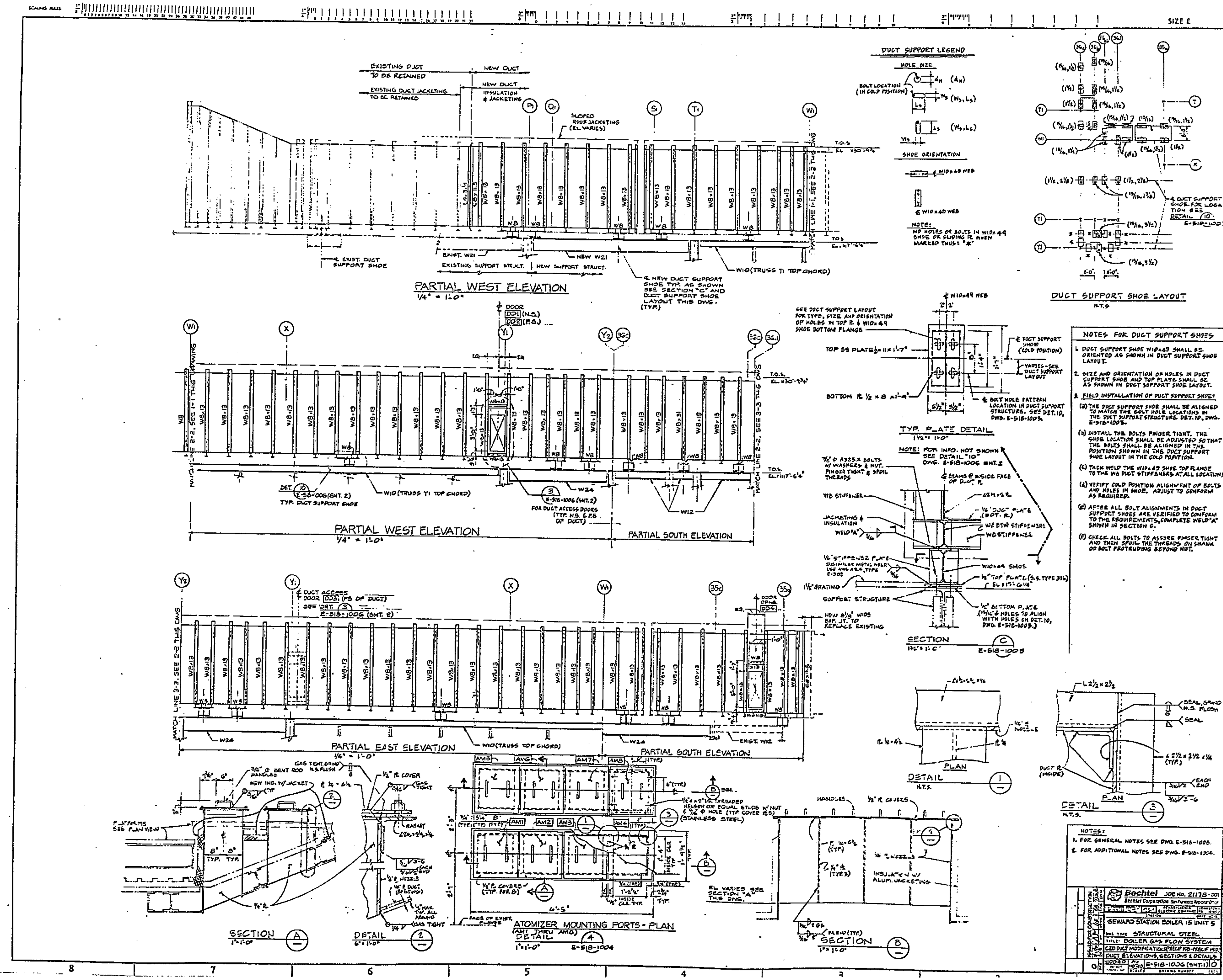

SIZE E
BOTTOM SECTION PLAN
1/4"=1'-0" BOT. DUCT ℞ (INSIDE SURFACE) EL. 1119'-1 1/2"
EXISTING DUCT TO BE RETAINED
PORTION OF EXISTING DUCT TO BE REMOVED (DURING BOILER 15 TIE-IN)
NEW DUCT
SECTION A
1"=1'-0"
KEY PLAN
1"=30'-0"
2"φ TEMPERATURE PROBE PORT
TYP. OF 20 (TP1 THRU TP20)
DETAIL 4
6"φ SAMPLE PORT
TYP. OF 4 (SP16 THRU SP19)
DETAIL 5
ROTARY SOOT BLOWER SLEEVE
TYP. OF 10 (RB1 THRU RB10)
DETAIL 7
2"φ SAMPLE PORT
TYP. OF 12 (SP4 THRU SP15)
DETAIL 6
N.T.S
E-518-1004
BOTTOM & SIDES
TOP
TYPICAL DUCT JOINT
(FIELD OR SHOP)
LEGEND
THERMOCOUPLES MOUNTED ON EXTERIOR FACE OF DUCT (BY OTHERS).
SIDE OF DUCT ST NO
BOTTOM OF DUCT ST NO
CALCULATED THERMAL MOVEMENTS AT EXPANSION JOINTS (BASE ON 350°F TEMPERATURE CHANGE)
REMOVABLE INSULATION PANEL (ON BOTTOM OF DUCT) FOR GROUNDING CONNECTION (8-LOCATIONS)

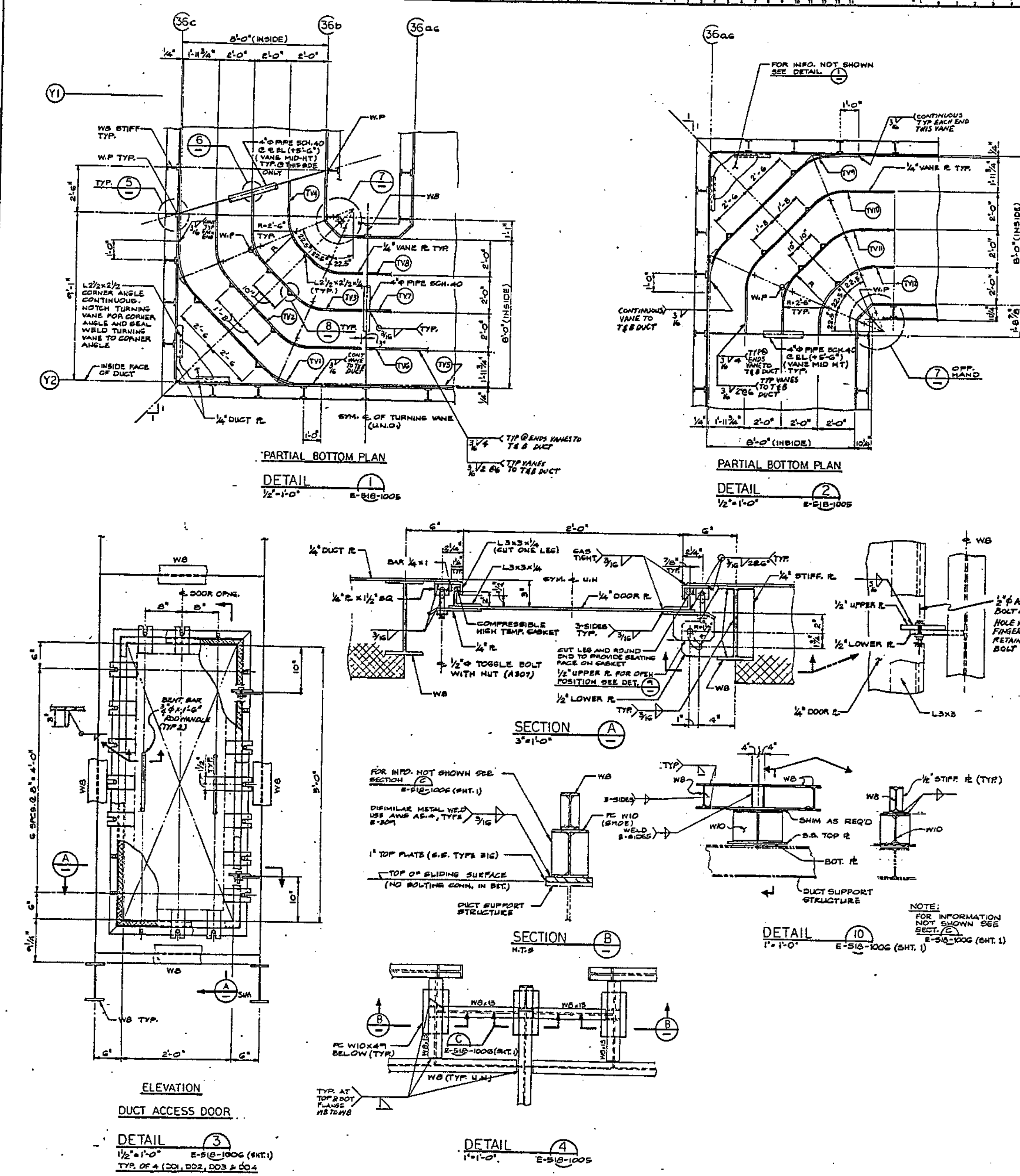
NOTES:

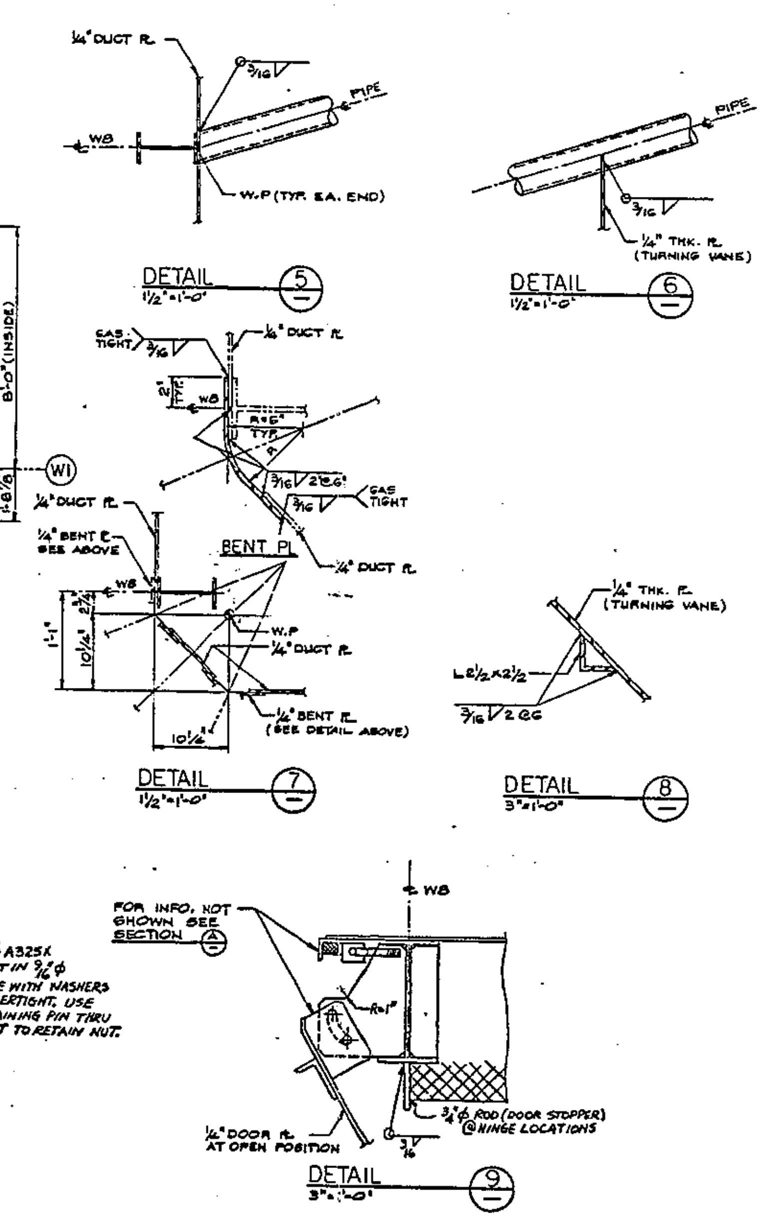
1. FOR GENERAL NOTES SEE DWG. E-518-1008.
2. FOR ADDITIONAL NOTES SEE DWG. E-518-1004.
3. THERMAL EXPANSIONS SHOWN ARE CALCULATED BASE ON 350°F TEMPERATURE CHANGE (50°F TO 400°F)

ISSUED FOR CONSTRUCTION

Bechtel JOB NO 21178-001
Bechtel Corporation San Francisco Regional Office
Penelec GPU PENNSYLVANIA ELECTRIC COMPANY
SEWARD STATION BOILER 15 UNIT 5
DWG TYPE: STRUCTURAL STEEL
TITLE: BOILER GAS FLOW SYSTEM
C2D DUCT MODIFICATION (PRECIP. 15 D-PRECIP. 15D)
DUCT BOTTOM PLAN, SECTIONS & DETAILS
DRAWING NUMBER E-518-1005 REV 0


SIZE E
EXISTING DUCT TO BE RETAINED
NEW DUCT
EXISTING DUCT JACKETING TO BE RETAINED
NEW DUCT INSULATION & JACKETING
SLOPED ROOF JACKETING (EL. VARIES)
EXIST. W21
NEW W21
EXISTING SUPPORT STRUCT.
NEW SUPPORT STRUCT.
℄ EXIST. DUCT SUPPORT SHOE
W10 (TRUSS T1 TOP CHORD)
℄ NEW DUCT SUPPORT SHOE TYP. AS SHOWN SEE SECTION "C" AND DUCT SUPPORT SHOE LAYOUT THIS DWG. (TYP.)
PARTIAL WEST ELEVATION
1/4" = 1'-0"
DUCT SUPPORT LEGEND
HOLE SIZE
SHOE ORIENTATION
NOTE: NO HOLES OR BOLTS IN W10x49 SHOE OR SLIPING PL WHEN MARKED THUS: "x"
DUCT SUPPORT SHOE LAYOUT
N.T.S.
PARTIAL WEST ELEVATION
1/4" = 1'-0"
PARTIAL SOUTH ELEVATION
TYP. DUCT SUPPORT SHOE
W10 (TRUSS T1 TOP CHORD)
W24
W12
FOR DUCT ACCESS DOORS (TYP. N.S. & F.S. OF DUCT)
TYP. PLATE DETAIL
1 1/2" = 1'-0"
SECTION C
E-518-1005
PARTIAL EAST ELEVATION
1/4" = 1'-0"
PARTIAL SOUTH ELEVATION
W10 (TRUSS TOP CHORD)
EXIST. W12
DETAIL 1
N.T.S.
DETAIL 3
N.T.S.
SECTION A
1" = 1'-0"
DETAIL 2
6" = 1'-0"
ATOMIZER MOUNTING PORTS - PLAN (AM1 THRU AM8)
DETAIL 4
1" = 1'-0"
E-518-1004
SECTION B
1" = 1'-0"
NOTES FOR DUCT SUPPORT SHOES
1. DUCT SUPPORT SHOE W10x49 SHALL BE ORIENTED AS SHOWN IN DUCT SUPPORT SHOE LAYOUT.
2. SIZE AND ORIENTATION OF HOLES IN DUCT SUPPORT SHOE AND TOP PLATE SHALL BE AS SHOWN IN DUCT SUPPORT SHOE LAYOUT.
3. FIELD INSTALLATION OF DUCT SUPPORT SHOE:
(a) THE DUCT SUPPORT SHOE SHALL BE ALIGNED TO MATCH THE BOLT HOLE LOCATIONS IN THE DUCT SUPPORT STRUCTURE DET. 10, DWG. E-518-1003.
(b) INSTALL THE BOLTS FINGER TIGHT. THE SHOE LOCATION SHALL BE ADJUSTED SO THAT THE BOLTS SHALL BE ALIGNED IN THE POSITION SHOWN IN THE DUCT SUPPORT SHOE LAYOUT IN THE COLD POSITION.
(c) TACK WELD THE W10x49 SHOE TOP FLANGE TO THE W8 DUCT STIFFENERS AT ALL LOCATIONS.
(d) VERIFY COLD POSITION ALIGNMENT OF BOLTS AND HOLES IN SHOE. ADJUST TO CONFORM AS REQUIRED.
(e) AFTER ALL BOLT ALIGNMENTS IN DUCT SUPPORT SHOES ARE VERIFIED TO CONFORM TO THE REQUIREMENTS, COMPLETE WELD "A" SHOWN IN SECTION C.
(f) CHECK ALL BOLTS TO ASSURE FINGER TIGHT AND THEN SPOIL THE THREADS ON SHANK OF BOLT PROTRUDING BEYOND NUT.
NOTES:
1. FOR GENERAL NOTES SEE DWG. E-518-1008.
2. FOR ADDITIONAL NOTES SEE DWG. E-518-1204.
Bechtel JOB No. 21178-001
Bechtel Corporation San Francisco Regional Office
SEWARD STATION BOILER 15 UNIT 5
STRUCTURAL STEEL
TITLE: BOILER GAS FLOW SYSTEM
C2D DUCT MODIFICATIONS (PRECIP 15B - PRECIP 15D)
DUCT ELEVATIONS, SECTIONS & DETAILS
110240
AS NOTED
E-518-1006 (SHT. 1)
0
ISSUED FOR CONSTRUCTION





NOTES:

1. FOR GENERAL NOTES SEE DWG. E-518-1008.
2. FOR ADDITIONAL NOTES SEE DWG. E-518-1004.
3. BREAK ALL SHARP CORNERS & EDGES ON DOOR R'S.

ISSUED FOR CONSTRUCTION

Bechtel JOB Nº 21178-001
Bechtel Corporation San Francisco Regional Office

Penelec/GPU PENNSYLVANIA ELECTRIC COMPANY

SEWARD STATION BOILER 15 UNITS

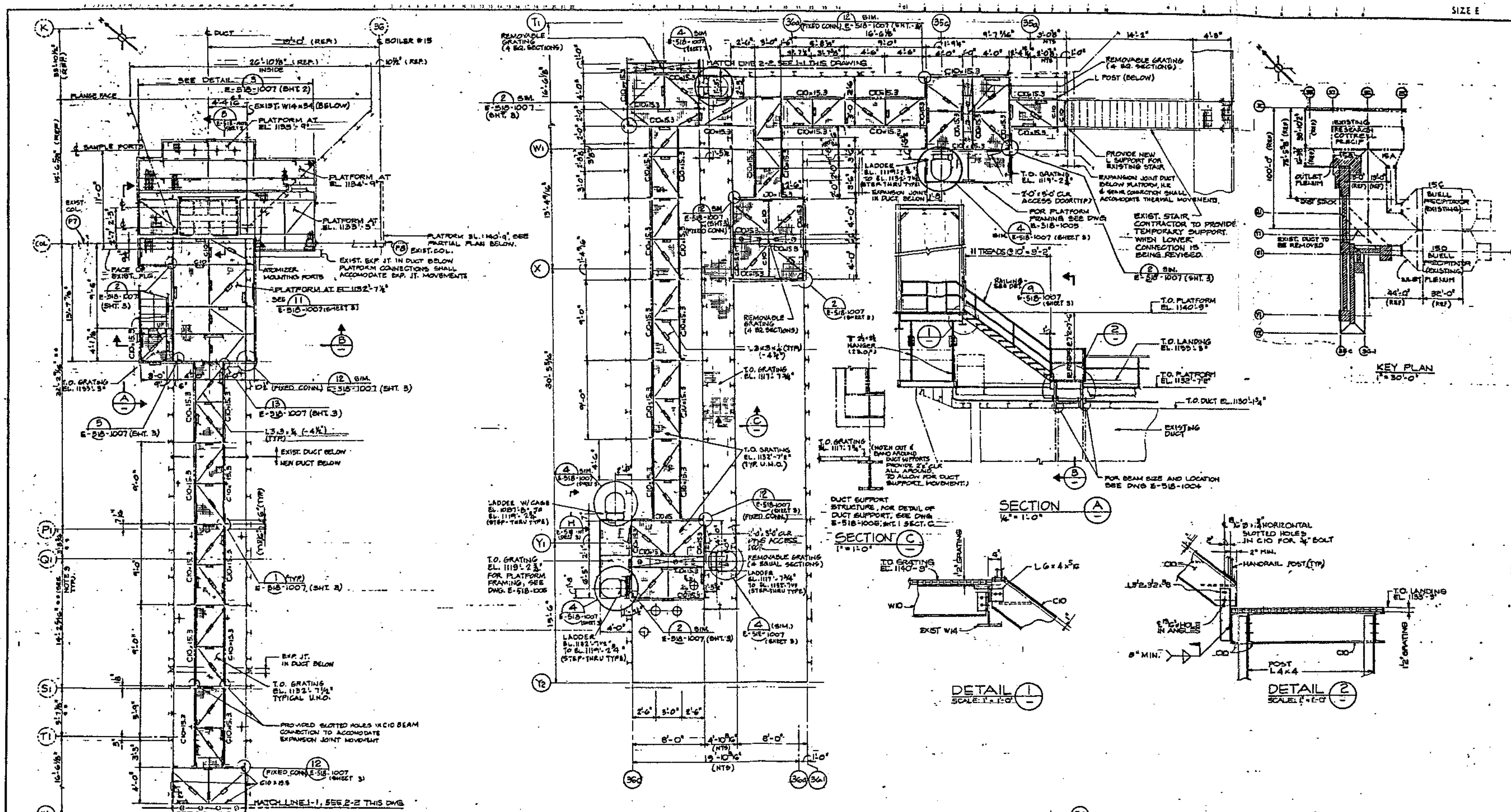
DWG TYPE: STRUCTURAL STEEL

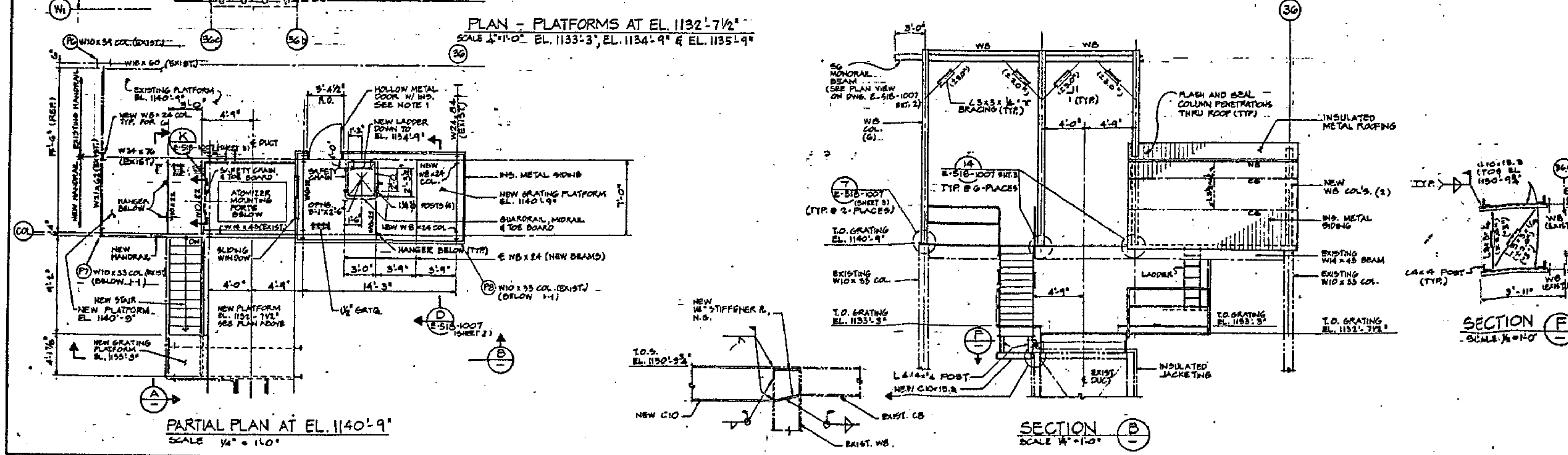
TITLE: BOILER GAS FLOW SYSTEM

C&D DUCT MODIFICATIONS (PRECIP. 15B-PRECIP. NO.

DUCT ELEV., SECTIONS & DETAILS

REV	PROJECT SYSTEM NO.	SCALE	DRAWING NUMBER	REV
0	110040	AS NOTED	E-518-1006 (SHT.2)	0





NOTES:

1. FOR GENERAL NOTES, SEE DWG. E-518-1008.
2. BOLTS FOR PLATFORM FRAMING SHALL BE ¾"φ A325 UNO FOR BEAMS AT LONGITUDINAL AND LATERAL DIRECTIONS, BOLTS AT ONE END SHALL BE TIGHTENED PER SPEC. REQUIREMENTS. THE CONNECTION AT THE OTHER END SHALL ALLOW FOR MOVEMENT BY USE OF SLOTTED HOLES AND FINGER TIGHT NUTS, THREAD END SHALL BE SPOILED AFTER BOLT INSTALLATION.
3. DIMENSION NOTED THUS "*" SHALL BE VERIFIED BY THE SUB-CONTRACTOR.
4. ALL CONNECTION SHALL BE DETAILED IN ACCORDANCE WITH THE AISC "MANUAL OF STEEL CONSTRUCTION, ALLOWABLE STRESS DESIGN" NINTH EDITION, TABLE II, EACH BOLTED CONNECTION SHALL HAVE AT LEAST TWO BOLTS. UNO
5. ALL PLATFORM BEAM CONNECTIONS NEAR THE EXPANSION JOINT IN THE DUCT SHALL PROVIDE SLOTTED HOLE TO ACCOMODATE THERMAL MOVEMENT OF DUCT.

AS BUILT

ISSUED FOR CONSTRUCTION

Bechtel JOB NO. 21178-001
Bechtel Corporation San Francisco Regional Office

Penelec / GPU PENNSYLVANIA ELECTRIC COMPANY

SEWARD STATION BOILER 15 UNIT 6

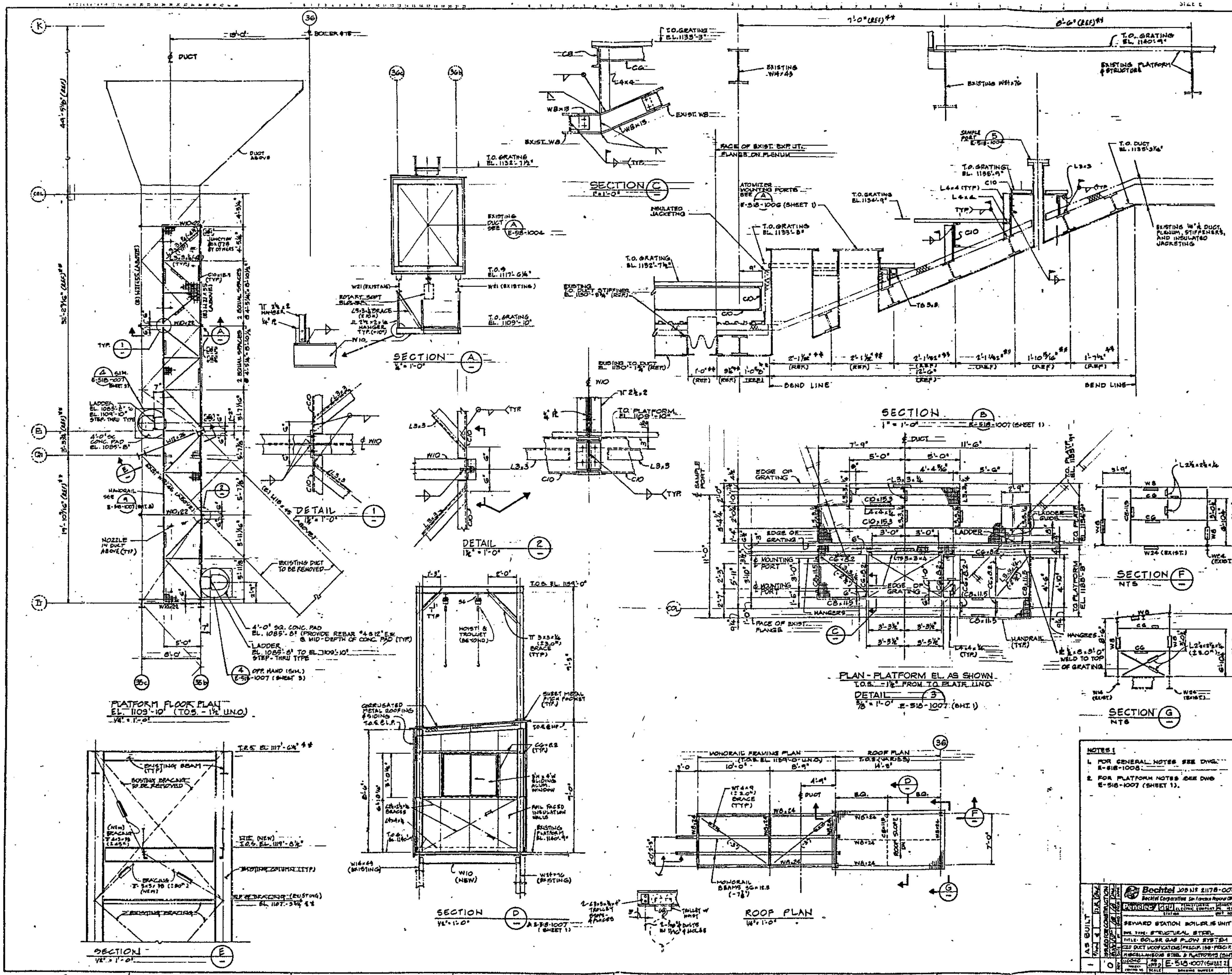
DWG TYPE: STRUCTURAL STEEL

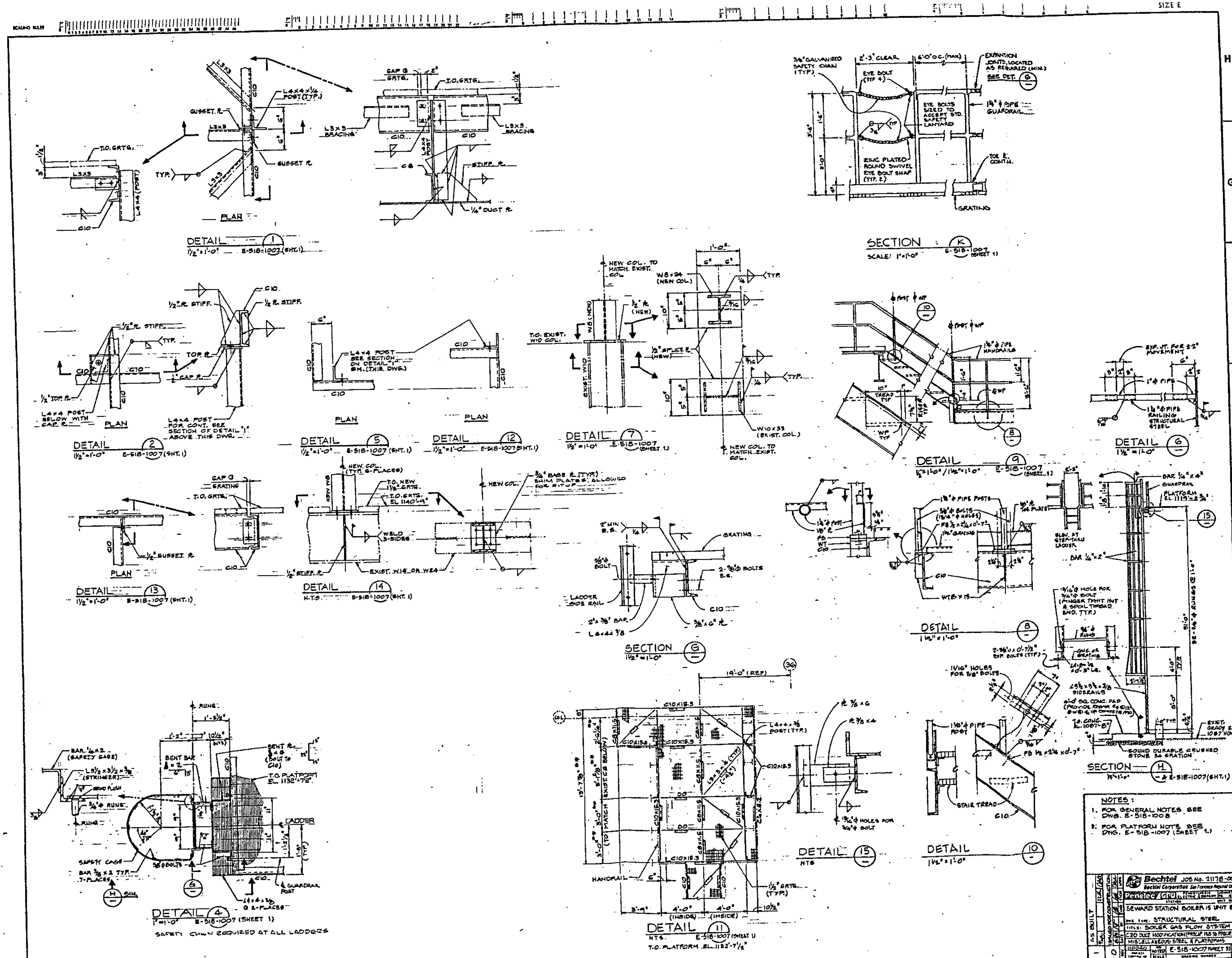
TITLE: BOILER GAS FLOW SYSTEM

C10 DUCT MODIFICATIONS PRECIP. 15B TO PRECIP 15C

MISCELLANEOUS STEEL & PLATFORMS

110040	AS NOTED	E-518-1007 (SHT 1)	1
PROJECT CONTROL NO.	SCALE	DRAWING NUMBER	REV


PLATFORM FLOOR PLAN
EL. 1109'-10" (T.O.S. - 1½ U.N.O.)
SECTION A
SECTION C
SECTION B
DETAIL 1
DETAIL 2
PLAN - PLATFORM EL AS SHOWN
T.O.S. - 1½" FROM TO PLATF. U.N.O.
DETAIL 3
E-518-1007 (SHT. 1)
SECTION F
NTS
SECTION G
NTS
SECTION D
SECTION E
MONORAIL FRAMING PLAN
ROOF PLAN
NOTES:
1. FOR GENERAL NOTES SEE DWG. E-518-1008.
2. FOR PLATFORM NOTES SEE DWG E-518-1007 (SHEET 1).
AS BUILT
ISSUED FOR CONSTRUCTION
Bechtel JOB NO 21178-001
Bechtel Corporation San Francisco Regional Office
Penelec/GPU
PENNSYLVANIA ELECTRIC COMPANY
SEWARD STATION BOILER 15 UNIT 5
STRUCTURAL STEEL
TITLE: BOILER GAS FLOW SYSTEM
DUCT MODIFICATIONS
MISCELLANEOUS STEEL & PLATFORMS (SHT. 2)
E-518-1007 (SHEET 2)
DRAWING NUMBER
SCALE
REV



NOTES:

1. FOR GENERAL NOTES SEE DWG. E-518-1008
2. FOR PLATFORM NOTE SEE DWG. E-518-1007 (SHEET 1)

Bechtel JOB No. 21178-001
Bechtel Corporation San Francisco Regional Office
Penelec/GPU
SEWARD STATION BOILER 15 UNIT 5
DWG. TYPE: STRUCTURAL STEEL
TITLE: BOILER GAS FLOW SYSTEM
C20 DUCT MODIFICATION (PRECIP. 15B TO PRECIP. 15C)
MISCELLANEOUS STEEL & PLATFORMS
AS BUILT
ISSUED FOR CONSTRUCTION
110040 AS NOTED E-518-1007 (SHEET 3) 1

SIZE E

GENERAL NOTES:

1. ALL WORK SHALL BE IN ACCORDANCE WITH SPECIFICATION E-110040-01.

2. ALL MATERIAL SHALL BE NEW UNLESS OTHERWISE NOTED.

3. THE SUBCONTRACTOR SHALL VERIFY EXISTING CONDITIONS AND DIMENSIONS OF EXISTING CONSTRUCTION AS NECESSARY TO COMPLETE THE WORK. ALL DIMENSIONS SHOWN ON THE DRAWINGS NOTED WITH "**" SHALL BE VERIFIED IN THE FIELD BY THE SUBCONTRACTOR.

4. ALL DIMENSIONS NOTED ON THE DRAWINGS AS "(REF)" ARE REFERENCE DESIGN DIMENSIONS FOR EXISTING CONSTRUCTION OR ARE CALCULATED BASED ON ORIGINAL DESIGN DIMENSIONS FOR EXISTING CONSTRUCTION. THE SUBCONTRACTOR SHALL BE RESPONSIBLE TO DETERMINE THE AS-BUILT DIMENSIONS FOR ALL DIMENSIONS NOTED AS REFERENCE DIMENSIONS IF THE DIMENSION IS REQUIRED FOR DETAILING AND INTEGRATION OF THE NEW WORK WITH EXISTING CONSTRUCTION

5. ALL FILLET WELDS SHALL BE THE MINIMUM SIZE FILLET WELDS REQUIRED BY AISC FOR THE THICKNESS OF THE PARTS JOINED WHERE THE SIZE IS NOT INDICATED ON THE DRAWING.

6. CONSTRUCTION SEQUENCE:

   A. THE SUBCONTRACTOR SHALL BE RESPONSIBLE FOR THE SEQUENCING OF THE CONSTRUCTION OF THE WORK. FIELD WELDS AS INDICATED ON THE DRAWINGS MAY BE SHOP WELDS AND SHOP WELDS MAY BE FIELD WELDS AT THE OPTION OF THE SUBCONTRACTOR TO SUIT THE REQUIRED CONSTRUCTION SEQUENCE, EXCEPT THAT THE ROTARY SOOT BLOWER SLEEVES, AND THE RETRACTABLE SOOT BLOWER SLEEVES PROVIDED BY OTHERS SHALL BE WELDED IN THE FIELD TO THE DUCTWORK BY THE SUBCONTRACTOR.

   B. THE DUCT SUPPORT STRUCTURE, MODIFICATIONS TO THE EXISTING DUCT SUPPORT STRUCTURE, AND DUCT EXTENSION WORK SHALL BE PERFORMED PRIOR TO THE BOILER 15 TIE-IN. THE EXISTING DUCT SUPPORT STRUCTURE IS TO REMAIN IN PLACE AND WILL FORM PART THE STRUCTURAL SUPPORT SYSTEM FOR THE NEW DUCT.

   C. THE BOILER 15 TIE-IN OF THE DUCTWORK AND ASSOCIATED WORK ON THE EXISTING PLENUM SHALL BE PERFORMED IN 5 DAYS IN ACCORDANCE WITH THE PROJECT SCHEDULE.

7. THE SLOTTED HOLES IN PLATFORM BEAM CONNECTIONS FOR PLATFORMS SUPPORTED FROM THE DUCTWORK OR PLENUM SHALL BE PROVIDED AT ONE END OF EACH BEAM AS REQUIRED TO ACCOMMODATE THERMAL EXPANSION TO THE DUCTWORK. THE HOLES SHALL BE SLOTTED IN THE DIRECTION OF THE THERMAL EXPANSION. BOLTS IN A SLOTTED HOLES SHALL BE INSTALLED IN A FINGERTIGHT CONDITION UNLESS NOTED OTHERWISE. SPOIL THE THREADS OF THE BOLT PROTRUDING BEYOND THE NUT TO PREVENT LOOSENING OF THE NUT.

8. ALL BEAM CONNECTIONS SHALL HAVE A MINIMUM OF TWO BOLTS AND A MINIMUM CAPACITY OF 6 KIPS.

9. ALL BRACING SHALL BE DESIGNED FOR A TENSION AND COMPRESSION LOAD OF 3 KIPS MINIMUM UNLESS NOTED OTHERWISE.

REFERENCE DRAWINGS:

Gilbert & Penelec drawings:

11-B-0149	Precipitator and Flue System General Layout (For Reference Only)
11-B-0001 Sh 1	New Service Road Location and Grading Plan (For Reference Only)
11-B-0001 Sh 2	New Service Road Location and Grading Plan (For Reference Only)
11-B-0002	New Service Road Typical Sections & Details (For Reference Only)
A-1390-1	New Precipitator Area Paving (For Reference Only)
C-787-100	Geologic Cross Sections (For Reference Only)
B-30959 Sh 1	Structural Steel Framing - Precipitator Supports - South End of Boiler House (For Reference Only)
B-30958 Sh 2	Structural Steel Framing - Sections & Elevations of Precipitator Supports - South End of Boiler House (For Reference Only)
B-487-101	Boiler Gas Flow System Precipitator & Duct Support Foundations Sections, & Details (For Reference Only)
B-587-104	Boiler Gas Flow System Duct Support Steel Inlet Side Of Precipitator, Boiler #15 (For Reference Only)
B-587-120	Boiler Gas Flow System Bottom Plan Inlet Ducts From Existing Precipitator To New Precipitator (For Reference Only)
B-587-121	Boiler Gas Flow System Top Plan Inlet Ducts From Existing Precipitator To New Precipitator (For Reference Only)
B-587-122	Boiler Gas Flow System Inlet Ducts - Sections & Details (For Reference Only)
B-587-123	Boiler Gas Flow System Inlet Ducts - Elevations & Sections (For Reference Only)
B-787-001	Civil Plot Plan Coal Pile Drainage (For Reference Only)
E-087-101	Layout - New Precipitator & ID Fans for Boilers 12,14,& 15 (For Reference Only)
E-087-102	Layout New Chimney And Future Plant Additions (For Reference Only)
E-387-006	Waste Treatment Yard Piping Plot Plan and Details (For Reference Only)
E-387-199	Layout of New Catch Basins and Drains, Plan, Section & Details (For Reference Only)
E-487-100	Boiler Gas Flow System Plan-Precipitator, Duct Support & I.D. Fan Foundations (For Reference Only)

Raybestos Manhattan drawings:

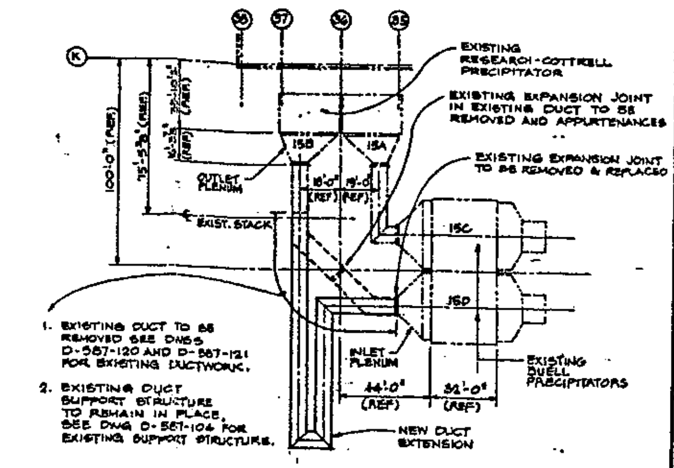
RL-1582-1	Expansion Joint Mark Y (For Reference Only)
RL-1582-1-A	Back-up Bars for Expansion Joint (Rectangle) (For Reference Only)

Buell drawings:

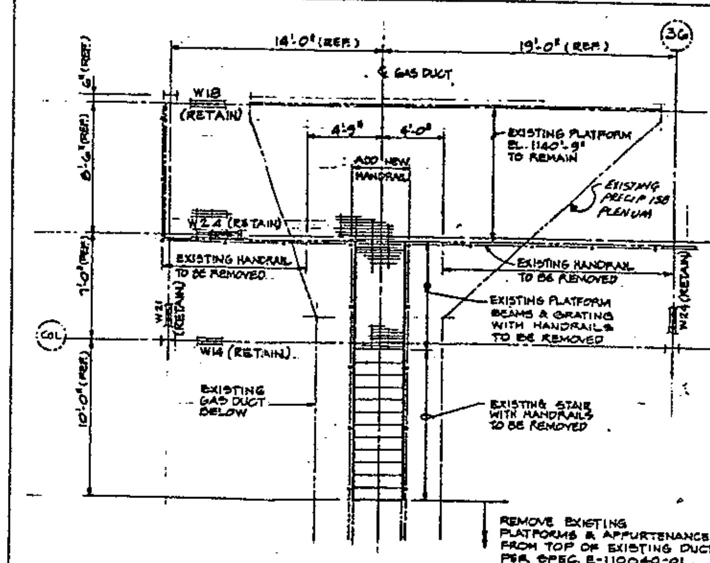
2-18348	Expansion Joint Data & Notes (For Reference Only)
2-18364	Expansion Joint Baffle Detail for Inlet Duct (For Reference Only)

Bechtel drawings:

E-408-1002	Boiler Gas Flow System - CZD Duct Modification (Precip 15B to Precip 15D), Foundations, Boiler 15
E-518-1002	Boiler Gas Flow System - CZD Duct Modification (Precip 15B to Precip 15D), Support Steel, Boiler 15
E-518-1003	Boiler Gas Flow System - CZD Duct Modification (Precip 15B to Precip 15D), Support Steel Sections & Details, Boiler 15
E-518-1004	Boiler Gas Flow System - CZD Duct Modification (Precip 15B to Precip 15D), Duct Top Plan, Sections & Details Boiler 15
E-518-1005	Boiler Gas Flow System- CZD Duct Modification (Precip 15B to Precip 15D), Duct Bottom Plan, Boiler 15
E-518-1006 Sheet 1	Boiler Gas Flow System - CZD Duct Modification (Precip 15B to Precip 15D) Duct Elevations, Sections & Details, Boiler 15.
E-518-1006 Sheet 2	Boiler Gas Flow System - CZD Duct Modification (Precip 15B to Precip 15D) Duct Elevations, Sections & Details, Boiler 15.
E-518-1007 Sheet 1	Boiler Gas Flow System - CZD Duct Modification (Precip 15B to Precip 15D) Miscellaneous Steel & Platforms, Boiler 15
E-518-1007 Sheet 2	Boiler Gas Flow System - CZD Duct Modification (Precip 15B to Precip 15D) Sections & Details - Miscellaneous Steel & Platforms, Boiler 15
E-518-1007 Sheet 3	Boiler Gas Flow System - CZD Duct Modification (Precip 15B to Precip 15D) Sections & Details - Miscellaneous Steel & Platforms, Boiler 15.
E-518-1008	Boiler Gas Flow System CZD Duct Modification (Precip 15B to Precip 15D) General Notes and Demolition Plan



DUCTWORK DEMOLITION PLAN
1" = 30'-0"



PLATFORM DEMOLITION PLAN
1/4" = 1'-0"

AS BUILT

ISSUED FOR CONSTRUCTION

Bechtel JOB No. 21178-002
Bechtel Corporation San Francisco Regional Office
Penelec / GPU PENNSYLVANIA ELECTRIC COMPANY

SEWARD STATION BOILER 15 UNIT 5

DWG TYPE: NOTES

TITLE: BOILER GAS FLOW SYSTEM
CZD DUCT MODIFICATION (PRECIP 15B TO PRECIP 15D)
GENERAL NOTES

110040 | AS NOTED | E-518-1008 | 1