HEALY CLEAN COAL PROJECT

PUBLIC DESIGN REPORT
FINAL REPORT: VOLUME 1

Prepared by:

The Alaska Industrial Development and Export Authority

for

The United States Department of Energy

Under

Cooperative Agreement DE-FC22-91PC90544

AUGUST 2000

Patent cleared by Chicago on: June 12, 2000

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Abstract

The Healy Clean Coal Project (HCCP) is a 50-megawatt coal-fired power generating facility at a site near Healy, Alaska. Design, construction, and operation of the facility was in response to the U.S. Department of Energy (DOE) Program Opportunity Notice issued in May 1989 for the Clean Coal Technology Demonstration Program. The Alaska Industrial Development and Export Authority (AIDEA) and the State of Alaska view the project as a major step in the development of Alaska's Interior region (Nenana Basin) coal resource for use in producing low cost, environmentally sound electrical power.

The facility will demonstrate the TRW Clean Coal Combustion System and the Joy/Babcock & Wilcox (B&W) Spray Dryer Absorber (SDA) System, an integrated air pollution control process that is designed to minimize emissions of NO_x, SO_2, and particulates from the facility while firing a broad range of coals.

The final total estimated project cost is $292,300,000. This total cost is inclusive of all demonstration, start-up, environmental delay, and dispute and litigation costs. The DOE’s cost share is $117,327,000 with the remaining funds coming from contributions from various project participants as well as an AIDEA bond sale.

A 90-day commercial operating test on HCCP was completed December 1999 resulting in generation of 102,373 MWH (megawatt-hours) of energy at a capacity factor of 94.79% over 90 days. The fuel flexibility, and corresponding positive economic, and waste minimization benefits associated with the new combustor technology were demonstrated by burning a blend of Run-of-Mine (ROM) and 83% previously unsaleable waste coal, including fines, over the 90-day test period. This blend of run-of-mine and waste coal, which had an average daily heating value range of 6739 Btu/lb. to 7844 Btu/lb. is representative of coal which would be supplied for the life of the plant (projected 35 years). In addition to attaining these results, all generation was achieved within permitted limits for emissions with the exception of short-term sulfur dioxide (SO_2), and opacity exceedences that occurred during plant start-up and equipment repairs. Demonstration of the technology was successful.

Executive Summary

The purpose of this Public Design report is to consolidate all design and cost information at completion of construction and start-up so it can be used as a reference for future demonstration of the technology and future commercial applications.

The Healy Clean Coal Project (HCCP) is a 50 megawatt coal-fired power generating facility at a site near Healy, Alaska. Design, construction, and operation of the facility was in response to the U.S. Department of Energy (DOE) Program Opportunity Notice issued in May 1989 for the Clean Coal Technology Program. The facility will demonstrate new technologies and meet power needs in central Alaska an environmentally acceptable manner. The Alaska Industrial Development and Export Authority (AIDEA) and the State of Alaska view the project as a major step in the development of Alaska's Interior region (Nenana Basin) coal resource for use in producing low cost, environmentally sound electrical power.

The HCCP is the first commercial-scale demonstration of the TRW Clean Coal Combustion System and the Spray Dryer Absorber (SDA) System, an integrated air pollution control process that is designed to minimize emissions of oxides of nitrogen (NO_x), sulfur dioxide (SO_2), and particulates from the facility while firing a broad range of coals. NO_x emissions are reduced in the coal combustion process by use of the fuel and air-staged combustor system and a boiler that controls fuel and thermal-related conditions that inhibit NO_x formation. The slagging combustor boiler system also functions as a limestone calciner and first stage SO_2 removal device in addition to its heat recovery function. Secondary and tertiary SO_2 capture are accomplished by a single spray dryer absorber vessel and a baghouse, respectively. Ash collection in the process is first achieved by the removal of molten slag in the coal combustors, bottom ash from the boiler, followed by fly ash particulate removal in the baghouse downstream of the spray dryer absorber vessel.

The plant contains the following major process areas, each of which are described in detail in this report:

Main Boiler System
Combustor System
Spray Dryer Absorber System
Materials Handling System
Ash Handling System
Pre and Post Combustion Air System
Turbine Generator and Steam System
Condensate and Feedwater System
Circulating Water System
Water and Wastewater Treatment System
Fire Protection System
Plant Controls System
Electrical System
Balance of Plant Systems

The final total estimated project cost is $292,300,000. This total cost is inclusive of all demonstration, start-up, environmental delay, and dispute and litigation costs. The DOE's cost share is $117,327,000 with the remaining funds coming from contributions from various project participants as well an AIDEA bond sale.

A 90-day commercial operating test on HCCP was completed in December 1999 resulting in generation of 102,373 MWH of energy at a capacity factor of 94.79% over 90 days. The flexibility, the positive economic, and waste minimization benefits associated with the new combustor technology were demonstrated by burning a blend of run-of-mine (ROM) and 83% previously unsaleable waste coal, including fines, over the 90-day test period. This blend of run-of-mine and waste coal, which had an average daily heating value range of 6739 Btu/lb. to 7844 Btu/lb. is representative of coal which would be supplied for the project's 35 year life. In addition to attaining these results, all generation was achieved within permitted limits for emissions with the exception of short-term SO_2 and opacity exceedences that occurred during plant start-up and equipment repairs. Demonstration of the technology was successful.

1.0 Project Overview

1.1 Purpose of the Public Design Report – Final Report: Volume 1

The purpose of this report is as follows:

- To consolidate, for the purpose of Public Use, all design and capital cost information on the project at the completion of the project.

- To serve as a reference for the demonstration of the technology and future commercial applications.

- To assist federal, state, and regulatory decisions regarding deployment of clean coal technology.

The technical and cost information provided in the report are specifically applicable only to low-grade, low-sulfur coal and to the Alaska Interior.

1.2 Brief Description of the Project

The Alaska Industrial Development and Export Authority (AIDEA) has constructed a nominal 50 megawatt (MW) coal-fired power generating facility at a site near Healy, Alaska. The location of the facility is on land adjacent to the existing Golden Valley Electric Association, Inc. (GVEA) Healy Unit No. 1 power plant. GVEA operated the new power generating facility, the Healy Clean Coal Project (HCCP), and purchased its net power generation from AIDEA. Construction of the facility was in response to the U.S. Department of Energy (DOE) Program Opportunity Notice issued in May 1989 for the Clean Coal Technology Program (CCTP). The facility demonstrated new technologies that can be used to meet local power needs in an environmentally acceptable manner.

1.3 Objectives of the Project

The objectives of the project are as follows:

- To demonstrate a novel power plant design which features the combined removal of SO_2, NO_x, and Particulate Matter (PM) using a combination of two advanced technologies.

- To further demonstrate reduced emission levels well below the requirements of the Environmental Protection Agency (EPA) New Source Performance Standards (NSPS) for new utility coal-fired units.

- To meet future energy needs in an environmentally acceptable manner.

1.4 Significance of the Project

The HCCP is the first commercial-scale demonstration of the TRW Clean Coal Combustion System coupled with the SDA System.

The commercial use of the HCCP will fulfill future needs for electrical power with less environmental impact than conventional coal-based power systems. The demonstration of the state-of-the-art clean coal technologies of the HCCP will help the electric generation industry by showing that this equipment can be used to produce low cost electrical power while reducing sulfur dioxide, oxides of nitrogen, and particulate emissions. Environmental impacts such as transboundary and interstate pollution would be reduced or eliminated.

The State of Alaska views the project as a major step in the development of Alaska's Interior region (Nenana Basin) coal resource for use in producing low cost, environmentally sound electrical power.

1.5 DOE's Role in the Project

The role of the DOE is to monitor the participant's progress in performing the project, and, to the extent specifically authorized in the Cooperative Agreement, to have a substantial role in project decision making. DOE has partially financed and facilitated the project through its Clean Coal Technology Program, a first-of-a-kind coal technology that offers superior environmental performance.

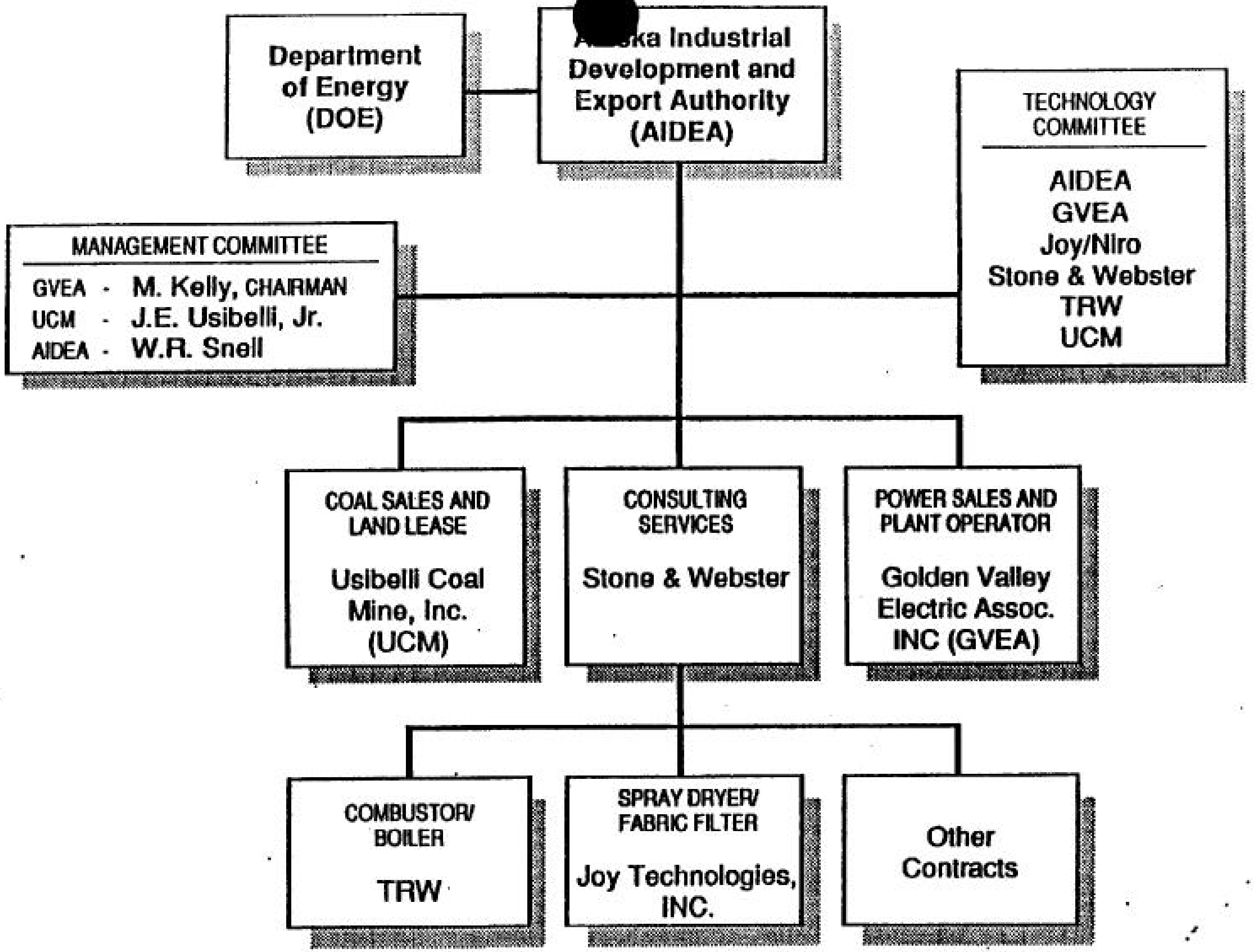
The original organization chart for the project and as presented in the DOE proposal is included in Figure 1-1.

2.0 Technology Description

2.1 Brief Description of the Technology Being Used

The HCCP utilizes a new power plant design that features the integration of advanced coal combustion and emission control processes. The integrated air pollution control process that results from the HCCP configuration of components has been designed to minimize emissions of SO_2, NO_x, and particulates from the facility while firing a broad range of coals. NO_x emissions are reduced in the coal combustion process by use of the fuel and air-staged combustor system and a boiler that controls fuel and thermal-related conditions that inhibit NO_x formation. The TRW Clean Coal Combustion System and boiler system also function as a limestone calciner and first stage SO_2 removal device in addition to its heat recovery function. Secondary and tertiary SO_2 capture are accomplished by a single spray dryer absorber vessel and a baghouse respectively. Ash collection in the process is first achieved by the removal of molten slag in the coal combustors, bottom ash from the boiler, followed by fly ash particulate removal in the baghouse downstream of the spray dryer absorber vessel.

The major process equipment identified are:



PROJECT ORGANIZATION
HEALY COGENERATION PROJECT
Alaska Industrial Development and Export Authority
August 29, 1989 **DE-PSOI-89FE61825**

Figure 1-1

TRW Clean Coal Combustion System: The TRW Clean Coal Combustion System (also referred to as slagging combustors) has been designed to provide efficient combustion, maintain effective limestone calcination, and minimize the formation of NO_x emissions in the boiler furnace. The main TRW Clean Coal Combustion System components include a precombustor, main slagging combustor, slag recovery section, tertiary air windbox, pulverized coal and limestone feed system, and combustion air system. In this unique arrangement, the slagging combustors are bottom mounted on the boiler hopper to yield optimum operation and cost benefits and satisfy spatial constraints. The coal-fired precombustor is used to increase the air inlet temperature to the main combustor for optimum slagging performance. It burns approximately 25-40 percent of the total coal input to the combustor. Combustion is staged to minimize NO_x formation.

Boiler. Steam to drive the turbine-generator is generated in the boiler fired by the TRW Clean Coal Combustion System. The steam generated in the boiler flows to the turbine and then, after releasing its energy to generate electricity, condenses and returns to the boiler as feedwater to be re-boiled and superheated, completing the steam cycle.

Turbine. The turbine-generator, condenser, boiler feed pumps, and other equipment is required to convert the high pressure, high temperature steam energy into electrical energy. The turbine-generator converts the energy in high temperature, high-pressure steam (950^0 F, 1,250 psig) to electrical energy. The electricity is transmitted to the main transformer and then to the substation for regional distribution.

Transformer. The HCCP main power transformer transforms electrical energy from the generator to a higher voltage for transmission via an overhead line to the transmission substation.

SDA. Combustion gases (flue gas) from the boiler flows to the SDA. The SDA removes SO_2 from the flue gas. The flue gas then flows from the SDA to the baghouse located downstream of the SDA.

Baghouse. The baghouse removes particulates, including solid sulfur compounds from the flue gas, before it is exhausted to the stack.

Ash/Limestone Area. The ash silos are located in the ash/limestone area. Ash is loaded in trucks in this area for disposal at the Usibelli Coal Mines (UCM) mine site. Limestone for the SO_2 removal system is unloaded from trucks in this area.

A more detailed explanation of the new TRW Clean Coal Combustion System is as follows:

The main slagging combustor consists of a water-cooled cylinder which is sloped toward a slag opening. The remaining coal is injected axially into the combustor, rapidly entrained by the swirling precombustor gases and additional air flow, and burned under substoichiometric (fuel-rich) conditions for NO_x control. The ash contained in the burning coal forms drops of molten slag and accumulates on the water-cooled walls as a result of the centrifugal force resulting from the swirling gas flow. The molten slag is driven by aerodynamic and gravity forces through a slot into the bottom of the slag recovery section where it falls into a water-filled tank and is removed by the slag removal system. Approximately 80 percent of the ash in the coal is removed as molten slag or boiler bottom ash.

The hot gas, containing carbon monoxide and hydrogen, is then ducted to the furnace from the slag recovery section through the hot gas exhaust duct. To ensure complete combustion in the furnace, additional air is supplied from the tertiary air windbox to NO_x control ports and to final overfire air ports located in the furnace.

Pulverized limestone is fed into the boiler for SO_2 control. While passing into the boiler most of the limestone is decomposed to flash calcined lime by the following reaction:

$CaCO_3$ + heat => $CaO + CO_2$

The mixture of this lime and the ash not removed by the combustors is called Flash Calcined Material (FCM). Some sulfur capture by the entrained Calcium Oxide (CaO) also occurs at this time, but the primary SO_2 removal mechanism is through the multiple step process described below, of spray drying the slurried and activated FCM solids.

Emissions of NO_x are expected to be demonstrated to levels significantly below EPA NSPS standards in the boiler by using slagging combustor technology and known combustion techniques.

The HCCP combustors achieve NO_x control as a combination of the following (two) factors:

1. The combustor functions as a well-stirred reactor under substoichiometric conditions for solid fuel combustion; converting the solid fuel components to a hot, partially oxidized fuel gas in an environment conducive to destroying the complex organic fuel bound nitrogen compounds which could easily be oxidized to NO_x in the presence of excess oxygen.

2. The combustor water cooled enclosure additionally absorbs approximately 10 to 25 percent of the total available heat input to the combustor.

These two conditions together reduce the potential for encountering combustion temperatures in the furnace sufficient for decomposition of molecular nitrogen compounds in the combustion air into forms which can produce thermal NO_x emissions as excess oxygen is made available.

When the exhaust gases leave the combustor, the coal has already been mixed with approximately 80 to 90 percent of the air theoretically necessary to complete combustion. A portion of the remaining 10 to 20 percent of the air is then allowed to mix slowly with the hot fuel gases exiting the combustor and entering the furnace. The hot gases radiate their heat to the furnace walls at rates faster than combustion is allowed to occur so that gas temperatures slowly decay from those at the furnace entrance. After the furnace gases have cooled sufficiently, a second and possibly third stage of furnace combustion air injection is performed as necessary to complete the coal combustion process in an oxidizing, controlled manner so that combustion gas temperatures are maintained below the thermal NO_x floor where significant NO_x formation begins. This is in contrast with a traditional coal-fired furnace where the pulverized coal is burned in suspension at high excess air rates. Resulting gas temperatures from pulverized coal furnaces typically rise significantly above the 2800 F temperature maintained in the slagging combustor and downstream furnace. In the traditional furnace, the pulverized coal is relatively poorly mixed with conventional low NO_x wall burner/suspension firing techniques, and local areas of combustion in the presence of stoichiometric oxygen create hot zones within the flame. These hot, turbulent stoichiometric zones can produce significant NO_x levels in the area of burner throats. This tendency for high, localized NO_x formation is minimized with the slagging combustor through slow, controlled mixing of furnace combustion air with the partially cooled, well-mixed fuel gases discharging from the combustor into the lower furnace NO_x control zone.

The HCCP will also demonstrate additional NO_x reduction techniques including furnace NO_x ports and over-fire air injection.

A more detailed explanation of the back-end scrubbing process is as follows:

Once FCM is produced in the furnace via equation (1), it is removed in the spray dryer and the baghouse. A portion of the material is transported to disposal. Most of the material however, is conveyed to a mixing tank, where it is mixed with water to form a 45% FCM solids slurry. The lime-rich FCM material is slaked by agitation of the suspension. A portion of the slurry from the mixing tank passes directly through a screen to the feed tank, where the slurry is continuously agitated. The remainder of the slurry leaving the mixing tank is pumped to a grinding mill, where the suspension is further mechanically activated by abrasive grinding.

By grinding the slurry in a mill, the FCM is activated by mechanical process whereby the overall surface area of available lime is increased, and coarse lime particle formation is avoided. Thus, the mill enhances the slaking condition of the FCM, and increases the surface area for optimal SO_2 absorption. FCM slurry leaving the tower mill is transported through the screen to the feed tank.

Feed slurry is pumped from the feed tank to the SDA, where it is atomized via rotary atomization. SO_2 in the flue gas reacts with the FCM slurry as water is simultaneously evaporated. The dry reaction product is removed via the SDA hopper or baghouse catch. SO_2 is further removed from the flue gas by reacting with the dry FCM on the baghouse filter bags.

Emission levels of SO_2 are controlled to and below NSPS levels using the recycle/reactivation SDA system.

2.1.1 Proprietary Information

TRW, Incorporated (TRW) is a corporation organized and existing under the laws of the State of Ohio. TRW is acting on behalf of its combustion business unit which has principal offices located at 2111 Rosecrans Avenue, El Segundo, California 90245. TRW holds the patent and associated rights to develop a Clean Coal Combustion System for use in the generation of electricity.

Joy Environmental Technologies, Inc. (Joy) was a U.S. corporation headquartered in Pittsburgh, Pennsylvania acting on behalf of its Environmental Systems Group with offices located in

Monrovia, California. Joy held the exclusive license from A/S NIRO Atomizer of Copenhagen Denmark for the supply of atomizer to be used in spray dryer absorber systems for acid gas removal in the North American market. Joy and A/S NIRO jointly owned the patent and associated rights to develop spray drying absorber and baghouse technology that will integrate with the TRW Clean Coal Combustion System. Babcock & Wilcox (B&W) has purchased all assets of Joy.

2.2 Overall Block Flow Diagram

Figure 2-1 is an overall process block flow diagram of the HCCP process. All major process elements are shown on the diagram.

3.0 Process Design Criteria

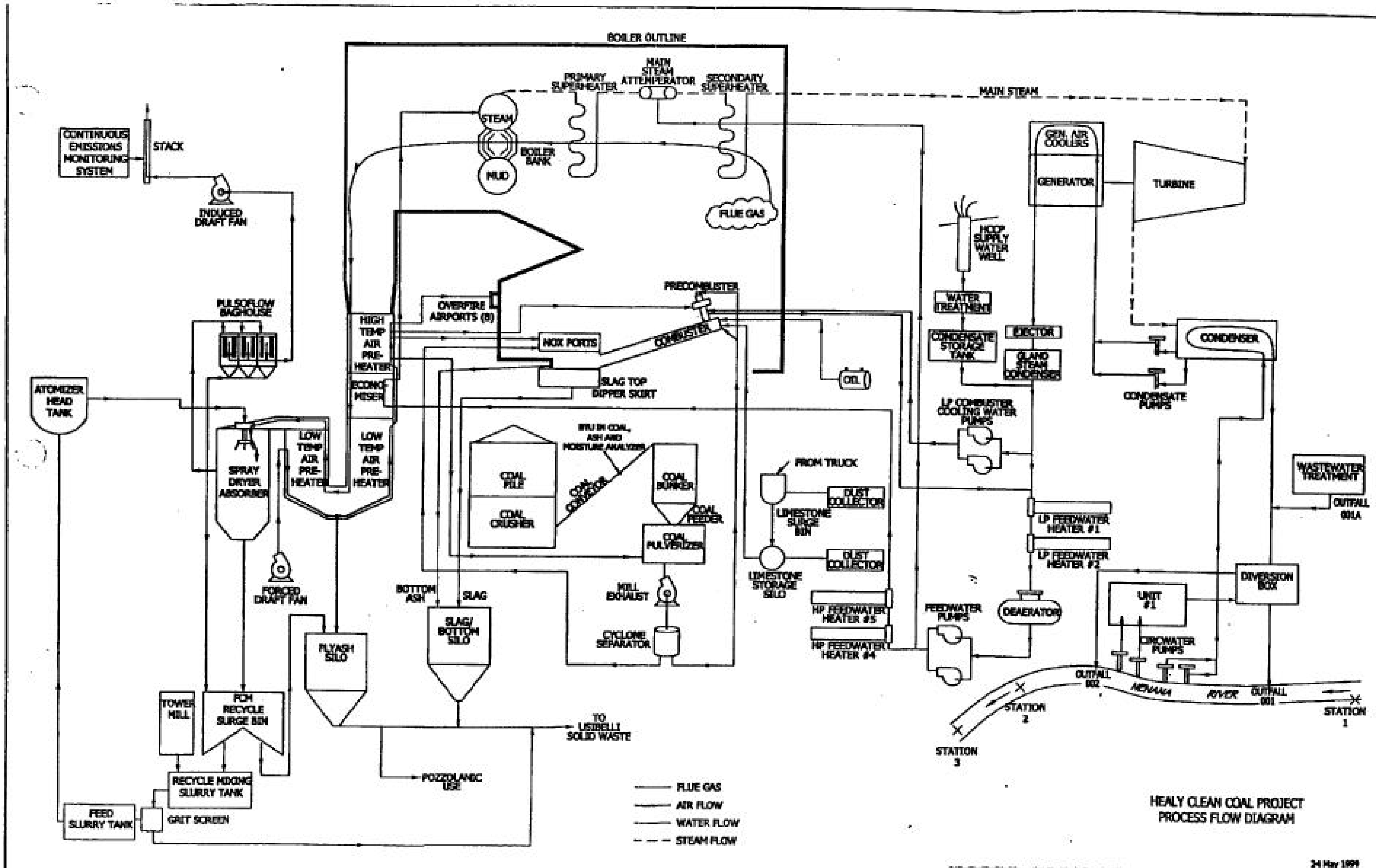
The HCCP is a nominal 50-MW coal-fired power plant. Technologies to be demonstrated include the TRW Clean Coal Combustion System with limestone injection in conjunction with B&W/Joy SDA with fly ash reactivation. The HCCP will include new technological features that have not been previously demonstrated in a commercial power plant.

They are described as follows:

- Model 85B TRW Clean Coal Combustion System. The system will utilize a forced boiler water circulation system to cool the combustor pressure parts enclosure. Each slagging combustor will be provided with an independent coal fuel feed system. Each coal fuel feed system will utilize a conventional gravimetric feeder at the inlet to a pulverizer. A high efficiency cyclone will be provided at the outlet of the pulverizer to separate the pulverized coal from the spent drying air. The spent drying air will then be discharged to the furnace NO_x control zone via the interfire NO_x ports, overfire air ports, combustor hot gas exhaust duct air purge annulus, and to the precombustor mix bustle. The pulverized coal will be continuously discharged without storage to the volumetric coal splitter/feeder. The volumetric coal feeder/splitter will proportion the coal into two coal streams to feed the precombustor and the main combustor axial coal injectors.

- Limestone injected into the furnace in the area of the combustor hot gas exhaust duct will be flash calcined forming flash calcined material (FCM). The FCM produced in the entrained combustion process will be captured along with fly ash in a baghouse furnished as part of the SDA System. Part of the FCM/fly ash product will be recycled through an FCM reactivation system. The remainder will be disposed of via a waste product storage silo to the Usibelli Coal Mine. The recycled FCM/fly ash will be reactivated in the FCM reactivating system to produce a slurry rich in reactive sorbent material. This slurry will be sprayed into the flue gas stream via an atomizer in the SDA, where it will remove SO_2 from the flue gas. Some of the flyash and SDA waste will be removed from the SDA vessel itself and the remainder will be carried by the flue gas to the baghouse.

The balance of plant (BOP) equipment, systems, and facilities are expected to be typical of conventional power plants.


BOILER OUTLINE
PRIMARY SUPERHEATER
MAIN STEAM ATTEMPERATOR
SECONDARY SUPERHEATER
MAIN STEAM
STEAM
BOILER BANK
MUD
FLUE GAS
CONTINUOUS EMISSIONS MONITORING SYSTEM
STACK
INDUCED DRAFT FAN
GEN. AIR COOLERS
GENERATOR
TURBINE
HCCP SUPPLY WATER WELL
WATER TREATMENT
CONDENSATE STORAGE TANK
EJECTOR
GLAND STEAM CONDENSER
CONDENSER
CONDENSATE PUMPS
PRECOMBUSTER
COMBUSTER
OVERFIRE AIRPORTS (8)
NOX PORTS
SLAG TOP DIPPER SKIRT
OIL
PULSOFLOW BAGHOUSE
HIGH TEMP AIR PRE-HEATER
ECONOMISER
LOW TEMP AIR PRE-HEATER
LOW TEMP AIR PRE-HEATER
ATOMIZER HEAD TANK
SPRAY DRYER ABSORBER
FORCED DRAFT FAN
COAL PILE
COAL CRUSHER
COAL CONVEYOR
BTU IN COAL, ASH AND MOISTURE ANALYZER
COAL BUNKER
COAL FEEDER
COAL PULVERIZER
MILL EXHAUST
CYCLONE SEPARATOR
FROM TRUCK
LIMESTONE SURGE BIN
DUST COLLECTOR
DUST COLLECTOR
LIMESTONE STORAGE SILO
LP COMBUSTER COOLING WATER PUMPS
WASTEWATER TREATMENT
OUTFALL 001A
LP FEEDWATER HEATER #1
LP FEEDWATER HEATER #2
HP FEEDWATER HEATER #5
HP FEEDWATER HEATER #4
FEEDWATER PUMPS
DEAERATOR
DIVERSION BOX
UNIT #1
CIRCWATER PUMPS
OUTFALL 002
NENANA RIVER
OUTFALL 001
STATION 1
STATION 2
STATION 3
BOTTOM ASH
SLAG
SLAG/ BOTTOM SILO
FLYASH SILO
TOWER MILL
FCM RECYCLE SURGE BIN
TO USIBELLI SOLID WASTE
POZZOLANIC USE
RECYCLE MIXING SLURRY TANK
FEED SLURRY TANK
GRIT SCREEN
FLUE GAS
AIR FLOW
WATER FLOW
STEAM FLOW
HEALY CLEAN COAL PROJECT
PROCESS FLOW DIAGRAM
24 May 1999

After the demonstration phase is completed, the plant is designed to operate as a base load unit.

The plant actual life shall be 35 years with a capacity factor of 85 percent. Basic guidelines for the conduct of all aspects of this project have been established as follows:

- Equipment and systems will be installed as necessary to ensure compliance with State and Federal environmental requirements, permits, and documents.
- Except for the technology demonstration systems, the design will be based upon and will utilize proven utility and/or industrial concepts and fully demonstrated equipment, systems, and components to the maximum extent practicable.
- Overall HCCP efficiency will be considered to provide optimum economic power generation within equipment, space, and reliability limitations.
- The HCCP was designed for attended operation. The unit shall be designed for manual start, but once online, it shall be designed for minimal operator support. Automatic safety features shall be provided to protect personnel and equipment whenever a system or equipment malfunction occurs. The unit shall be designed for base load operation.
- The unit shall be capable of automatic runback to reduced load in the event of the loss of key equipment such as coal pulverizers.

The coal used in the project is as follows:

	Run – of - Mine (ROM) Coal	**Waste Coal**	**Performance**
Proximate analysis			
Moisture, %	26.35	23.87	25.11
Ash, %	8.20	25.00	16.60
Volatile, %	34.56	27.00	30.78
Fixed, carbon, %	30.89	24.13	27.51
Total, %	100.00	100.00	100.00
Btu/lb	7,815	6,105	6,960
Ultimate Analysis			
Moisture, %	26.35	23.87	25.11
Ash, %	8.20	25.00	16.60
Carbon, %	45.55	35.59	40.57
Hydrogen, %	3.45	2.70	3.07
Sulfur, %	0.17	0.13	0.15
Oxygen, %	15.66	12.23	13.94
Chlorine, %	0.03	0.02	0.03
Total	100.00	100.00	100.00

There are two types of waste coal – conventional waste and fines waste. HCCP waste (described above) is coal that is typically excavated along the edges of the coal seam and as a result has a lower heating value, approximately 5000 – 8000 Btu/lb. Fines waste is ground ROM coal that is too finely ground to be saleable and burned in export boilers. The heating value of the fines waste is similar to ROM coal, but tends to vary more (typically 6500 - 9000 Btu/lb) as a result of going through a grinding process. Also, the fines waste can also contain high quantities of silica because the small grain size of silica allows it to pass through the smallest sieves.

The combustors will be designed to burn 100 percent ROM, 55 percent waste/45 percent ROM, and performance - 50 percent waste/50 percent ROM. The combustors will also be capable of burning 100 percent waste coal blends.

The Healy Clean Coal Project will be a nominal 50-MW coal fired power plant. The project will be located along the railroad between Anchorage and Fairbanks, adjacent to the existing Healy Unit No. 1, 25 MW generating plant. The design ambient conditions are as follows:

- Site elevation is approximately 1272 feet.
- Ambient temperature ranges between -51^0 F and 82^0 F dry bulb (95% of the time) with 40% humidity. The annual average temperature is approximately 27^0F.
- The design indoor ambient air temperature range is from 40^0 F to 105^0 F.
- There is no direct rail from the contiguous states to Alaska. All materials must be transported by ship or rail car barges and be prepared for ocean shipping conditions. A railroad spur serves the jobsite and may be used for shipping materials from an ocean dock unloading point to the jobsite.

DESIGN CRITERIA AND PERFORMANCE PARAMETER TABLES

Design criteria and performance parameters are provided in this section. There are 14 major plant process areas listed below. New technology process areas (3.0.1 through 3.0.6) are described, as are other process areas more typical of conventional plants (3.0.7 through 3.0.14).

3.0.1 Process Area - Main Boiler System

DESIGN CRITERIA	INFORMATION
Forced circulation boiler with forced circulation combustors.	Provide 1300 psig and 955^{o} F (+ 10^{o} F) steam at the superheater outlet over the range of 60 to 100 percent of boiler maximum continuous rating.
Maximum continuous rating (MCR) and minimum steaming capacity.	490,000 lb/hr and 75,000 lb/hr, respectively.
Steam quality and capacity requirement	Meet quality of turbine generator and capacity requirements while operating with a continuous blowdown rate equal to one percent of the MCR flow rate.
Draft furnace design	Contain a balanced draft furnace with a dry hopper bottom and shall be gas tight with welded, water-cooled walls.
Insulation and lagging on the boiler envelop.	Insulation and lagging on the boiler envelope shall not have a surface temperature of greater than 140^{o}F when the ambient temperature is 80^{o}F or less. Personnel protection shall be considered for all normally accessible areas.
Operation and control of the boiler.	Operation and control from the main control room. All valves necessary to operate during normal startup, operation, and shutdown shall be motor operated.
Access and observation ports.	Permit access to all compartments, removal of slag accumulations, and observation of all critical parts of the boiler.
Chemical cleaning.	Allow for chemical cleaning of internal tube surfaces.

Performance Parameter	Reference Value – based on Performance Coal and with TRW Combustors
Steam capacity and pressure	Operate from minimum stable load of 75,000 lbs. of steam per hour, up to its MCR of 490,000 lbs. of steam per hour at 1300 psig steam pressure at the superheater outlet.
Steam temperature control rating	Average steam temperature at the superheater outlet will be maintained at 955^{o}F from 60% to 100% MCR with full 1300 psig steam pressure at the superheater outlet.
Pressure loss – drum to superheater outlet	126 psig with 1300 psig steam pressure at the superheater outlet.
Pressure loss - economizer inlet to drum	50 psig at 1300 psig steam pressure at the superheater outlet.
Draft loss- furnace to gas outlet of main tubular air heater	19 inches water gauge (wg)
Maximum pulverizer gearbox shaft input power	330 kilowatts (KW) each
Pulverizer coal fineness, passing 200 mesh	70%

3.0.2 Process Area – Combustor System

DESIGN CRITERIA	INFORMATION
Turndown ratio	The turndown ratio for each combustor is expected to be at least 2:1 based on the maximum combustor firing rate.
Coal quality	Designed to burn 100 percent ROM, 55 percent waste/45 percent ROM, 65 percent waste/35 percent ROM, and performance - 50 percent waste/50 percent ROM. Capable of burning 100 percent waste coal blends.
Insulation and lagging on the combustors.	Shall not have a surface temperature of greater than 140^{o}F when the ambient temperature is 80^{o}F or less.
Burner control	Operation and control shall be conducted from the main control room. All valves shall be motor operated. All process indication shall be provided in the main control room.
Access ports	Access and observation ports shall be provided to permit access to all compartments, removal of slag accumulations, and observation of all critical combustor components.
Combustor cooling	Two separate forced circulation cooling loops, one high pressure and one low pressure. The high pressure loop will utilize boiler water supplied from the boiler steam drum. The low pressure loop will utilize condensate supplied from the condensate pumps.

Performance Parameter	Reference Value – based on Performance Coal
Peak rating per combustor	350 MMBtu/hr.
Maximum continuous rating per combustor	315 MMBtu/hr.
Percent fuel input to preCombustor	38
Percent fuel input to slagging combustor	62
Turndown ratio per combustor	2:1
Ash removal as slag, by weight (minimum)	70%
Slag size	¼ in. to 6” in.
Carbon burnout	99% by weight
NO_x emissions	Less than 0.35 lb./MMBtu
SO_2 emissions	Less than 189 lb/hr.
Outside surface temperature	Less than 140^o F.

3.0.3 Process Area – SDA System

DESIGN CRITERIA	INFORMATION
SO_2 removal system	In normal operation the bulk average temperature of the flue gas exiting the spray dryer absorber vessel shall be between 18 ^{o} F and 35 ^{o} F above the adiabatic saturation temperature of the flue gas. The absorber vessel shall be designed to support the mass of the vessel including, if the vessel hopper becomes filled with solids to the centerline of the outlet duct and all other surfaces have buildup equivalent to 50 lb/sq ft. With regard to $S0_2$ removal, the design of the SDA system shall not be based on any assumed credit due to fly ash alkalinity. The absorber vessel shall be designed to give a minimum flue gas retention time of 11 seconds based on the target operating parameter values. Retention time shall be defined as V/Q, where: V = The net inside volume of the absorber vessel available for the gas/slurry reaction from the gas inlet adjacent to the atomizer to the physical separation of the outlet gas duct from the vessel (the volume of an inlet gas duct contained within the vessel and the volume taken up by the atomizer insert is not available for the gas/slurry reaction and shall not be included in this net inside volume; however, the volume taken up by an outlet duct internal to the vessel may be included in this net inside volume), cubic ft. Q = The actual flue gas volume flow which would exit the absorber vessel with the maximum load flue gas condition, at the plenum outlet, cubic ft per second. The conveyor system underneath the absorber vessel to the FCM Recycle Surge Bin shall be capable of removing ash/scrubber waste at a rate of 2.0 times the maximum ash/scrubber waste collection rate for the performance coal conditions, assuming either slagging combustors or Low-NO_x burners, whichever is worst case.

Process Area – SDA System continued -----

Baghouse	The pulse jet baghouse will be designed as follows: Gross air to cloth ratio shall not exceed 2.95 Net air to cloth ratio shall not exceed 3.30 Service air to cloth ratio shall not exceed 3.70 where gross air to cloth ratio is defined as all compartments in service, the maximum gas flow going through the baghouse, and no cleaning being performed; net air to cloth ratio is the maximum gas flow going through the baghouse and one compartment is off-line for cleaning; and service air to cloth ratio is maximum gas flow going through the baghouse and one compartment is off-line for cleaning and another compartment is off-line for servicing. Minimum spacing between bags is 2 inches Minimum spacing between bags and internal structures is 3 inches Particulate density for particulate hopper capacity design 45 lb per cubic ft Particulate density for particulate hopper structural design 90 lb per cubic ft

Performance Parameter	**Reference Value**		
	Operating Parameter		
	Minimum	**Target**	**Maximum**
Heat input from fuel, MMBtu/Hr.	632	643	652
Uncontrolled SO_2 emissions, (lb/MMBtu)	0.42	0.43	0.52
Total particulate flow into SDA, (Mlb/Hr.)	3.6	5.2	7.3
Limestone sorbent flow, (Mlb/Hr.)	1.1		
Limestone conversion which results in reactive CaO at SDA inlet	Greater than 80%	Greater than 80%	Greater than 80%
Flue gas temperature into SDA (^{0} F)	280	300	320
Flue gas O_2 into SDA (% Vol Dry)	3.20	3.25	3.60
Flue gas moisture into SDA (% Vol)	13.7	13.9	14.1

SO_2 removal	Emissions will not exceed 30% of the uncontrolled SO_2 emissions. SO_2 loading at the baghouse outlet of 79.6 lb/hr.
Particulate removal	Particulate emission at the particulate collector outlet duct will not exceed 0.015 lbs. per MMBtu heat input if Teflon coated bags are used, or 0.01 lbs per MMBtu if Reyton bags are used.
Opacity guarantee	The opacity measure at the stack, not to exceed eight feet in diameter, shall not exceed 20% for more than 3 minutes in any hour. This excludes opacity resulting from condensation or chemical formation downstream of the baghouse. Opacity during the 3-minute period can not exceed 27%.

3.0.4 Process Area – Materials Handling System

DESIGN CRITERIA	**INFORMATION**
Coal handling system	Transfer coal from the coal pile in the yard to the coal storage silos in the building. Storage maintained in the coal yard and alongside the HCCP boiler in silos. Supply of up to 30 days maintained. Supply based on a total plant firing rate of 75 tons/hour assuming that ROM coal will be used in Unit No. 1 and blended coal will be used in the HCCP. The two HCCP coal storage silos shall be sized for 24 hours of operation at maximum continuous rating on a blend of 65 percent waste coal and 35 percent ROM coal.
Dust control system	Provide a means to control dust in coal handling conveyors, HCCP coal storage silos, the fly ash/FCM waste storage silo, and the limestone bulk storage silos and day bin. Dust collectors shall be removable bag type with air-to-cloth ratios not exceeding 6:1 when used in conjunction with an exhaust fan. Fans shall be located on the clean air side of the dust collectors. The fans shall be belt driven, airfoil, backward inclined type. The ductwork system shall be of the blastgate design. Dust hoods shall be provided, as required, to capture the fugitive dust at transfer points, storage silos, etc.
Limestone handling system	Receive, store, and convey limestone to the TRW combustors. The system shall be designed to receive pre-processed limestone that is delivered to the site in bulk transport trucks. The system shall include storage capability for 3 days of operation on waste coal at 110,000 lb/hr and 0.5 percent sulfur content at a stoichiometric ratio of 1.9 Ca/S. Limestone shall be pneumatically conveyed by the trucks to the storage tank and from storage to the combustors. The system shall be designed to handle limestone with a material size of 70 percent passing through 200 mesh. Utilize limestone with a calcium carbonate purity of approximately 90 percent and a limestone with a moisture content of approximately 0.03 percent. The system shall utilize positive displacement blowers for limestone metering and injection.

Process Area – Materials Handling System continued -----

Performance Parameter	Reference Value
Coal Handling	
Coal size as initially received	24 in. x 0 in.
Size after primary crushing	4 in. x 0 in.
Size after secondary crushing	1 in. to ¾ in. x 0 in.
Density	50 to 60 lb./cubic foot
Angle of repose	35 degrees
Belt conveyor loading	240 tph normal / 274 tph design
Belt speed	450 feet per minute
Angle of surcharge	20^{0}F
Crusher upgrade	240 tph (tons per hour) at full capacity each
Troughed belt feeder	274 tph at full capacity each
Bucket elevator	125% of design capacity (1.25 x 274 tph = 343 tph)
Dust Collection	
Outlet grain loading	<0.02 grains per standard cubic feet (SCF).
Ductwork transport velocities	4000-4500 fpm (feet per minute).
Dust hoods maximum taper angle	45^{0}
Limestone Handling	
Limestone Size	100% passing through a 100 mesh screen and 70% passing through a 200 mesh screen.
Conveying system speed	30 tph, normal 25 tph
Dust collector air-cloth ratio	8:1
Dust collector outlet discharge	0.01 grains per SCF.

3.0.5 Process Area – Ash Handling System

DESIGN CRITERIA	INFORMATION
Bottom and slag ash handling.	Bottom ash is from the boiler and slag ash is from the combustors. Bottom and slag ash is collected in a quench tank and transferred out of the tank by a wet drag conveyor. The bottom ash and slag ash will be de-watered along the inclined portion of the wet drag conveyor(s) as it is conveyed to a bucket elevator. The bucket elevator shall transfer the combined ash into the storage silo. Of the total ash present in the coal, 90 percent shall be designed to be removed via the Bottom/Slag Ash System. The bottom/slag ash storage silo shall be sized to store the ash produced in 5 days when operating at full load (approximately 1000 tons).
Middle ash handling.	Middle ash is the heavier portions of the fly ash/FCM that falls out of the flue gas stream before reaching the SDA vessel. The middle ash will be collected from the boiler bank or the air heater hoppers and will be conveyed directly into the bottom/slag ash drag conveyor. None of the middle ash shall be conveyed to the FCM storage silo. Of the total ash leaving the boiler, 5 percent shall be assumed to be removed via the Middle Ash System. The density of the middle ash is assumed to be approximately 50 lbs per cubic foot.
Fly ash/FCM handling.	Fly ash/FCM will be removed from the baghouse and SDA vessel and transferred to a bucket elevator. The bucket elevator transfers it into an 8-hour surge bin where some of the fly ash/FCM is recycled in the SDA and the remainder is pneumatically conveyed to the combined HCCP/Unit No. 1 flyash/FCM waste silo. Fly ash/FCM storage silo sized to store the ash produced in 5 days when operating at full load, when using Low-NOx burners, and while burning performance coal (approximately 1000 tons). The system shall be sized for a rate of removal from the baghouse and SDA vessel of 200 percent of the expected rate of accumulation.

Performance Parameter	Reference Value
Bottom Ash/Slag Ash Handling	
Burn rate	50 tons per hour
Total slag ash as percent of total ash	90 percent slag ash based on firing 100% waste coal
Slag ash density	150 lb/ft3
Slag ash volume	90 lb/ft3
Normal slag size range	1/4 inch to 6 inches

Process Area – Ash Handling System continued ------

Total bottom ash as percent of total ash	30 percent bottom ash based on firing 100% waste coal
Bottom ash density	130 lb/ft3
Bottom ash volume	90 lb/ft3
Fly Ash/Middle Ash Handling	
HCCP quantity	2.5 tons per hour
Fly ash density	58-65 lbs/ft3
Removal rate	9 tons per hour
Storage silo capacity	570 tons net
Dustless unloader system speed	100 tons per hour

3.0.6 Process Area - Pre and Post-Combustion Air System

DESIGN CRITERIA	INFORMATION
Boiler combustion air	Supply heated atmospheric air, at the proper flow and pressure, to the TRW combustor and to the boiler for supplemental combustion of combustor gases. Utilize one full capacity forced draft fan. Be sized to account for expected system flow and pressure upsets as well as expected steady state conditions as required by the boiler and combustor manufacturers. Utilize a tubular air heater.
Heating glycol for combustion air preheating	Utilize auxiliary steam to heat glycol which in turn will be used as a source of freeze resistant combustion air heating. Provide sufficient heat transfer capacity so that combustion air will be heated to the desired temperature at the maximum combustion air flow rate and at the minimum ambient air temperature. Utilize two 100 percent capacity steam/glycol heat exchangers. Design the glycol/air heat exchangers to be mounted in the combustion air inlet duct and sized to handle the air heating duty required. Utilize two 100 percent capacity glycol circulating pumps.
Flue gas	Exhaust spent combustion gases to the atmosphere. The system shall, in conjunction with the combustion air system, hold furnace pressure at approximately -0.5 inch water gauge. The system shall be designed so that the ID fan and system ductwork are sized for the expected system flow and dust grain loading at normal steady state conditions and during pressure and temperature upsets. The system shall meet the requirements of the boiler, scrubber, and baghouse manufacturers. Maintain flue gas exit temperature at the air heater outlet at a level sufficiently above the saturation temperature, for all operating conditions. At full-load conditions, the target air heater outlet temperature, with the spray dryer absorber operating at 18^{o} to 35^{o} F above the adiabatic saturation temperature, will be 300^{o}F.
Continuous Emissions Monitoring System (CEMS)	Continuously capture a dilute flue gas sample via the in-stack probe and deliver this sample to the chemical analyzers via the heated sample transport umbilical.

3.0.6 Process Area - Pre and Post-Combustion Air System - continued

Performance Parameter	**Reference Value**		
Based on TRW Heat and Material Balance for Performance Coal at 100% MCR	**Mass Flow (lbs/hr.)**	**Pressure (in. wg)**	**Temperature (^{o} F)**
Secondary air From HT (High Temperature) heater	175,312	45.0	741.0
Secondary air From Precombustor (PC) Burner	64,188	40.0	741.0
Secondary air to PC mix annulus	96,106	25.0	741.0
Secondary air to NO_x ports	15,017	5.0	741.0
Cyclone air to NO_x ports	74,989	5.0	135.0
Cyclone air to PC mix annulus	12,715	25.8	135.0
Precombustor cyclone air Injection	12,715	25.8	135.0
Total NO_x port flow	90,006	5.0	135.0
CEMS relative accuracy for NO_x	No greater than 20% of the average of the EPA reference methods.		
CEMS relative accuracy for SO_2	No greater than 10% of the applicable emission limit.		

3.0.7 Process Area – Turbine Generator System

DESIGN CRITERIA	INFORMATION
Continuous operation	Continuous operation at maximum capacity.
Start and tripping.	Manual start with all necessary automatic tripping features.
Operation over entire load range.	Capable of starting with minimum attention and operating continuously over its entire load range.
Base loaded unit.	Unit shall be capable of operation under automatic load dispatch along with other units of an interconnected system.
Turbine VWO condition.	Designed with a 5 percent flow margin above that required to produce the nameplate output.
Main and extraction steam	Safely conduct steam from the boiler superheater to the turbine stop valve and from the turbine to the feedwater heaters. Also provide steam to the steam jet air ejectors and to the turbine low pressure gland seals. The main steam line shall be sized for the maximum expected steam flow. Designed in accordance with ASME/ANSI "Recommended Practices for Prevention of Water Damage to Steam Turbines Used for Electric Power Generation."

Performance Parameter	Reference Value
Electrical output	When operating at valves wide open (VWO), the electrical output will be 61,890 KW net when operating at rated steam inlet conditions of 1264 psia, 950^{o}F measured at the inlet connections to the turbine stop valve(s), with an exhaust pressure of 1.5 inches mercury absolute (HGA) for the turbine, with a 1.0 percent make-up with all stages of feed-water heating in service.
Shaft vibration	Shall not exceed 3.0 mils peak to peak under steady-state conditions after proper alignment and balance.
Short circuit ratio	Not less than 0.6
Excitation of response	0.1 sec
Generator and turbine inertia	106,700 lb-ft2
Steam system design parameters:	Design Pressure 1326 psig Temperature 965^{o}F

3.0.8 Process Area - Condensate and Feedwater System

DESIGN CRITERIA	INFORMATION
Main condenser	The purpose of the main condenser is to condense steam exhausted from the steam turbine or vented from plant processes, and to collect condensate drains from plant auxiliaries including feedwater heaters. Optimized based on the turbine selected and the economics of the unit. The hotwell shall have a minimum of 5 minutes of condensate storage at VWO conditions. Condenser waterboxes shall, as a minimum, have 3-inch vents and drains.
Condensate	Collect condensed steam from the condenser and return it to the Boiler Feedwater System via the low pressure feedwater heaters and deaerator. Upon trip of one of the two 100 percent capacity condensate pumps, the spare pump shall automatically start and maintain condensate flow. The system shall contain two low pressure, closed feedwater heaters. Each feedwater heater will be capable of passing the maximum condensate flow based on Low-NO_x burner retrofit conditions. The system shall contain one 100 percent capacity deaerating feedwater heater. Dissolved oxygen content at the deaerator outlet shall not exceed 7 ppb. The system shall provide cooling water to the TRW Clean Coal Combustion System as required and return the heated water to the deaerator.
Feedwater	Safely conduct feedwater from the outlet of the deaerating feedwater heater to the boiler inlet. The system shall utilize two 100 percent capacity electric motor driven feedwater pumps. The system shall be designed to operate continuously at turbine VWO conditions. The system shall include two high pressure, closed feedwater heaters. The system shall be designed to raise the pressure of the feedwater from the deaerator pressure to the required boiler and superheater attemperator pressure.

Process Area - Condensate and Feedwater System continued -----

Performance Parameter	**Reference Value**	
Available condensate discharge from the condenser condensate pumps	180,000 lb/hr of condensate Normal discharge pressure = 242 psig.	
Low Pressure (LP) combustor cooling water pumps	Inlet pressure Outlet pressure	242 psig 350 psig
Feedwater for the boiler/combustor	Consist of condensate from a surface condenser serving a turbine generator with makeup from a demineralizer. Feedwater will be deaerated.	
	Variable	**Reference Value Setting for normal operation**
Boiler feedwater pumps	Flow Total head	1150 gpm 3,730 ft
High Pressure (HP) feedwater heater	Flow Inlet temperature Outlet temperature	494,900 lbs/hr 312.2°F 370°F
HP feedwater heater	Flow Inlet temperature Outlet temperature	494,900 lbs/hr 370°F 425.2°F

3.0.9 Process Area - Circulating Water System

DESIGN CRITERIA	INFORMATION
Circulating water system	Provide cooling water flow to the main condenser and to the Component Cooling System. Incoming circulating water shall pass through an intake structure. The intake structure shall include provisions for travelling screens. Circulating water piping shall direct water flow from the intake structure to the pump bays. The discharge of each pump shall have a motor-operated butterfly valve, which is electrically interlocked with the pump for startup and shutdown. The circulating water pumps shall be controlled from the control room. Circulating water for component cooling shall be directed to the component cooling water heat exchanger from upstream of the main condenser and discharged downstream of the main condenser. This loop shall be designed to allow sufficient circulating water to flow through the exchangers utilizing the head loss through the condenser as the sole driving force under the normal operating mode. Provisions for minimizing debris, mud, and silt accumulations in condenser tubes, the condenser water box, and the component cooling water heat exchanger shall be incorporated. Provide means of measuring circulating water flow for field performance testing. The circulating water system shall be provided with a means of priming, if required, and connections for air release at required high points. Access manways shall be provided in the supply and return piping.

Performance Parameter	Reference Value	
Circulating Water Pumps	**Normal Operating Settings**	
Total head	42 ft water	
Flow	15,000 gpm	
Condenser differential pressure	10 psi	
Cooling Components	**Description**	**Setting**
Component cooling system	Heat exchanger discharge temperature Header pressure	90°F 80 psig
Component cooling water pumps	Flow Head	1030 gpm 160 ft water
Component cooling water surge tank	Operating range: High Low	 18 in water 6.5 in water

3.0.10 Process Area - Water and Wastewater Treatment System

DESIGN CRITERIA	INFORMATION
Plant water supply system	The Plant Water Supply System is to provide a source of filtered water for plant process use. The raw water source to the Plant Water Supply System will be one or more deep wells. Raw water shall be supplied from one new well to be developed on the plant property and a Unit No. 1 well. The new well for the HCCP will be located within the HCCP building enclosure. Raw water will be filtered and treated with chlorine solution prior to storage. The filtered well water tank will be sized for a nominal volume of 20,000 gallons. A Makeup Demineralizer System will be provided as a source of high quality demineralized water. Influent water shall be supplied from the Plant Water Supply System. Influent water will be treated by the following unit operations: reverse osmosis, decarbonation, and mixed bed ion exchange. Mixed bed effluent will be stored in the demineralized water tank. The tank will be sized for a nominal volume of 20,000 gallons.
Process wastewater	Process wastewater will be treated by the following unit operations, where appropriate: oil/water separation, neutralization, and suspended solids removal. Treated process wastewater will be reused to the maximum extent possible. Process wastewaters will be treated so that they meet the Federal discharge requirements. The system will also be designed to meet the requirements of the HCCP National Pollution Discharge Elimination System (NPDES) Permit. Sampling capability will be incorporated into the Sampling (Water/Steam) System so that effluent quality can be monitored prior to discharge. The system will not be designed to treat wastewater generated from boiler chemical cleaning. All boiler chemical cleaning wastewater shall be disposed of by the chemical cleaning contractor in a manner consistent with the latest environmental regulations.

Process Area - Water and Wastewater Treatment System continued--

Performance Parameter	Reference Value			
Makeup Demineralizer				
Effluent Characteristics:				
Total hardness, as $CaCO_3$	0 micro grams per liter (ug/l)			
Specific conductance	<0.2 ug/l umho/cm			
Silica (as SiO_2)	<20 ug/l			
Sodium (as Na)	<10 ug/l			
Hydrogen Ion Concentration (pH)	6.5 to 7.5			
Wastewater Treatment				
Effluent characteristics:	Maximum		Average	
Suspended solids	5 ppm		1 ppm	
Turbidity	5 Turbidity Units (NTU)		1 NTU	
Oil	<10 ppm		<5 ppm	
	No Flow	Max. Flow	Average Flow	Min. Flow
Wastewater pump discharge pressure:	125 psig		80 psig	
Wastewater design temperature:		140^0F	65^0F	40^0F

3.0.11 Process Area – Fire Protection System

DESIGN CRITERIA	INFORMATION
Fire protection	The Fire Protection System presently installed for HCCP shall be cross-connected to the Unit No. 1 Fire Protection System. The system shall be designed in accordance with NFPA 850. Plans shall be submitted to Insurer and the Alaska State Fire Marshall's office for design review and approval.

Performance Parameter	Reference Value
Water supply system	2000 gpm, 150 psi diesel pump supplied from the circulating water system.
Hose pipe and sprinkler locations	Throughout the plant and in accordance with NFPA codes.
Flood type carbon dioxide systems	In key areas of plant, especially around electrical, application rate to achieve concentration of 30% in 2 mins. and design concentration in 7 minutes for a total of 30 minutes.

3.0.12 Process Area – Plant Controls System

DESIGN CRITERIA	INFORMATION
Plant Control System	The Plant Control System (PCS) will perform the basic plant coordinated load control, boiler control, unit interlocking, and control of balance of plant power cycle systems. Stand alone programmable controller based systems may be utilized for soot blowing, water treatment, SDA, and combustor management and flame safety subsystems. All subsystems will have the ability to be operated and monitored from the main control room. The PCS will be a distributed microprocessor-based system. Continuous plant operation will be dependent upon the continued operation of the PCS. The system will be based on the following: 1. A primary Operator Console(s) consisting of Cathode Ray Tube (CRT)/Keyboard will be located in the main control room. 2. Engineer's Console(s) will allow an Engineer access to the on-line parameters as well as the ability to modify the system configuration or tuning parameters off-line and download new configurations to the control system. Basic loop control configuration will be done in a menu driven format easily learned by a control engineer or technician with little or no computer programming background. 3. Control will utilize field proven distributed control technology hardware and software. 4. Sequential and discrete digital logic for motor control and interlocking as well as analog control for modulating control loops will be employed. 5. Sequence of events logging capability will be provided as an integral part of the PCS. 6. All PCS microprocessor based devices will be capable of communicating with one another on a redundant data highway. 7. CRT interactive graphics with dynamic data updating will be provided. Process & Instrument Diagram (P&ID) style graphics will be presented as the vendor standard as approved by the Owner. 8. A considerable amount of analysis, performance calculations, custom report generation, and long term data archiving will be required which is most effectively done in a mini computer or personal computer connected to the data highway. 9. 40 percent spare rack space containing approximately 20 percent spare Input/Output (I/O) hardware for each type of I/O will be provided.

Process Area – Plant Controls System continued----

Plant Control System	10. The system and control room equipment spacing will have the capability for expansion to allow integration with other control system(s) of similar size. 11. The system will have the capability to interface through a modem or local area network with a personal computer for transfer of report data. 12. The alarm reporting system will have the capability to group and prioritize incoming alarms (minimum 4 priority levels) as well as to disable alarms or groups of alarms. 13. The system will have the capability to interface with the major brands of programmable logic controllers. 14. The PCS will be capable of handling any normal logic complexity associated with plant interlocks and shall also be capable of being programmed in the field with minimum effect on operating plant systems. The application software (firmware) will be non-volatile. 15. All critical components of the PCS will be redundant and single loop integrity will be maintained. The extent of the redundancy will be determined by the severity of the loss of component impact on the operating system. 16. The failure mode of individual control loops will be selectable to allow failure to a safe protecting state. Ground fault, short circuit or other individual loop failure will not directly affect any other loop operating function. 17. The PCS will be designed and constructed so that it will not be affected by transient or continuous electro-magnetic interferences. 18. The PCS will have continuous and historical trending capabilities for any point in the system. 19. The system will be capable of generating shift, daily, and monthly logs with user selectable points and custom user formatted logs on a demand basis. 20. PCS power will be supplied from redundant plant supplies. 21. The PCS shall have the capability to generate control system configuration hardcopy (drawings) or displayed CRT screen information. 22. The overall, end to end system installation is. For a given process signal input change the entire data collection, interpretation response and updating shall be completed within the allotted time delay.

Process Area – Plant Controls System continued----

Performance Parameter	Reference Value
Sequence of events logging updating time capability	1 millisecond or faster
Control loop data functions receiving, processing, and output generation time	0.3 seconds or faster
Maximum permissible system updating time delay for the entire PCS	1 second

3.0.13 Process Area – Electrical System

DESIGN CRITERIA	INFORMATION
Electrical	Startup power will be from the 138 kV source running back through the main transformer. During normal operation, while the plant is generating, the main power source will be from the unit turbine-generator. A 138 kV non-segregated phase bus will connect the generator to the primary windings of two three-phase, unit auxiliary transformers. Within the plant, the medium and low voltage power system will consist of two 4.16 kV metalclad switchgear busses, supplied from the station service transformers. Supply large motors (above 200HP) and 480 V load centers with a system voltage of 4.16 kV, 3 phase, 60 Hz. Large 480 V loads are powered by load centers connected to the 4.16 kV busses. Supply small motors (1/2 HP through 200HP and loads less than or equal to 200kW) with a nominal voltage of 480 V, 3 phase, 60 Hz. Small 480 V loads and motors up to 100 HP will be powered from Motor Control Centers located throughout the plant. Size load center transformers so that one transformer will handle the entire bus. All electrical equipment located outdoors will be provided with full weather protection, NEMA rating on electrical enclosures, and TEFC housings for motors. Indoor enclosures and motor housings will be NEMA 4 (or equivalent) and TEFC, respectively, when located in areas where water wash down is expected (all of the boiler building and portions of the turbine building). All other indoor building areas will have NEMA 12 rated electrical enclosures and open-drip-proof motors. Locations with a corrosive environment, such as the water treatment area, will have NEMA 4X rated electrical enclosures and motors will have corrosion protected TEFC enclosures with sealed or encapsulated windings. Explosion proof and dust ignition proof requirements will be instituted in locations defined as hazardous by the National Electric Code. All power and control wiring external to the enclosed areas, with the exception of the intake structure, will be above ground. Electrical disconnect devices shall accommodate the locking-out requirements of OSHA, effective date October 31, 1989.

Process Area – Electrical System continued----

Electrical	Provide dual-level overexcitation protection for protection of the generator and its connected transformers.
	The 138kV line breaker should be provided with breaker failure protection. This scheme will employ a phase and a ground instantaneous relay, with a minimum of 2 phase units.

Performance Parameter	**Reference Value**
Power transformers	1 main transformer, 2 unit auxiliary transformers, and 6 medium voltage transformers
Switchgear	Medium voltage, load center, and excitation switchgear according to drawings
Generator breaker	15 kV, 3500 A, 3 pole, 60 Hz
Disconnect switch	15 kV, 3500 A
Power and non-segregated phase bus	According to drawings

3.0.14 Process Area – Balance of Plant

DESIGN CRITERIA	INFORMATION
Plant drainage	Collect washdown water and water collected from equipment drains and processes that water using an oil/water separator. Convey, by gravity, the maximum expected drainage from any floor drain or equipment drain to a centrally located oil/water separator. Oil-free effluent should be pumped to the Process Wastewater Treatment System for further treatment prior to reuse or discharge.
Heating, ventilating, and air conditioning	Maintain the indoor environment. Ventilation rates for all areas shall be adequate to prevent stagnation and the build up of temperatures, noxious odors, vapors, fumes, and dust. All electrically powered supply and exhaust fans shall be direct-drive with low speed motors. Vibration eliminators, inertia pads, and flexible duct connections shall be used to prevent the transmission of vibration and noise to building structures. Electrically powered supply and exhaust fans, air louvers, and gravity roof ventilators shall be constructed of aluminum, fiberglass, or galvanized steel.
Domestic water system	Size to meet the domestic water demand for both the HCCP and Unit No. 1 during a major maintenance.
Service air systems	Supply a source of clean, compressed air for miscellaneous plant use. Three 100 percent capacity service air compressors shall be supplied. A cross-tie that connects the service air system with the instrument air system shall be provided for system redundancy. Provide air for instrument air system. The system shall be cross-tied with Unit No. l's Service Air System.
Instrument air	Provide clean, dry, compressed air for plant instrumentation and controls. For freeze protection, instrument air shall be available for use at outdoor service air stations. The system shall be cross-tied with Unit No. l's Instrument Air System.

Process Area – Balance of Plant continued -------

Performance Parameter	Reference Value
Heating, ventilating, and air conditioning fan tip speeds	Multiple blade design and shall not exceed 12,000 feet per minute (fpm).
Heating, ventilating, and air conditioning air inlet velocities through net openings of exterior wall louvers and storm-proof fan air inlets	Shall be limited to 1000 fpm.
Instrument air	Supply clean, oil-free, dry air with no particles greater than 3 microns.

4.0 Detailed Process Design

4.1 Plot Plan and Plant Layout Drawing

Figure 2-1 is an overall process block flow diagram of the HCCP process. All major process elements are shown on the diagram. Figure 4 –1.1 is a plot plan of the Healy site.

4.2 Major Plant Process Areas

There are 14 major plant process areas listed below and each are described in the following sections. New technology process areas (4.2.01 through 4.2.06) are described in detail, while other process areas, more typical of conventional plants (4.2.07 through 4.2.014) are more briefly described.

4.2.01 Process Area - Main Boiler System and Coal Feed System (CFS)

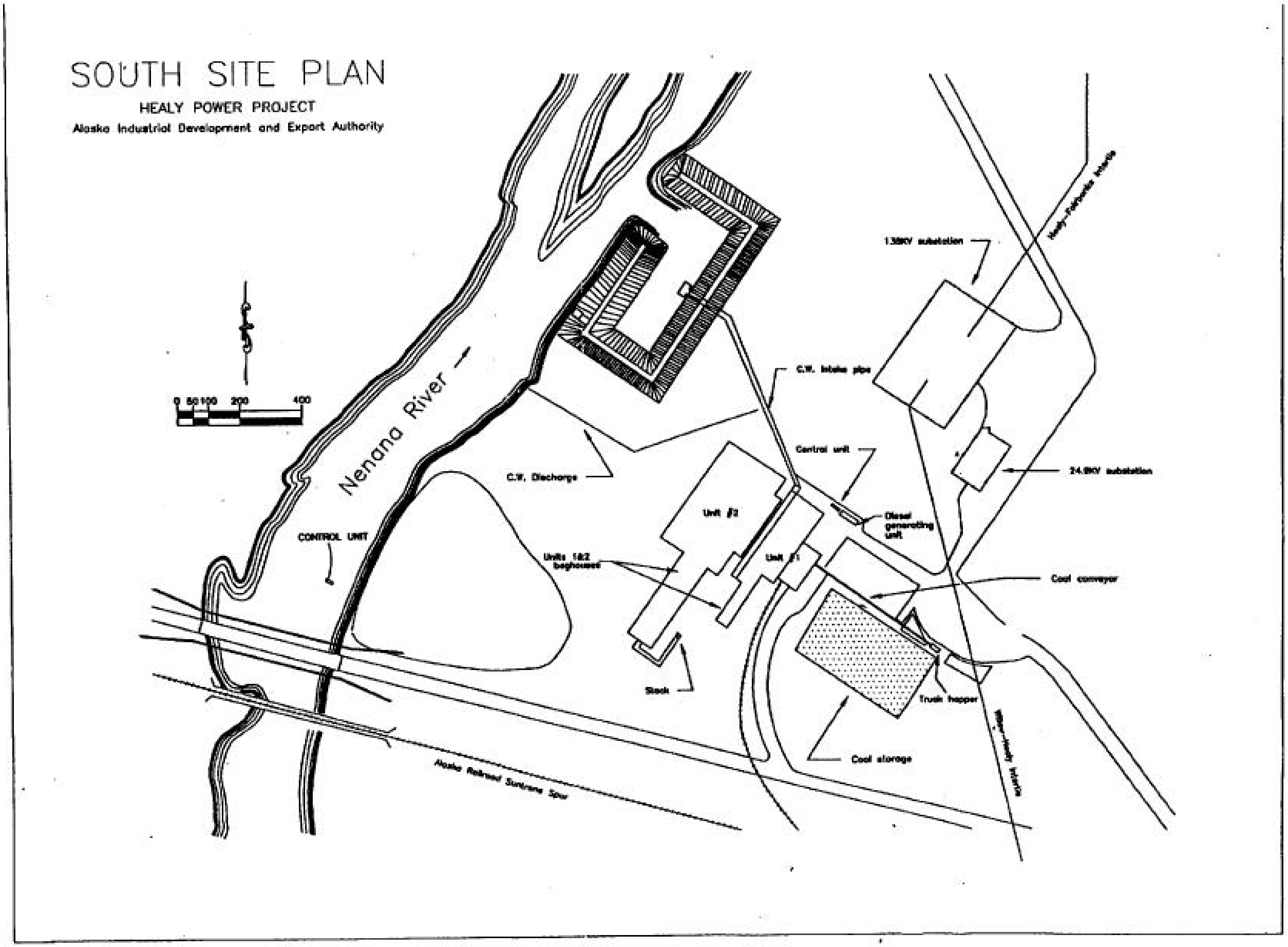
The pulverizer and exhauster fan system prepares and delivers the coal fuel to a TRW coal feed system. The function of the coal feed system is to split the coal/air stream into two streams with the proper flow ratio, and to control the amount of carrier air used to transport the split coal streams to the precombustor and slagging combustor. Two combustor/pulverized coal systems provide the heat input required by one steam generator boiler. The associated systems are used to measure boiler steam quality, control steam temperature, control drum level, provide pegging steam to the deaerator, provide boiler safety, provide auxiliary steam to the pulverizer/splitter inerting station, and provide sootblower steam. Figure 4-1 is a functional schematic of the coal feeder and splitter and Figure 4-2 is a functional schematic of the boiler/combustor water and steam flow system.

Figure 4-1 shows a layout of the exhauster fan in relation to associated systems. The fans blow coal into the splitter. After completion of the 90-day test blades on the exhauster fans were badly worn and identified as being an area of the plant in need of repair prior to commercial operation. Remediation options to be considered are placing the fans on the clean air side, using eductors instead of fans to supply the small amount of high pressure air required, adding two small pulverizers (removing the exhauster fans and splitter), improving the durability of exhauster fan materials, reducing the fan blade tip speed, adjusting the air flow rates, or simply changing out the exhauster fans on a regular basis as needed.

Coal Feed System

The coal feed system begins with the pulverizer which is fed pre-crushed coal from the bunker. Each pulverizer provides 50% of the heat input to the boiler or 100% of the heat input to each combustor.

The pre-crushed raw coal is delivered into the pulverizer on a gravimetric belt coal feeder. Coal pulverization occurs between the spherical surface of the grinding rollers and a mating grooved grinding ring. Primary air lifts and conveys the coal fines to the coal feed system. The preheated primary air is provided by the forced draft fan and exhausted from the pulverizer, located at the

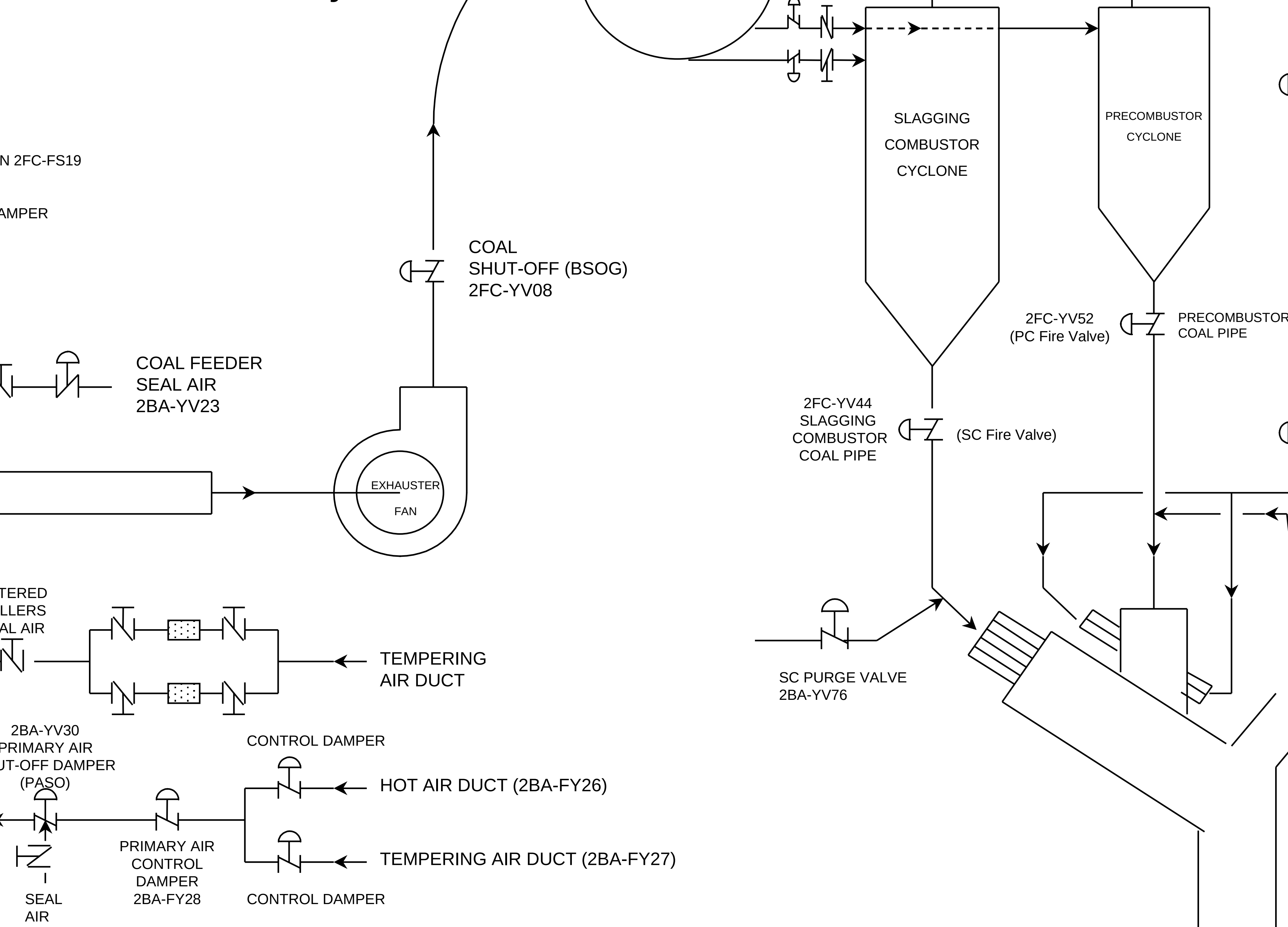


SOUTH SITE PLAN
HEALY POWER PROJECT
Alaska Industrial Development and Export Authority
0 50 100 200 400
Nenana River
CONTROL UNIT
C.W. Discharge
C.W. Intake pipe
13.8KV substation
Control unit
24.9KV substation
Unit #2
Diesel generating unit
Units 1&2 baghouses
Unit #1
Coal conveyor
Stack
Truck hopper
Coal storage
Alaska Railroad Suntrana Spur

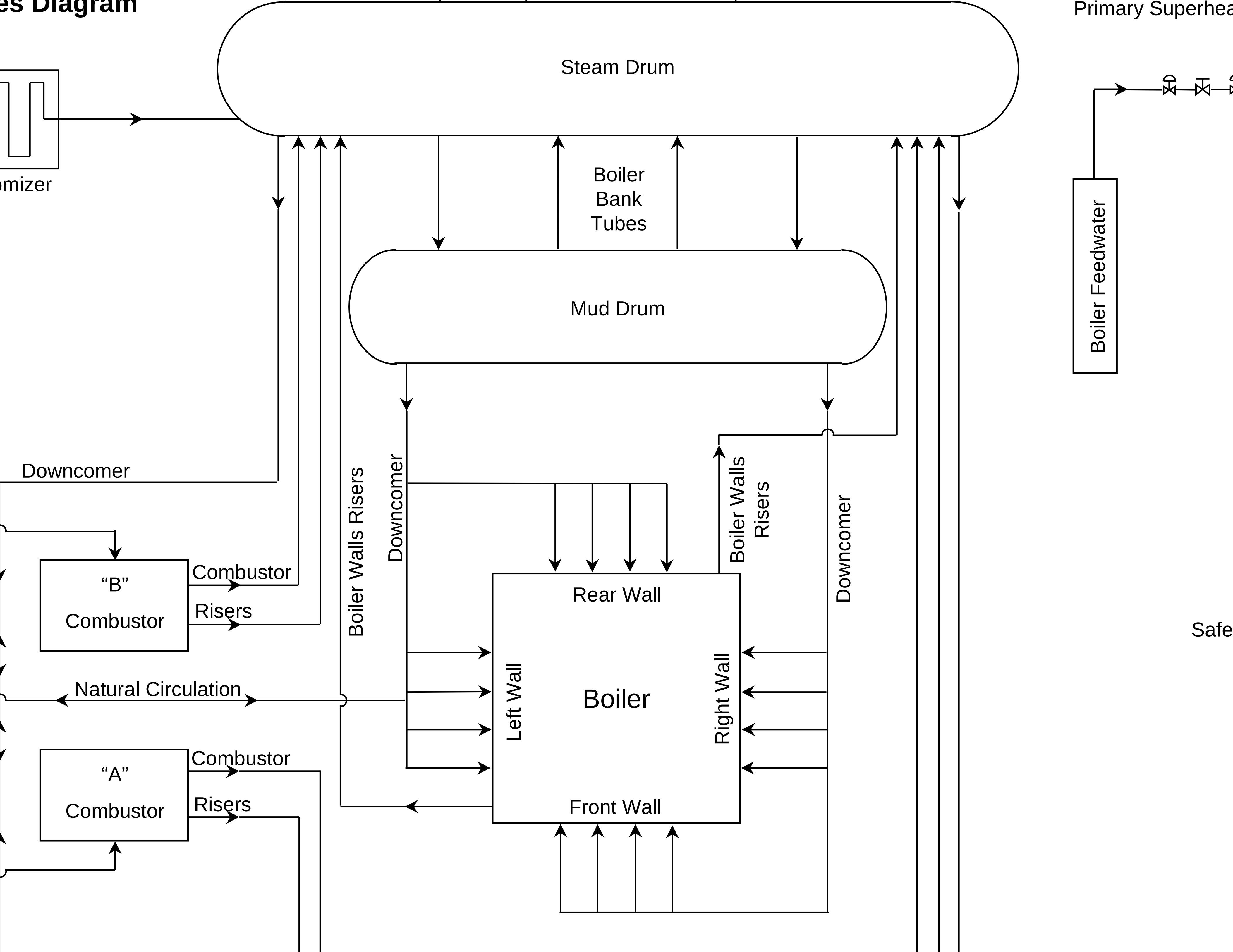
Figure 4-1.1

Basic Flow Diagram

Pulverized Coal System



es Diagram



Primary Superhea
Steam Drum
omizer
Boiler
Bank
Tubes
Mud Drum
Boiler Feedwater
Downcomer
Boiler Walls Risers
Downcomer
Boiler Walls
Risers
Downcomer
"B"
Combustor
Combustor
Risers
Rear Wall
Safe
Natural Circulation
Left Wall
Boiler
Right Wall
"A"
Combustor
Combustor
Risers
Front Wall

mill outlet. Isolation and regulating dampers are provided for a wide range of operations, and each pulverized coal system is fire protected by a steam inerting system at the pulverizer and splitter. The coal feed system splits the coal/air stream from the mill exhauster fan into two streams, and controls the amount of carrier air used to transport the split coal stream to the precombustor and slagging combustor. Isolation and regulating dampers are provided to achieve proper coal split and constant carrier air. The pulverizers are equipped with a pyrite reject removal system. The reject system will transport the coal to the slag ash conveying system either during grind out or normal operation.

Boiler and Associated Systems

The boiler water and steam flow starts with feedwater entering the drum after passing through the economizer. The economizer preheats the feedwater while lowering the gas temperature entering the low temperature air heater. Cooling of the waterwalls of the combustors is provided by two high pressure (HP) pumps. Each pump is capable of supplying 100% of the cooling water flow for each combustor. The cooling water to each pump supplies and returns water to and from the steam drum. An auxiliary connection to the mud drum is provided. This connection is used in case of HP combustor cooling water pump trip and will provide a source of cooling water for the combustor waterwall via natural circulation. The connection is controlled by two motor operated natural circulation valves. Cooling of the boiler waterwalls is provided by natural circulation. Higher temperature water and steam, being lighter than cooler water, will rise. This density difference provides adequate natural circulation. Incoming feedwater, at a temperature below saturation, first enters the steam drum. The resulting mixture of feedwater and saturated water in the drum remains in the sub-cooled condition as it enters the main downcomer circuits. Water circulates in the furnace sections and the boiler bank because of the differential pressure between the inlet and outlet of each circuit. Provided that continuous heat is applied to these circuits, the required differential will be maintained and the circulation will be continuous.

The water, which returns to the drum either from the boiler waterwalls or combustors waterwalls, first enters the horizontal separators, then the chevron dryers in the drum, before the saturated steam exits the drum. The saturated steam enters the primary superheater, then the secondary superheater. An attemperator is provided in the primary superheater outlet header to control secondary superheater outlet temperature to the turbine.

The boiler is protected by safety valves, which are the final safeguard between a controlled boiler and a catastrophic explosion. The boiler is also protected by an electromatic relief valve, which is an electrically activated pressure relief device.

Control Description - Coal Feed System (CFS)

There are several control functions associated with the coal feed system. The four primary control loops are the pulverizer coal/air mixture control, pulverizer outlet temperature control, coal feed system carrier air control and the coal split control.

The pulverizer coal/air mixture control is a primary air flow curve which is based on coal feeder flow, with a minimum set primary air flow to ensure adequate velocity in coal pipes. The pulverizer outlet temperature control is a combination of hot and cold air dampers that modulate to maintain constant mill outlet temperature.

The coal feed system carrier air control is a blowdown control damper, the carrier air is maintained at constant flow for all loads. The plant control system (PCS) control loop utilizes the pulverizer total air flow transmitter and cyclone exit air flow transmitter to control the CFS blowdown damper for a constant carrier air flow. The pulverizer air flow transmitter is temperature compensated, and the cyclone exit air flow transmitter is temperature/pressure compensated with an auto/purge feature. The cyclone exit air can be injected in the precombustor NO_x ports or boiler NO_x ports based on coal flow and boiler load.

The cyclone exit air to boiler NO_x ports and precombustor NO_x ports is controlled by a boiler NO_x port balance damper and an air flow transmitter in the precombustor NO_x port pipe, which is temperature/pressure compensated with an auto/purge feature.

The variable splitter, upstream of the splitter dampers, is inherently set to approximately provide the required split in coal flow between the precombustor and slagging combustor. The splitter dampers are then positioned by an operator adjustable setpoint characterized for a more accurate split.

Control Description - Boiler and Associated Systems

There are several control functions associated with the boiler and associated systems. The two primary boiler control loops are the steam drum level control and the secondary superheater exit temperature control. There are three auxiliary control functions connected with the associated systems; the boiler safety valve control, startup blowdown control and the continuous blowdown control.

The steam drum level control is a classic three element level control. The feedwater flow is compared to the steam flow and the difference proportioned to the actual steam drum level.

The secondary superheater exit temperature control is a standard attemperator with feedwater spray nozzle. The attemperator feedwater valve is modulated to control superheater outlet steam temperature to the turbine. The attemperator is located between the primary superheater and the secondary superheater.

There are three mechanical boiler safety valves, two on the drum with two different pressure settings, and one on the superheater outlet header. In an over-pressure situation, the pressure in the drum or superheater outlet header safety valve inlet increases until the force on the disc exerted by the system pressure equals the force exerted by the spring. This causes the safety valve to pop, or lift, relieving the excess steam until the system pressure is reduced to the desired level. A fourth relief valve is located at the superheater outlet header. This electromatic relief valve (ERV) control is an electrically actuated pressure relief device, which may be operated at will, by closing a switch or automatically, with a pressure sensing switch to relieve pressure. The ERV opens automatically at a pressure slightly lower than the mechanical superheater safety valve.

The startup blowdown is controlled by the DCS. This loop is drum level controlled. The valve opens at a maximum set drum level and closes at a minimum set drum level.

The continuous blowdown is controlled by the DCS. During startup this loop is pressure controlled. The motor operated valve opens at a minimum set drum pressure and closes at a maximum deaerator set pressure, in order to provide supplementary pegging steam for the deaerator. During normal operation, the operator manually positions the valve to achieve the desired blowdown rate. The continuous blowdown helps to maintain boiler water chemistry, by extraction of dissolved solids from the location with the expected greatest concentration.

4.2.02 Process Area – Combustor System

Two 350 MMBtu/hr (88 million kcal/hr) TRW multistage slagging combustors were designed for the HCCP. Each consists of a precombustor, a slagging stage and a slag recovery section. The main chamber of the slagging stage is approximately 9 feet in diameter by 16 feet in length. The walls of the combustor were fabricated using tube-membrane construction, primarily with 1.5 inch tubing. The combustors are cooled by a two-phase forced circulation system directly integrated with the boiler drum (1400 psia, 585^0F). The twin combustors were fabricated at Foster Wheeler's facility in Dansville, NY, per TRW specification drawings and were transported to the plant in several subassemblies. The combustors are suspended from the boiler (top-supported).

The combustors are positioned in a symmetrical arrangement (mirror image). Two independent fuel trains (including coal silo, coal feeder, pulverizer, exhauster fan, and TRW coal feed system) are located east of the boiler. Each fuel train can be operated separately for loads up to 50%, and the two are operated together for loads in the 50-100% range. An isometric view of one of the combustors is shown in Figure 4-3 and a functional schematic of the combustion system is shown in Figure 4-4.

Pulverized coal is injected in both the precombustor and slagging stage. The precombustor is used to boost the combustion air temperature from the air heater (typically 500 - 700°F) to 2,300 to 3400°F by burning 30 to 45% of the total pulverized coal flow rate. The precombustor is a vital component of the system because it controls the temperature and velocity of the oxygen-rich combustion gases entering the slagging stage for optimum combustion and slag removal. It is designed to ensure stable, efficient combustion of a wide variety of coals, and to prevent slag freezing within the slagging stage while burning high fusion temperature coals under fuel-rich conditions. Low volatility coals can be accommodated by firing a larger portion of the coal in the precombustor.

In the initial HCCP design, the combustion process in the precombustor was accomplished in two stages. In the primary combustion zone, coal was burned at a stoichiometric ratio (C/O_2) of 0.8 to 1.0 followed by a mixing section where additional secondary air was added, resulting in a stoichiometric ratio greater than 2.0 (fuel lean) at the exit of the precombustor.

The high temperature combustion gases from the precombustor enter the slagging stage tangentially, generating a high velocity, high temperature confined vortex flow. The balance of the pulverized coal (55 to 70%) is injected through a multi-port injector at the head end of the slagging stage. The high gas temperature produced by the precombustor promotes a hot slagged surface on the interior of the slagging stage, which combined with the strong recirculation patterns, ensures stable ignition and combustion. The multi-port injector helps distribute the coal evenly for better coal/air mixing and combustion. The slagging stage is operated at fuel-rich conditions at stoichiometric ratios typically in the range 0.70 to 0.90. Carbon conversion to gases is maximized and NO_x emissions are minimized by controlling the mixing and stoichiometric conditions in the slagging stage.

The precombustor, slagging stage, and the slag recovery section are operated in a slagging mode, i.e., the coal ash melts to form a molten slag layer which coats the inside surfaces. The coal

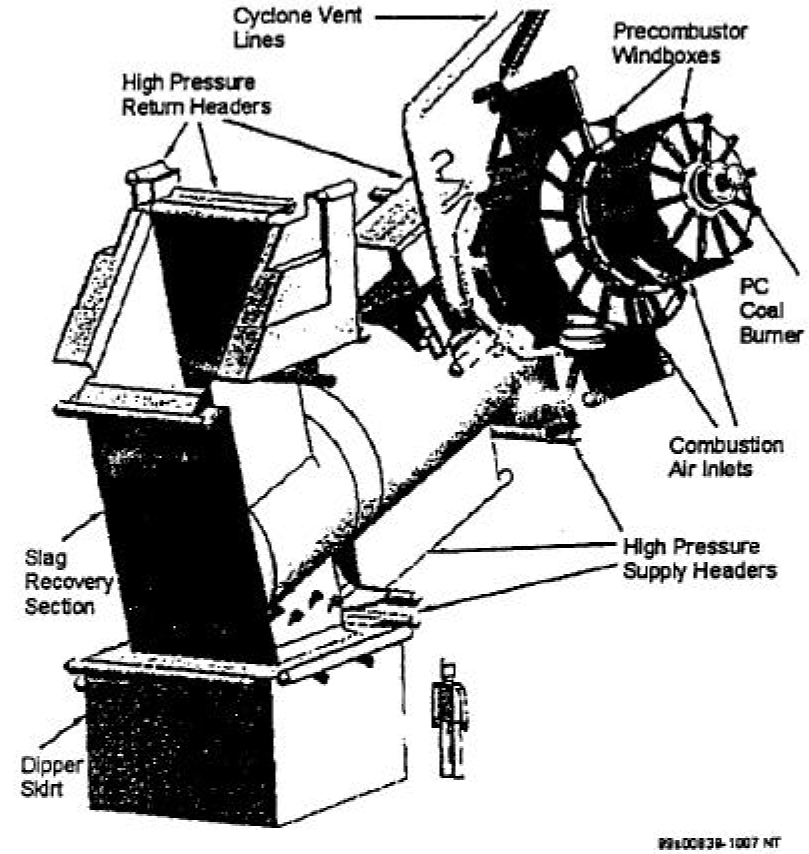


FIGURE 4-3 ISOMETRIC VIEW OF ONE OF THE TWO 350 MMBTU/HR TRW SLAGGING COMBUSTORS

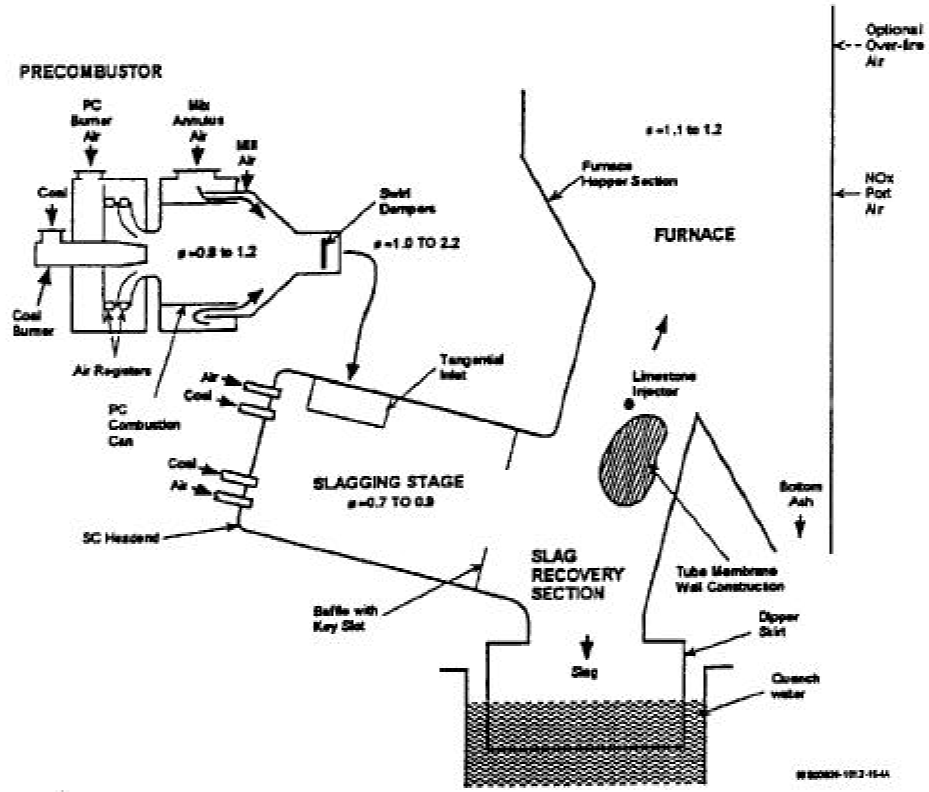


FIGURE 4-4 FUNCTIONAL SCHEMATIC OF TRW COMBUSTION SYSTEM

particles are combusted at a high enough temperature to melt the residual coal ash contained within each particle. Slag droplets are produced, which are centrifuged to the walls of the combustor, forming a self-replenishing slag layer. This slag layer is molten on the surface and frozen at the tubewall interface. The frozen slag layer is approximately 0.5 to 1.5 inches thick and protects the water-cooled metal body of the combustor from erosion, abrasion, and corrosion, and also reduces the heat transferred to the water in the combustor body. The molten slag is transported along the walls by shear and gravity forces. The molten slag flows through a key slot, along the bottom to the slag tap opening located in the slag recovery section. Up to 90% of the coal ash waste is discharged through the slag tap by gravity. A dipper skirt arrangement is used to provide a water seal and pressure seal for the system. The molten slag drops into the water, where it shatters upon contact and is rapidly quenched, yielding a granular glass-like product. The slag is removed from the slag tank by a drag chain conveyor.

Only 10 to 25% of the original coal ash enters the boiler. Because of the aerodynamics of the cyclonic slagging stage, the majority of this entrained slag will be molten droplets of less than 10 microns in size. As the fine slag droplets solidify at lower temperatures in the furnace, spherical shaped particles are formed that are expected to have lower fouling and erosion characteristics than conventional flyash particles, potentially increasing the life of the furnace and its convective tubes.

NO_x emissions are reduced in the TRW coal combustion process by the use of both fuel and air staging within the integrated combustor / boiler system. The combustor is primarily operated under carefully controlled, fuel-rich conditions. These conditions minimize the formation of NO_x by balancing the production rates of oxidized fixed nitrogen species (NH_i and NO). TRW test data and analytical model calculations indicate that combustor NO_x production is minimized by operating the combustor at a stoichiometric ratio (actual air/theoretical air) in the range of 0.70 to 0.85 (fuel-rich). For stoichiometric ratios above 0.85, excess NO is produced, while for stoichiometric ratios below 0.70, excess reduced nitrogen species (NH_i, HCN) are produced, which subsequently oxidize to NO within the boiler furnace.

As the fuel-rich combustion gases exit the TRW combustor and enter the furnace, the addition of the final combustion air is delayed until the gas temperature is reduced by radiative cooling to the walls. This reduces the peak temperatures in the furnace and helps to further minimize NO_x formation.

Using this staged combustion process, CO emissions are also typically lower than conventional low NO_x burner systems. In a low NO_x burner system, both solid fuel combustion and CO oxidation are accomplished within the furnace. CO emissions are typically in the 200-1000 ppm range due to both delayed secondary air mixing as well as low excess O_2 (2-3% O_2) within the furnace. With the TRW combustor, solid fuel combustion is essentially completed before the combustion gas enter the furnace. The furnace is used primarily for CO oxidation (gas-gas reaction), which is primarily dependent on efficient gas-gas mixing, rather than particle residence time and temperature history within the furnace.

The slagging combustor / boiler system also functions as a limestone calciner and first stage SO_2 removal device in addition to its combustion, heat recovery, and NO_x control functions.

Pulverized limestone (primarily $CaCO_3$) is injected in the upper region of the slag recovery section of the boiler. The limestone particles are calcined in the furnace, resulting in highly reactive flash-calcined lime (CaO) particles. By the time these lime particles mix and move with the combustion products to the exit of the boiler, a portion of the flue gas SO_2 is absorbed to form gypsum (CaSO4). The amount of SO_2 removal in the furnace is dependent upon the amount of sulfur in the coal and the Ca/S ratio. For low sulfur coal (less than 1% sulfur), the SO_2 removal in the furnace is typically 15 to 30%. For higher sulfur coal (2 to 4% sulfur), the SO_2 removal can be as high as 50 to 70%.

The precombustor consists of four major sections:

Primary Burner and Windbox.
Combustion Chamber (also referred to as "PC Combustion Can") with Integral Baffle
Secondary Air Mix Annulus and Windbox
Round to Rectangular Transition Section including Swirl Damper Blades

The PC combustion chamber, baffle, and transition section are all tube waterwall components fabricated from 1.5 inch diameter tubing. The gas-side surfaces of these components are covered with 3/8" diameter studs and a 1 to 2 inch sacrificial silicon-carbide refractory layer. These components are all cooled with boiler feed water, nominally 1400 psig atm., 585°F.

The water-cooling circuits are designed to be drainable. In the HCCP, the heat absorbed by the cooling water is recovered by directly integrating the combustor cooling water with the water in the steam drum through a separate forced-circulation circuit.

The precombustor mill air ports are integral with the PC transition section. There are six, 6-inch carbon steel ports, fabricated from Type 304 stainless steel "squashed" pipes. Seal boxes filled with castable refractory surround each port.

The swirl damper blades are tube waterwall components, fabricated from Grade B carbon steel pipe. During the Demonstration Test Program, an Inconel 625 weld overlay, 0.10" thick, was applied along a 1.5 in. wide surface on the downstream edge of the blades in order to minimize localized particle erosion along this surface. The blades are cooled with water from the low pressure cooling circuit of the plant condensate system, nominally 350 to 380 psia, at 100^0F.

The slagging combustor, or slagging stage, is comprised of four major sections:

Headend, including 6 Coal Injectors and 6 Secondary Air Ports
Tangential Air Inlet Section
Cylindrical Chamber Section
Keyslot Baffle

All of the slagging stage combustion-side components are tube membrane waterwall construction. The headend, air inlet, and cylindrical chamber section are fabricated from 1.5 inch diameter tubing. All of the components are cooled with boiler feed water, nominally 1400 psig atm., at 585^0F. The gas side surfaces are covered with 3/8 inch diameter studs and a 3/4 inch thick sacrificial silicon-carbide refractory.

The coal injectors are located at 52.5 inch diameter on the headend and the secondary air ports are located at 74 inch diameter of the tapered slagging combustor. The coal injectors are installed flush with the refractory surface of the headend. During the Demonstration Test Program, one of the coal injector ports was deliberately blocked off due to a strong flow recirculation pattern in this region of the headend. The current configuration has 5 coal injector ports and seven secondary air ports.

For the test program, there were three coal flame scanners installed on the headend. They were located on the Secondary air ports, at 3:00, 11:00 (or 1:00), and 9:00 locations.

The slag recovery section, is comprised of 4 vertical walls, tube membrane waterwall construction, fabricated from tubing. All 4 walls are cooled with boiler feed water, nominally 1400 psig atm. at 585^0F. The gas side surfaces are covered with 3/8” diameter studs and a 3/4” thick sacrificial silicon-carbide refractory. The limestone injector is located flush with the refractory surface at approximately 4feet below the furnace inlet.

The dipper skirt, fabricated from duplex stainless steel, forms the gas and water seal. The skirt is protected from direct radiation and convection by a tube membrane waterwall shield. The shield, fabricated from duplex stainless steel tubes and fin material, is cooled by the low temperature cooling circuit of the plant condensate system, nominally 350 to 380 psig atm. at 100^0F.

4.2.03 Process Area – SDA System

The purpose of the SDA system is to remove dust and sulfur from the flue gas. These flue gas pollutants must be controlled to meet the Environmental Protection Agency and the Alaska Department of Environmental Conservation permit limits. A functional schematic of the SDA is shown in Figure 4-5.

The SDA system is an air pollution control system designed to remove sulfur dioxide (SO_2) and particulate from the effluent gases of the furnace/combustors. The sulfur dioxide is removed within the spray dryer absorber chamber. The system is supplied by B&W/Joy. B&W/Joy's licenser, Niro Atomizer, supplied the rotary atomizer. Particulate is removed from the effluent gases in a fabric filter (baghouse) located downstream of the SDA. A slurry of ash lime and water is injected into the SDA by the atomizer.

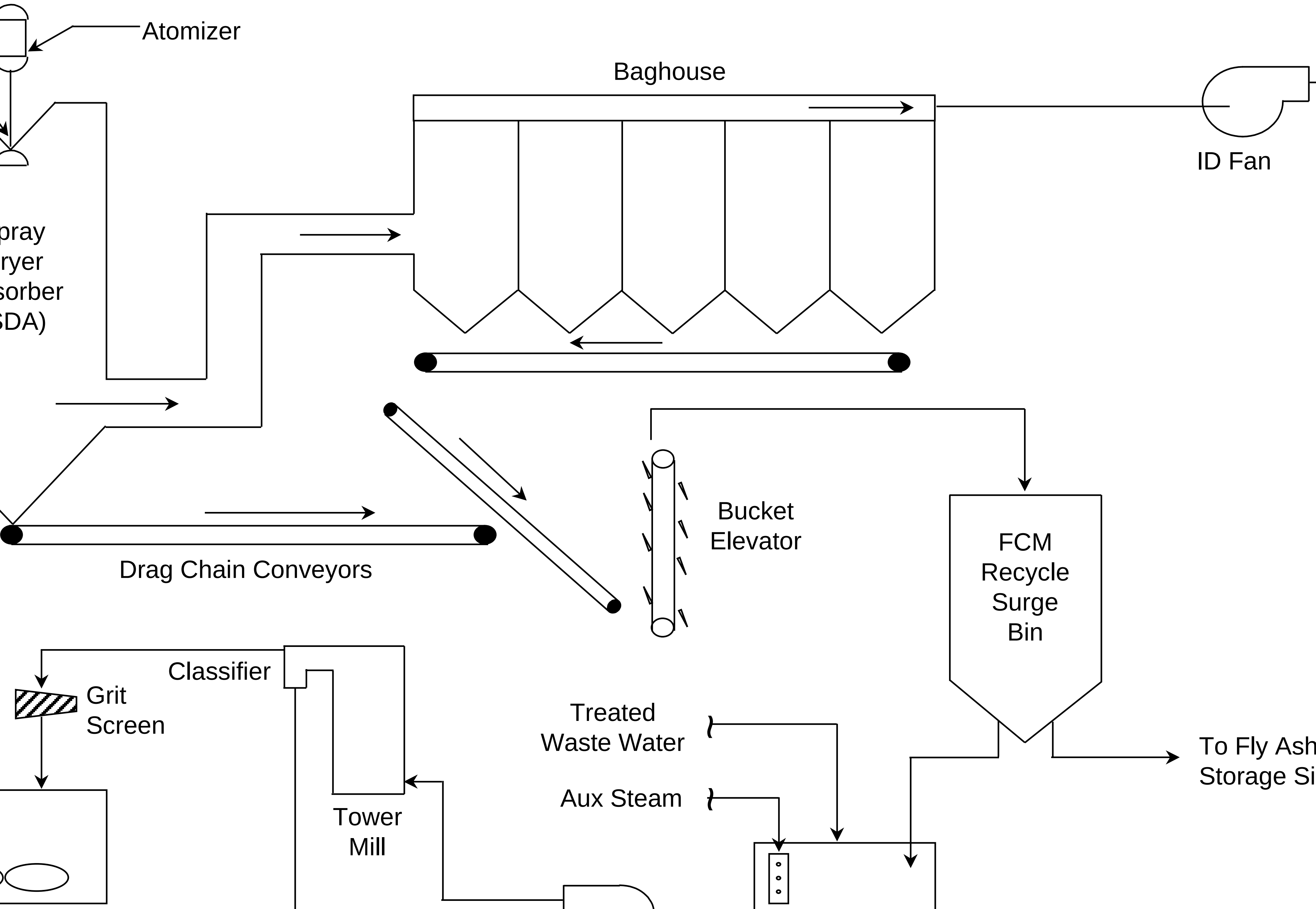
The sulfur removal process begins in the boiler combustors where powdered limestone is injected through feed nozzles just downstream of the slagging combustors. The heat from the combustion process instantly converts this limestone ($CaCO_3$) into lime ($Ca(OH)_2$). This lime absorbs some of the SO_2 and SO_3 from the combustion process and is then entrained with the flue gas to be carried into the SDA system. This lime material along with fly ash from the combustion process is called flash calcined material (FCM) and is collected in the baghouse and recycled to form a slurry, which is used in the spray dryer absorber.

The flue gas first passes through the spray dryer absorber (SDA) where it is exposed to a fine mist of slurry droplets containing particles of the FCM. This lime reacts with the remaining SO_2 in the flue gas to produce calcium sulfate. At the same time, the heat of the flue gas causes the liquid portion of the droplets to evaporate leaving a dry powder material, which is then collected either in the bottom of the SDA chamber or in the downstream baghouse.

After leaving the SDA, the flue gas passes through the baghouse which contains 10 compartments, each with 225 bags. The bags are Teflon-coated fiberglass and are held in place by wire cages. The gas passes upward through the bags, depositing any particulate material on the outside of the bags. This material is periodically cleaned off by closing the compartment outlet damper and then pulsing the bags with compressed air. The air pulse causes a ripple to move down the bag which dislodges the material caked on the outside and drops it into a hopper below the compartment. The hoppers are provided with electric heaters to prevent condensation and keep the ash material free flowing. The baghouse also has two bypass dampers which connect the inlet and outlet plenums. These bypass dampers are used during startup or to protect the baghouse in case of high inlet temperature or high differential pressure.

The FCM material, which is collected in the baghouse hoppers and the SDA hopper, is discharged through rotary feeders and then conveyed to the recycle surge bin by a set of drag chain conveyors and a bucket elevator. From the recycle surge bin, it is discharged into a recycle slurry mixing tank where it is mixed with water and grinded. This tank can be heated by a steam sparger (presently removed to avoid plugging) to speed up the lime slaking reaction and is provided with an agitator for mixing and a dust scrubber for cleaning of the vent air. Excess FCM material which cannot be recycled is diverted from the recycle surge bin into the fly ash silo, where it is removed by truck. The FCM recycle surge bin is provided with a bin vent filter

Flue Gas Desulfurization System



for controlling dust and an aeration blower and heater unit for promoting free flow of the material out of the bin.

From the mixing tank, the slurry is pumped up into a tower mill which grinds the suspended solids into extremely small particles and then discharges them through a particle size classifier and grit screen into a feed slurry tank. This tank holds the material and keeps it agitated until it is used in the spray dryer. The larger size particles from the mill classifier get fed back to the slurry mixing tank to be recycled through the tower mill.

From the feed slurry tank the material is pumped up to an atomizer head tank at the top of the spray dryer. From there it flows by gravity to the atomizer to be sprayed into the flue gas stream.

The atomizer consists of a liquid distributor and a rapidly spinning wheel with small nozzles on its periphery. The slurry is forced through the nozzles at high velocity by the centrifugal force and is broken up into extremely small droplets, which provide a large surface area for reaction and are easily evaporated.

The atomizer head tank has an overflow line, which continually recirculates the slurry back to the feed slurry tank. This is done to keep the slurry moving and prevent settling out of the solids. The entire slurry system, also, has provisions for manual flushing of all pipes in order to prevent set up or solidification when the system is shut down.

Due to its high speed and high temperature operating conditions, the atomizer has specially designed lube oil, cooling water, and seal water systems, which are self-contained within the atomizer enclosure. There is, also, extensive monitoring and alarm instrumentation on both the atomizer and its drive motor. In order to minimize downtime in case of an atomizer failure, a second spare atomizer is provided which can be installed quickly in place of the failed one.

Control Description

The control of the baghouse and SDA systems is done by a combination of a local programmable logic controller (PLC) and the plant control system (PCS). The PLC handles control of the baghouse and the discrete (i.e., on-off) portions of the spray dryer controls. The PCS handles the analog portions of the SDA control (i.e., continuous feedback control loops) and all of the operator interface functions.

There are several major control loops associated with the SDA. The two most important are control of the SO_2 measured in the stack and control of the flue gas temperature at the outlet of the spray dryer. These two are closely interrelated, because maintaining the spray dryer temperature close to, but not below, the saturation temperature increases the efficiency of the chemical reactions.

The stack SO_2 control loop is used to modulate the feed rate of limestone to the combustors by adjusting the limestone weigh feeder speed. This has the effect of not only controlling SO_2 by increasing or decreasing the amount of sulfur capture in the combustor, but will, also, end up changing the amount of lime in the FCM material used in the spray dryer, thus changing its absorption efficiency.

The setpoint for this loop is automatically selected as either the stack SO_2 limit or the percent SO_2 removal limit, whichever is lower.

The spray dryer outlet temperature control loop is used to modulate the feed rate of slurry into the atomizer by adjusting a pinch-type control valve. This changes the amount of spray in the flue gas stream which must be evaporated and thus the amount of temperature reduction. The volume of flue gas flow, as measured by the pressure drop across the spray dryer, is used as a feed forward signal for this loop so that changes in boiler load can be anticipated, before they cause an outlet temperature change. The setpoint of this loop can either be manually set by the operator or automatically adjusted based on the amount of SO_2 removal which will be required.

Other control loops associated with the spray dryer include:

- Slurry density control - this loop maintains a fixed slurry density by adjusting the feed rate of FCM material from the FCM recycle surge bin to the recycle slurry mixing tank.

- Recycle slurry mixing tank level control - this loop adjusts the amount of waste water added to the tank in order to maintain a constant level

- Recycle slurry mixing tank temperature control - this loop maintains a constant mixing tank temperature by varying the amount of steam fed to the sparger

- Feed slurry tank level control - this loop maintains a constant level in the feed slurry tank by controlling the rate of slurry addition from the tower mill

- FCM recycle surge bin level control - the level in this bin is maintained by adjusting the speed of the rotary feeder which discharges material to the fly ash silo for disposal. This is not a continuous control loop, but rather, the disposal feed rate is adjusted in steps of 0%, 25%, 50% and 100%, based on level switches in the bin. It may, also, be manually set at any rate.

The baghouse is controlled independently of the spray dryer. The baghouse bypass dampers can be controlled manually, such as, for boiler purge or oil firing. They are, also, opened automatically whenever the baghouse inlet temperature or differential pressure reaches a level which could cause damage to the bags or compartments. The cleaning sequence for the bags can either be initiated manually or set to operate automatically based on a preset time interval or baghouse differential pressure.

4.2.04 Process Area – Materials Handling System

Coal Handling and Dust Collection Systems

The purpose of the coal handling and dust collection systems is to receive coal from a bulldozer or front end loader and deliver it to the Unit No.1 coal bunkers and HCCP coal silos, without excessive dust emissions. A functional schematic of the coal handling and dust collection system is shown in Figure 4-6.

Filling the Unit No. 1 360 ton (total) coal bunkers requires approximately 1.5 hours. This is based on an expected feed rate of approximately 240 tons per hour. This feed rate is provided by either one of the two variable speed feeders and its corresponding secondary crusher. Unit No. 1 can run for approximately 14 hours at full load with its bunkers full of coal. It will take an additional 5 hours to fill the HCCP silos, which have a 24-hour capacity.

The two Unit No. 1 coal bunkers are rectangular. Bunker 1A is the east bunker and bunker 1B is the west bunker. The HCCP silos 1A and 1B are aligned north to south.

The coal flow sequence begins at the Stamler feeder breaker inlet hopper. After the coal is loaded into the inlet hopper, it is conveyed through the feeder breaker into the selected coal hopper. The diverter gate determines the selected hopper. An external blue light illuminates when the run-of-mine (ROM) coal hopper is selected and an amber light illuminates when the waste coal hopper is selected. This system is not used in lieu of pile blending. The selected coal hopper discharges coal onto its corresponding belt feeder, which conveys the coal under a magnetic separator before discharging it to its corresponding crusher. The crushers discharge onto conveyor 1, which transports the coal over the belt scale, through the moisture and ash analyzers and up to the Unit No. 1 coal bunkers. The coal drops off conveyor 1 through the coal sampler chute to either bunker 1A or, depending on the bunker selected, conveyor 2.

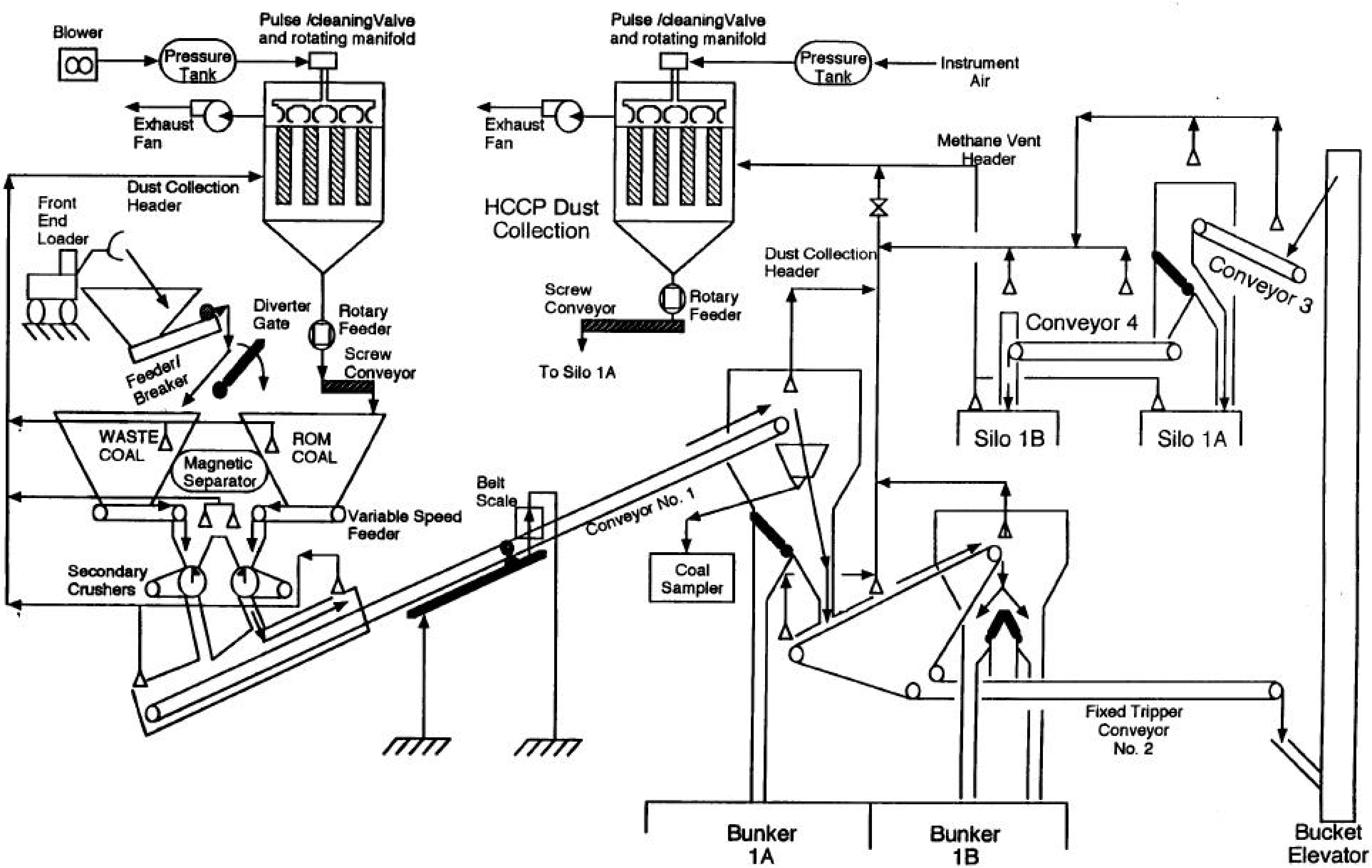
If the coal is diverted onto conveyor 2, which is a fixed-tripper conveyor, it will be diverted over the horizontal section of conveyor 2 and through the pant leg chutes into bunker 1B or, depending on the diverter gate position, the coal may be transferred to the HCCP bucket elevator, which lifts and transfers the coal to the HCCP coal handling and dust collection area above its coal silos. Conveyor 3 receives coal from the bucket elevator and discharges to silo 1A or, depending on the position of the diverter gate, to conveyor 4, which discharges to silo 1B.

Coal Loading Facilities

Three types of coal may be received. They are run-of-mine (ROM), waste, and low-grade seam coal. When blending is required, it will be performed by mixing the pile to a homogenous mixture, or by varying the speeds of the waste and ROM variable speed feeders. Blending the piles, prior to loading the silos, is the preferred method.

A rubber tired, front end loader with a coal bucket unloads the raw coal which passes through 24" x 30" openings in the grizzly. Larger pieces will need to be removed and broken-up with the

Figure 4-6
Coal Handling and Dust Collection Flow Diagram



loader bucket or a dozer. The grizzly discharges to the inlet hopper of the Stamler feeder breaker, which was provided to reduce coal size to no more than 4" across at its largest dimension with all of its conveying flights installed.

The feeder breaker discharges to either the west side ROM coal receiving hopper or to the east side waste coal receiving hopper, depending on the position of the diverter gate. Spill bar gates are provided at the base of these two hoppers for isolation, if required. The ROM hopper is the preferred direction for coal feed, because a screw conveyor transfers fines from the unloading hopper area dust collection system to the ROM hopper. If the waste coal hopper is used, it may be necessary to run the ROM variable speed feeder (and crusher) or to place a bucket under the screw conveyor discharge and monitor and empty it into the waste coal hopper to ensure that coal fines do not accumulate excessively on the idle variable speed coal feeder corresponding to the ROM hopper. A fire hazard could result if the coal fines are not properly handled. The position of the feeder breaker discharge diverter gate is controlled from the mobile radio unit in the front end loader.

Yard Hopper Area Dust Collection System

This system collects coal dust from the ROM and waste coal yard hoppers, the variable speed coal feeders, the belt loader hood and the conveyor 1 hood. Flow is induced through these hoods by an air exhaust fan. The flow of individual exhaust hoods is controlled by hand operated dampers in the ducts between the hoods and the dust filter. The exhaust fan draws dust laden air from the outside of the bags. Coal dust, collected on the outside of the filter bags, is cleaned by reverse pulsed air from the cleaning air blower, which discharges to a pressure storage vessel. The cleaning air is provided to the bags through nozzles on a motorized manifold, which moves across the bags. A diaphragm valve provides pressurized air from the pressure storage vessel and cleans the bags from the inside out in the direction opposite to the normal flow direction created by the exhaust fan. The coal dust falls from the outside of the bags to the dust collector outlet hopper and then through the rotary airlock. The rotary airlock feeder discharge is transferred horizontally via screw conveyor at grade to the ROM coal hopper and re-introduced to the coal feed stream. To indicate a problem with the air pulse system, a pressure differential indicator transmitter measures the pressure differential across the tubesheet and provides an alarm on high (8" wg) pressure differential. To indicate a bag failure, an opacity monitor is provided in the duct between the filter outlet and the fan inlet.

HCCP Silo Area Dust Collection System

The permanent HCCP silo area dust system collects coal dust from the following points:

- Conveyor 1 (head pulley discharge only)
- Conveyor 2
- Bucket Elevator 1
- Conveyor 3
- Conveyor 4
- Silo 1A
- Silo 1B

Flow is induced through the dust collection hoods, by the dust collection exhaust fan. It is manually controlled by dampers in the ducts between the hoods and the dust filter. The exhaust fan is driven by a two-speed motor, which runs at high-speed when coal is loaded. When coal is not being loaded, the fan motor speed reduces to remove methane gas from the coal silos at a lower power consumption level than when loading coal. Coal dust collected on the outside of the filter bags is cleaned by reverse pulsed air from the instrument air system. The cleaning air is provided to the bags through nozzles and cleans the bags from the inside out in the direction opposite to the normal flow direction created by the exhaust fan. The coal dust falls from the outside of the bags to the dust collector outlet hopper and then through a rotary airlock. The rotary airlock discharges to a screw conveyor which discharges to coal silo 1A.

Control Description

The conveyor system may be started automatically or manually. When all of the equipment is in automatic, only the coal hopper receiving coal needs to be identified. The yard hopper dust collection and HCCP dust collection systems will start, the appropriate alignment of diverter gates will take place, and the proper sequence of conveyor starts will occur.

The operator may select automatic silo switching. This alternates the flop gate between the silos at chosen increments of tons of coal loaded. The operator selects the increment of tons to load in each silo by entering the value on the main graphic. If the silo selector is in automatic, the system will load the selected amount in one silo, swap to the other and so on.

The plant control interface consists of one primary graphic and the associated alarm, control and trend selections. The primary graphic provides control interfaces for all of the coal handling equipment configured for PCS control, with the exception of the sample system.

The graphic displays the control and operating status of the above described equipment, as well as, several process indicators.

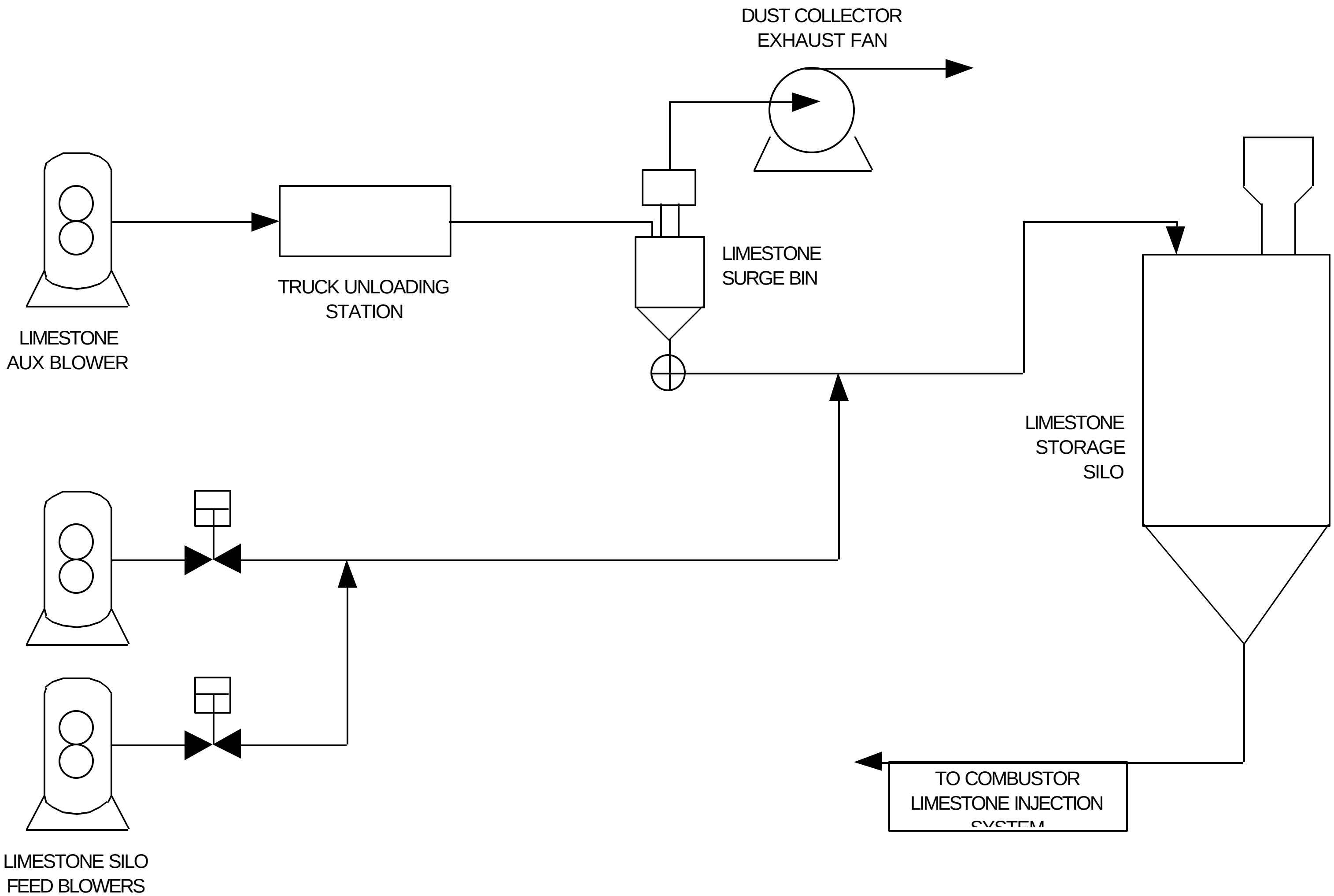
Limestone Handling System

The purpose of the limestone handling system is to unload the limestone delivery vehicles and transfer the limestone to the limestone silo located in the plant. The purpose of the limestone feed system is to meter and feed the limestone from the storage silo into the slagging combustors at an adjustable rate as required for SO_2 removal. A functional schematic of the limestone handling system is shown in Figure 4-7.

The product limestone will be a dry, free-flowing granular material. The size distribution is anticipated to be 100% passing a 100 mesh screen, and 70% passing a 200 mesh screen. The bulk density will be 68 pounds per cubic foot.

Limestone will be delivered by tractor-trailer to the jobsite. The trailers will be an enclosed, over-the-road pneumatic type, with a bottom outlet piping system for pneumatic unloading. The trailers will be unloaded by a blower mounted integral with the trailer.

FIGURE 4-7
BASIC LIMESTONE HANDLING SYSTEM DIAGRAM



The limestone will be conveyed from the truck to a nearby surge bin located inside the material handling bay. The conveying air used to transport the limestone from the truck to the surge bin will be filtered by a gravity type dust collector. The filtered air from the bin vent will be discharged into the fly ash silo. A fan and ductwork system will be used to move the air from the collector to the ash silo.

The hopper outlet of the surge bin will include a bin activator to assist limestone flow and a rotary air lock feeder to meter the limestone into the secondary pneumatic transfer system. The limestone will be pneumatically conveyed to the limestone storage silo near the HCCP boiler. The conveying air used to transport the limestone from the surge bin to the storage silo will also be filtered and vented to atmosphere by a gravity type bin vent filter located on the storage silo roof.

The storage silo and downstream components of the limestone handling equipment are designed and supplied by TRW.

Both the truck unloading and silo feed portions of the limestone handling system will be a pneumatic type, dilute phase, pressure conveying system. The design capacity for the limestone pneumatic conveying system will be 30 tph, with a normal guaranteed conveying capacity of 25 tph. The surge bin and blowers will be located between the bottom and fly ash silos on an enclosed elevated platform protected from the weather. The truck unloading and silo feed portions of the system are normally operated at the same time, because the surge bin does not have sufficient capacity for a fully loaded truck.

A dust collector is installed on the surge bin to filter the conveying air. The conveying air is discharged through the dust collector and exhausted into the upper area of the fly ash silo.

Bag cleaning is by intermittent high pressure pulses. Compressed air for bag cleaning is furnished from the plant instrument air system. Bag cleaning is controlled by a solid state electronic adjustable timer or by differential pressure across the bags.

A dust collector exhaust fan is provided to convey clean air exhausted from the dust collector to an inlet at the top of the fly ash silo. The fan is designed to operate against the total ductwork system static pressure including allowances for starting under cold weather conditions.

The truck unloading station includes all necessary equipment, piping, valves, fittings and controls to unload pneumatic trailers. The truck unloading station is located outdoors near the ash storage silos.

A control panel is furnished to allow the truck drivers to unload the trailers. The panel is located outdoors adjacent to the limestone truck unloading connections.

All flexible connections from trailer to unloading station are heavy duty material handling hose. Connections will be quick-disconnect type.

The coal slagging combustors are designed for injection of limestone in the slag recovery section of the boiler just prior to entering the furnace. The hot combustion gases, at this point, convert the limestone into quicklime which in turn reacts with the SO_2 in the combustion gases to form calcium sulfate or gypsum. This gypsum, along with the remaining excess quicklime is then carried with the flue gas and captured in the baghouse downstream of the boiler. It is termed flash calcined material (FCM) and is subsequently recycled, as a slurry, from the baghouse back into the spray dryer absorber for further flue gas sulfur reduction.

The limestone feed system is a pneumatic conveying system designed to transport a metered amount of limestone from the storage silo to the combustor injection port. The maximum design capacity of the system is 7000 lb/hr. The limestone is fed from the silo by means of a variable speed gravimetric feeder which has a load cell and drag chain type conveyor. This unit controls the delivery rate of the limestone based on a remote signal from the PCS. The silo has a vibrating type bin activator to promote smooth flow into the feeder.

From the feeder, the limestone passes through a constant speed rotary type air lock valve and a diverter gate into two pressurized type pneumatic conveyor systems. The diverter gate has three positions and can be set to divert all the limestone into one of the two conveyor systems or in a 50-50 split, depending on the number of combustors in service.

Each of the two conveying systems has a dedicated carrier air blower and an eductor for sucking the limestone from the diverter gate into the carrier air stream. A cross tie valve, upstream of the eductors, allows either blower to be used for either system in case of a blower failure. Each blower is furnished with an inlet filter and silencer. There are isolation valves at the discharge of each blower and near the injection port of each combustor. When the combustor isolation valves are closed, the injection ports and piping are automatically purged with service air for cooling.

Control Description - Limestone Handling and Feed

The limestone handling system is controlled through the PCS from a local panel located at the truck unloading station to coordinate unloading operations with the operation of the balance of the limestone handling system. The startup and shutdown sequences are automated and are initiated when the truck operator presses the System Start or System Stop buttons on the local panel. The PCS provides the control function and monitoring for limestone handling equipment.

The two silo feed blowers may also be manually started and stopped through the PCS. Only one blower is required to operate at any one time and the two blowers are alternated with each use of the system. The start sequence of the blower automatically opens its associated discharge isolation valve. The discharge isolation valves may also be opened and closed manually through the PCS.

The auxiliary blower may also be manually started and stopped through the PCS. A set of limit switches on the hose connections provide interlocks to insure that the hoses are connected before the blower starts. A manual emergency trip switch is provided at the truck unloading panel. This switch immediately trips the blower via the PCS and alarms the trip to the operators.

Each blower incorporates an inlet header pressure switch for detection of low pressure, indicating a clogged filter. The discharge headers include local pressure indicators. The blower enclosures have vent fans which are automatically started when the fans are started.

The surge bin is fitted with high and low level switches. These alarms on the PCS alert operators as to the capacity of the bin. Normally, limestone is discharged from the bottom at the same rate or at a slightly higher rate than is being loaded. A high level in the bin results in an alarm to alert unloading personnel to the condition via a local light and an annunciator horn. The response should be to lower or stop the feed of limestone.

The surge bin hopper includes a bin activator to aid the flow of limestone. This is started and stopped through the PCS, with the automated sequence, and is interlocked to run only when the rotary airlock is running and in an open position. It operates on a timed sequence of five seconds on and twenty minutes off.

The rotary airlock is located on the outlet of the bin activator to meter limestone into the pneumatic system and provide an air seal. It is also started and stopped through the PCS, with the automated sequence.

A dust collector is installed on the surge bin to filter the conveying air. Bag cleaning is by intermittent high pressure pulses. Bag cleaning is controlled by a solid state electronic adjustable timer or by differential pressure across the bags. No PCS interface exists for this controller. High differential pressure across the bags is alarmed on the PCS.

A dust collector exhaust fan is provided to convey clean air exhausted from the dust collector to an inlet at the top of the fly ash silo. It is operated anytime limestone is being unloaded from the trailer into the surge bin. It is not necessary to operate this system element when only the silo is being unloaded.

A control panel is furnished to allow the truck drivers to unload the trailers. The panel is located outdoors adjacent to the limestone truck unloading connections. A plant phone is also located in this area for direct communications to the control room.

The panel includes the following instrumentation, controls, and equipment. Unless otherwise noted, these devices are interfaced to the PCS. A short functional description is included for each device.

The limestone feed system is controlled by the PCS. The primary control loop associated with the system is the limestone feed rate control using the weigh feeders. This control loop is based on the measured SO_2 level in the stack and uses a setpoint, which is based on the maximum emissions permit limit. There are minimum limits set on the feed rate to assure that the spray dryer receives enough FCM material for its use. The weigh feeder, also, has a local control panel which calculates the mass flow rate from the load cell and conveyor speed signals. It, also, allows local control of the feeder and has a backup volumetric feeding mode, if the load cell is not functioning.

The limestone silo has an ultrasonic level transmitter for the monitoring of the level at the PCS. The diverter gate should be positioned through the PCS based on which combustors are in service. The conveying and feed system equipment are started and stopped manually from the PCS.

4.2.05 Process Area – Ash Handling

Slag and Bottom Ash

The purposes of the bottom and slag ash system are listed as follows:

- To provide a seal between the combustion gas, within the furnace, and the air space in the boiler building; and between the combustion gas, in the combustor slag tap dipper skirts, and the air space in the boiler building.

- To quench, cool and remove slag and bottom ash.

- To receive and de-water bottom ash from Unit No. 1 and HCCP pulverizer rejects.

- To transfer and store, for disposal, the coal grinding and combustion solid waste

A functional schematic of the slag and bottom ash systems is shown in Figure 4-8.

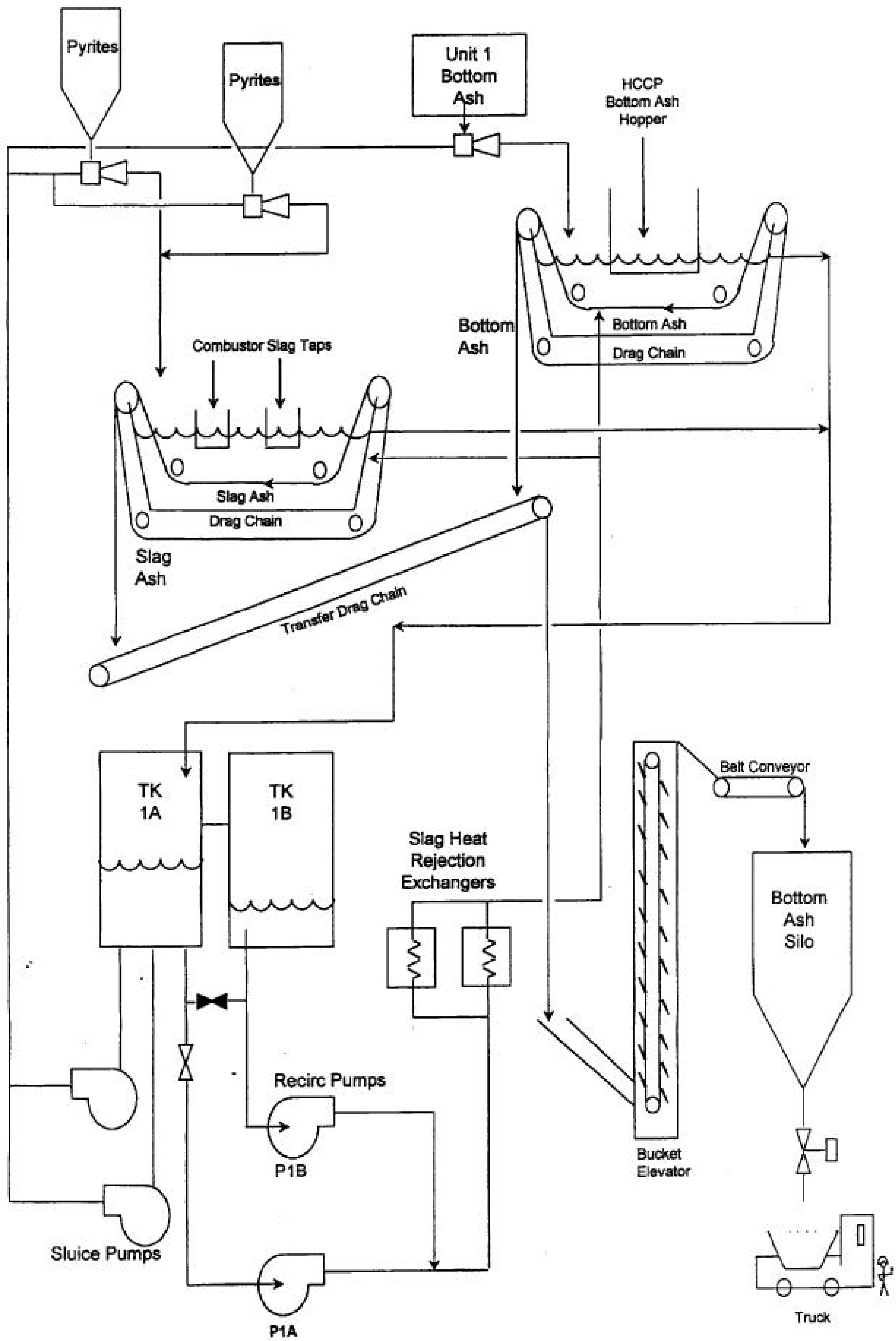
The bottom and slag ash system consists of two drag chains, which receive slag and bottom ash. One drag chain is located underneath the HCCP furnace and the other is located under the combustor slag tap dipper skirts. These drag chains de-water and discharge the solids to a transfer drag chain conveyor, a bucket elevator, and then to a belt conveyor, which discharges to the bottom ash silo.

To form a seal between the combustion process and the air space within the boiler building and to quench the slag and bottom ash, the lower half of the drag chains are submerged. The water level is maintained by one of two 100% recirculating pumps (one operating, one spare), which pumps water from the ash water surge tank through either of two 100% heat exchangers to the drag chain reservoirs. These then overflow back to the ash water surge tank. The heat exchanger transfers the heat from the slag to the circulating water system.

In addition to bottom and slag ash from the HCCP, bottom ash from Unit No. 1 is sluiced into the target box of the bottom ash drag chain; and pyrites rejected from the HCCP pulverizers are sluiced to the target box on the slag drag chain. The reject material from the pulverizers include both iron and rock pieces, which cannot be ground up by the pulverizer; and coal, which must be emptied out after an emergency trip. There are two 100% sluice pumps (one operating, one spare). Each sluice pump is a two speed pump which runs on high speed when providing sluice water to Unit No. 1 and runs on low speed when sluicing the pyrites from the pulverizer reject hoppers.

Solids drop to the bottom of each drag chain reservoir, where the drag chain transfers them along the bottom of the reservoir, and up the ramp, where the solids are dragged out of the water and dumped onto a vibrating screen. The material too large for the screen is rejected to a grizzly, where it must be manually poked through or removed. The solids from the slag drag chain drop onto the transfer drag conveyor near its tail end and the bottom ash drag chain discharges to a separate point further up the transfer drag chain, which then discharges the material to a bucket

Figure 4-8
Slag and Bottom Ash System



elevator. The bucket elevator lifts the slag and bottom ash above the top of the bottom ash silo and discharges to the belt conveyor, which transfers the product to the center of the bottom ash silo. The bottom ash silo is equipped with vibrators and stores the ash until it is unloaded onto coal trucks. The bottom ash silo, also, has a discharge gate, which can be operated and observed from the mezzanine level walkway through the window between the ash bay and the boiler area.

Control Description

Unloading of the silo, weight measurement, and operation of the vibrators are local functions. Level indication in the silo is accomplished at the PCS.

Fly Ash and Middle Ash

The purpose of the fly ash conveying system is to pneumatically convey collected ash from the source hoppers to the fly ash silo. The silo ash is then periodically emptied to trucks. A functional schematic of the fly ash system, including the Air Pre-Heater Hoppers (APH), is shown in Figure 4-9.

The fly ash conveying system utilizes two methods to convey fly ash with each method serving designated areas. The first method is a dry vacuum system and utilizes a positive displacement blower located downstream from the hoppers from which it collects. The second method is a dry pressurized system and utilizes a positive displacement blower located upstream of the hopper it serves.

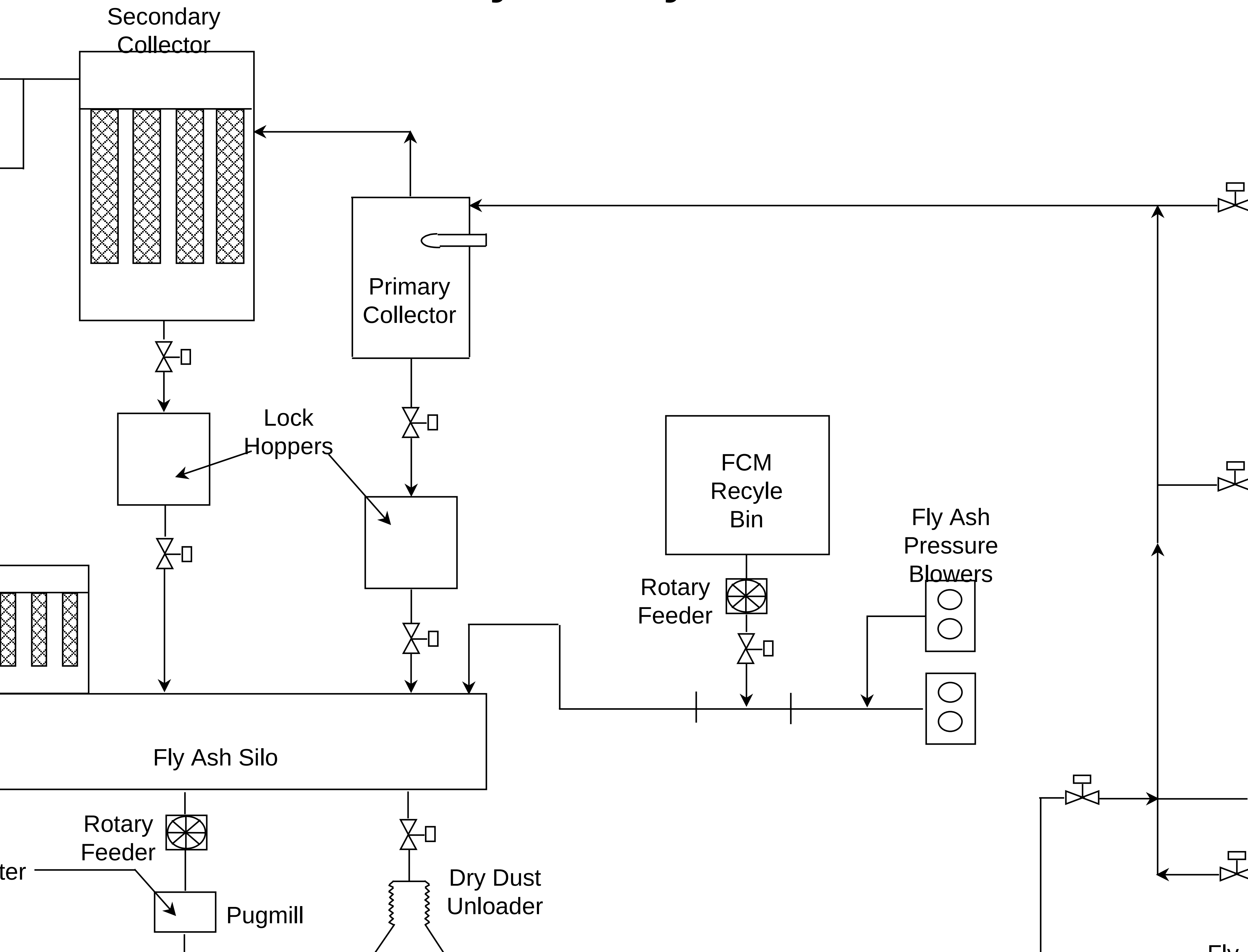
The dry vacuum fly ash conveying system pneumatically conveys collected ash through a pipeline from the existing Unit No. 1 backpass and baghouse hoppers and from the new HCCP boiler bank and air heater hoppers to the fly ash silo. The dry pressurized system pneumatically conveys the product from the SDA recycle bin to the fly ash silo. The ash collected from both the vacuum and pressurized system is conveyed to the common fly ash silo, which is periodically emptied to either tank type trucks, by means of a dry dust unloader, or to open-type trucks.

Control Description

The conveying system is designed for automatic sequential collection from each group of hoppers. Manual indexing to selected hoppers is also possible. The existing Unit No. 1 controls are maintained and continue to function, such that fly ash from the Unit No. 1 backpass hoppers and baghouse hoppers may be collected by either the existing Hydrovactors® (wet) or by the new dry system. The HCCP air heater and boiler bank hoppers are controlled solely by the plant control system (PCS) through a CRT display panel. The necessary interlocks and permissives are incorporated into the existing system controls to allow them to function in conjunction with the PCS system. Selection of the wet or dry mode for the existing Unit No. 1 system is made by the PCS operator. When dry is selected, operation of the existing Unit No. 1 hoppers is initiated from the PCS. Also, the existing system may be selected to bypass or collect by the PCS operator.

The SDA recycle bin ash transport is also controlled solely by the PCS through a CRT display panel.

Fly Ash System



4.2.06 Process Area - Pre and Post-Combustion Air System

The purpose of the combustion air system is to operate in conjunction with the flue gas system to control total boiler air flow as necessary to allow complete combustion of the fuel. All Pre and Post-Combustion Air exit the system as flue gas. The air flow is provided to the boiler through:

- Primary air to the pulverizers
- Precombustor and mix annulus secondary air
- Overfire secondary air
- Purge air
- Clean NO_x secondary air
- Coal feeder seal air
- Oil burner stabilizing air
- Scanner cooling air
- Precombustor/slagging combustor (PC/SC) coal pipe purge air
- Pulverizer table/roller seal air

A functional schematic of the Combustion Air & Flue Gas flow system is shown in Figure 4-10.

The combustion air system originates at the forced draft (FD) fan inlet. Combustion air passes through the glycol fin tube air heater, then through the low and high temperature air heaters to the precombustors and mix annulus secondary air dampers, overfire secondary air dampers, clean NO_x secondary air dampers, and the pulverizers, before entering the combustors and the boiler. When the combustion air exits the combustor, it becomes flue gas.

The purpose of the flue gas system is to operate in conjunction with the combustion air system to control furnace pressure, transport combustion gases from the furnace through the air heater and SDA system, and then discharge the clean flue gas through the stack to the atmosphere.

The flue gas system originates at the combustor/furnace interface. The flue gas passes through the furnace, superheaters, boiler bank, tubular air heaters and the economizer. The flue gas then flows into and out of the SDA system where sulfur dioxide (SO_2) is removed, and through the flue gas baghouse where fly ash is removed and collected. The flue gas continues through the induced draft (ID) fan and, from the discharge of the ID fan, is exhausted through the stack to atmosphere.

A glycol heating system is provided to warm the air entering the air heater to avoid corrosion. The system is comprised of fin tube heat exchangers in the forced draft fan inlet duct, steam-to-glycol shell and tube heat exchangers, pumps, pipes and controls.

Combustion Air and Glycol Heating

All combustion air is preheated by the glycol fin tube air heater to a tempering air temperature before entering the FD fan. Total air, which has been tempered, is split into combustion air, cooling air, seal air, purge air and tempering air to the pulverizers. Then, combustion air is subsequently preheated through the tubular air heater.

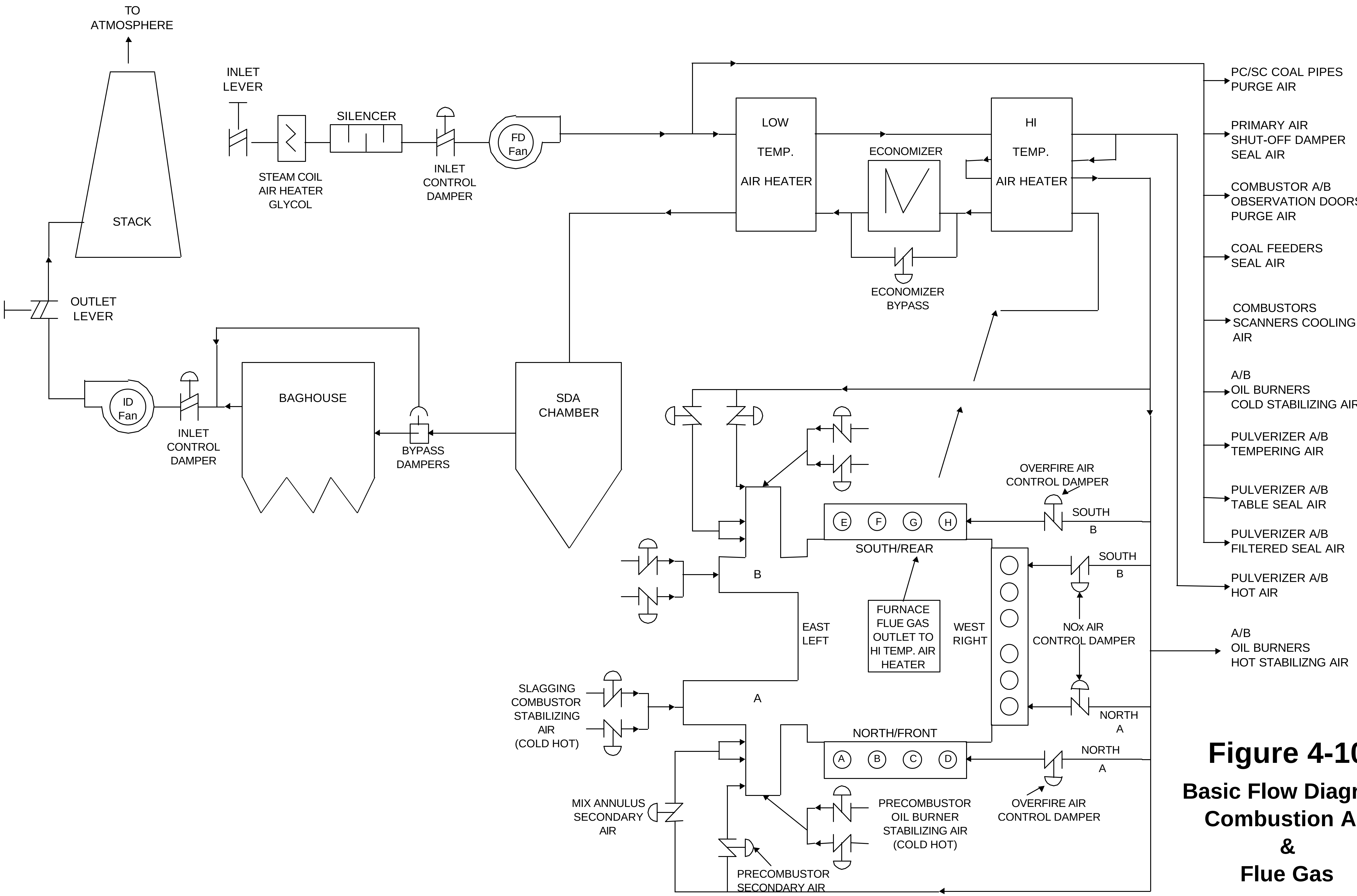


Figure 4-10

Basic Flow Diagram
Combustion Air
&
Flue Gas

The glycol heating system is made up of two major components; the fin tube glycol-to-air heat exchangers and the steam-to-glycol shell and tube heat exchangers. A glycol mixture is pumped through the shell and tube heat exchangers (one in service and one backup), where it is heated by steam. From these heat exchangers, the mixture is passed through the fin tube heat exchangers at the FD fan inlet where the heat is transferred to the incoming air. The steam for heating the glycol mixture is supplied from the auxiliary steam system at about 10 psi.

The condensate from the steam is drained to either the auxiliary condensate system or the main condenser. The steam shell side of the glycol heat exchangers can be vented to the atmosphere or to the main condenser. The most efficient arrangement is to vent and drain the steam from the glycol heat exchangers to the condenser due to the additional heat released from the steam at the lower pressure.

The glycol heating system has a nitrogen supply to maintain an oxygen free atmosphere in the head tank.

The preheated combustion air passes through the low temperature tubular air heater and the high temperature tubular air heater. The combustion air makes three passes through the high temperature air heater. Some combustion air is extracted at the second pass through the high temperature air heater to provide the hot primary air to the pulverizers. The combustion air that exits the final pass of the high temperature air heater becomes the secondary hot air to the combustors, secondary overfire air and clean hot NO_x air.

The combustion air pressure varies with the boiler load and is controlled with a single FD fan. The fan motor is a constant speed design and the fan utilizes inlet vane control.

Flue Gas

The flue gas leaving the furnace envelope is composed primarily of the products of combustion. In addition, fine particles of flash calcined material (FCM, a combination of fly ash and calcined lime particles) are suspended in the flue gas. Flue gas passes through the secondary superheater, the primary superheater and the boiler bank before entering the boiler back pass. In the boiler back pass, the flue gas passes through the high temperature tubular air heater and the economizer, before it passes through the low temperature tubular air heater, where lower grade combustion heat is recovered. The cooled flue gas leaves the air heaters and flows through the spray dryer absorber (SDA) for SO_2 removal, and through the fabric filter (baghouse) for removal of the fly ash. The ID fan discharges the flue gas to the stack.

The flue gas system is designed to exhaust combustion gases to the atmosphere and hold furnace pressure slightly below atmospheric pressure. The flue gas ductwork and ID fan are designed to account for the expected system flow, varying pressure and temperature conditions, dust grain loading, and the steady-state and transient conditions required by the boiler and the SDA systems.

The ID fan is driven by an electric motor and is located indoors. It has a constant speed design and utilizes inlet vane control. The ID fan volumetric flow is adjustable down to at least 15% of the rated capacity of the fan. The ID fan outlet damper is a louver type, designed for shutoff with a maximum leakage of 15% of the design static pressure and temperature when closed. The damper is manually actuated and has open and closed limit switches for plant control system (PCS) indication.

The 315-foot double-walled stack is provided to discharge the flue gas to atmosphere. The continuous emission monitoring (CEM) system probes, which measure opacity, nitrogen oxides (NO_x), and sulfur dioxide (SO_2), are located in a room contained within the annulus around the stack, which is accessible from the SDA area.

Control Description

Combustion air flow is controlled in conjunction with the fuel flow to set the firing rate of the boiler. The overall combustion air demand is set by the boiler master controller based on the desired unit load. The air is divided between the pulverizer coal transport (primary) air, combustor secondary air, and boiler NO_x port/overfire air. Although different criteria are used to control the flow for each of these, the overall air supply is controlled by the FD fan inlet dampers. These dampers are adjusted to maintain a set pressure at the low temperature air heater inlet. This set pressure increases with the unit load and is set by the steam flow to the turbine.

The primary air flow to the pulverizer is controlled by the coal flow demand from that pulverizer in order to assure adequate transport air. The secondary air flow to the combustor is also set by the coal flow demand and it is divided between the primary combustor and slagging combustor, based on a ratio which can be adjusted by the operator (stoichiometric correction). The distribution of this air is important for maintaining the correct slagging conditions within the combustor. The remaining air is directed to the boiler overfire air and NO_x control ports. The NO_x port air flow is increased in proportion to the unit load and its setpoint is adjusted based on the steam flow rate to the turbine. This air is used to obtain the correct level of oxygen in the flue gas leaving the boiler. The overfire air ports are normally left closed during firing of the boiler, however, they are opened during boiler purge.

The control loop for the flue gas system is designed primarily to maintain the draft in the furnace at a prescribed constant value slightly below atmospheric pressure. The system is also designed to operate closely with the boiler safety interlock system so as to prevent high negative pressure excursions which can occur, for example, on a master fuel trip (MFT).

The furnace draft control is, basically, a two element system utilizing a feed forward signal from combustion air flow control and measured furnace draft. Three redundant furnace draft transmitters have been provided for comparison and alarm, for auto-hand transfer on deviation, and for manual selection of one primary transmitter for control purposes.

The glycol heating system is controlled via the PCS. The inlet air temperature, after the finned tube air heater, is measured and compared to the setpoint value. If the temperature is below the setpoint, additional steam is admitted to the in-service glycol heater.

4.2.07 Process Area – Turbine Generator and Steam System

Turbine

The purpose of the turbine is to convert the thermodynamic energy, which has been produced by the boiler in the form of high pressure, high temperature steam into mechanical energy, which can be used to drive the generator and generate electricity. It does this by allowing the steam to expand in a controlled fashion through a series of thirty-five stages of turbine blading, causing the rotor to turn and finally exhausting it under vacuum conditions to a condenser, where it is condensed and recycled to the boiler. A functional schematic of the turbine systems flow is shown in Figure 4-11.

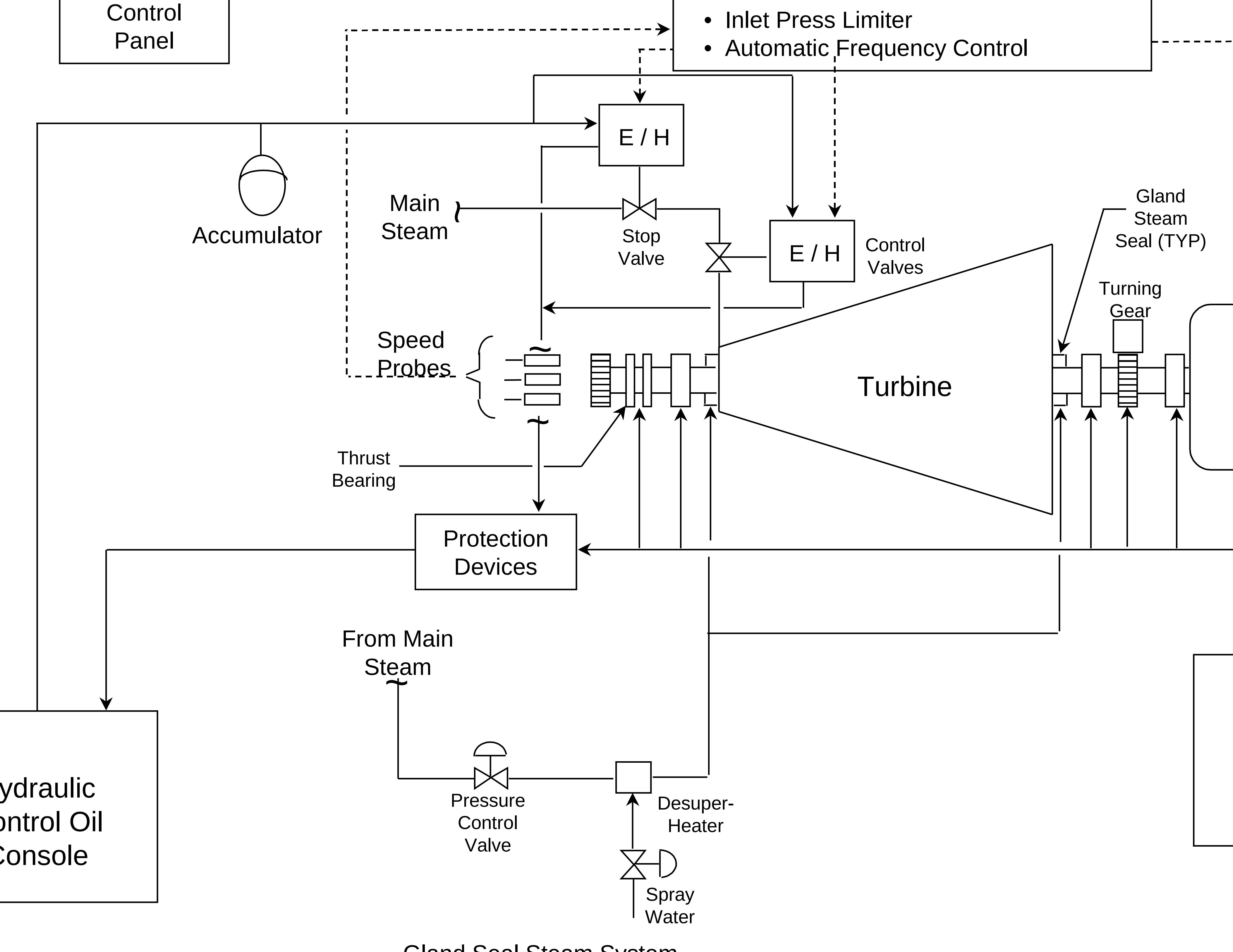
The turbine receives steam from the boiler superheater outlet header at a nominal pressure of 1250 psig and a temperature of 950°F. The steam passes through the main stop valve and three governor control valves, into the turbine first stage inlet (or wheel chamber). From there it expands through thirty-five stages of turbine rotating and stationary blades and then exhausts into the condenser, which is maintained at approximately 1.5 in. Hg absolute pressure. In doing so, it generates a rated shaft output power of 61,940 KW.

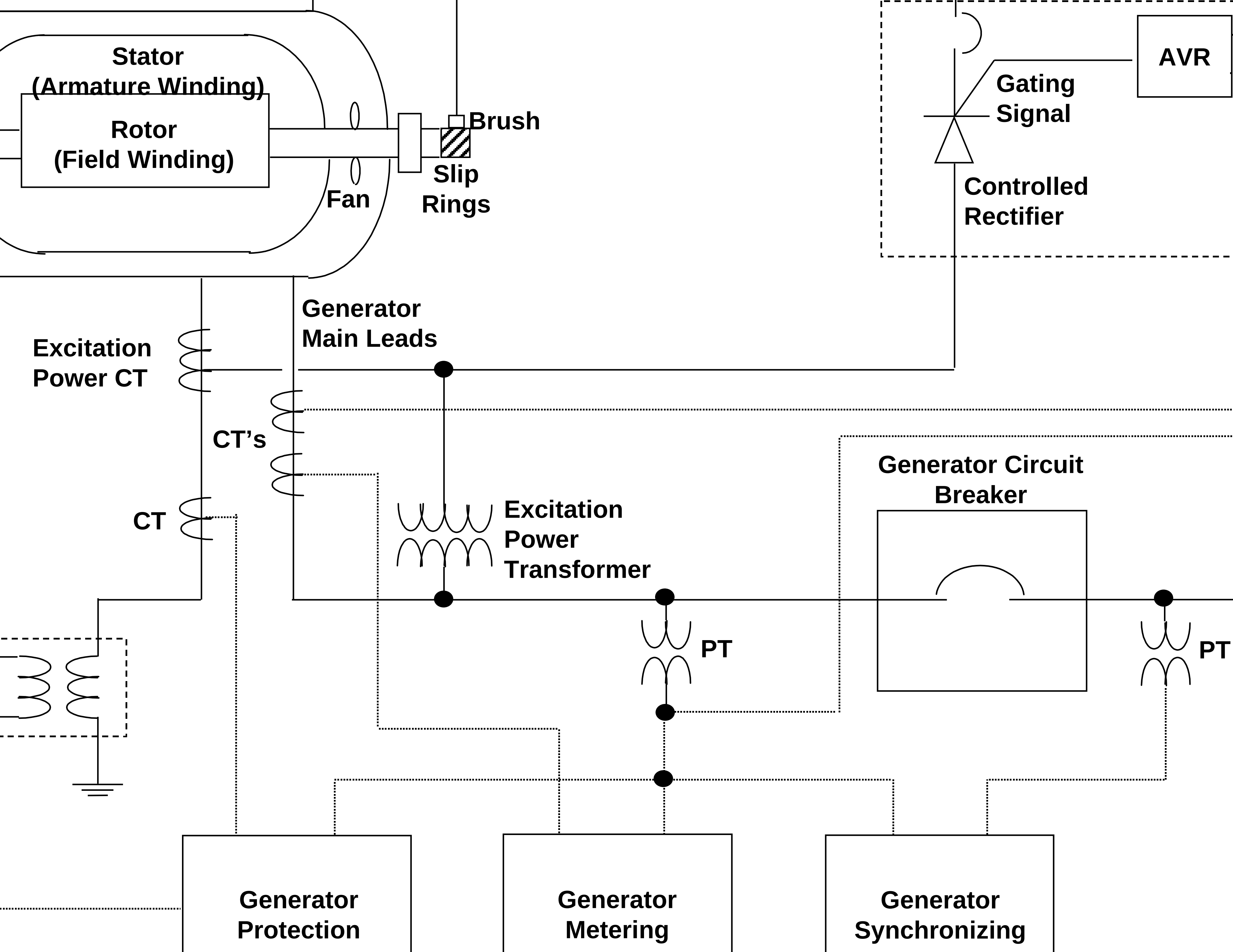
Generator

The purpose of the generator is to convert the mechanical energy produced by the turbine into electrical energy, which can be sent over the transmission system grid to the various points where it is used. It does this by causing a magnetic field which is generated by windings on the rotor, to move through the windings on the stator as it rotates. This causes a current to be generated at the stator winding terminals. A functional schematic of the generator systems flow is shown in Figure 4-12.

The generator excitation system supplies and controls the current to the generator field windings. The generator air cooling system removes the heat which is generated in both the stator and rotor windings. The generator metering system measures and records the electrical output from the generator. The generator protection system trips the generator off-line when a short circuit or other type of electrical fault is detected. The generator synchronizing system is used for safely connecting the generator to the transmission line and the generator neutral grounding system provides a stable reference for the generator voltages and provides ground fault current limiting and detection.

The generator is coupled to the end of the turbine shaft and converts the mechanical power output from the turbine into electrical energy, which is transmitted out into the electrical transmission grid. The generator consists of a rotating field winding, which produces a rotating magnetic field and a stator or armature winding, which generates an electrical current due to this moving magnetic field which passes through it.


Control Panel
Inlet Press Limiter
Automatic Frequency Control
E / H
Accumulator
Main Steam
Stop Valve
E / H
Control Valves
Gland Steam Seal (TYP)
Turning Gear
Speed Probes
Turbine
Thrust Bearing
Protection Devices
From Main Steam
Pressure Control Valve
Desuper-Heater
Spray Water


Stator
(Armature Winding)
Rotor
(Field Winding)
Fan
Brush
Slip
Rings
AVR
Gating
Signal
Controlled
Rectifier
Generator
Main Leads
Excitation
Power CT
CT's
CT
Excitation
Power
Transformer
Generator Circuit
Breaker
PT
PT
Generator
Protection
Generator
Metering
Generator
Synchronizing

Control Description

Turbine Control

The turbine control system provides a feedback regulating mechanism for the steam governing valves, which is based on either turbine speed or generator load, depending on which operating mode the turbine is in. During initial rolling and warm up of the turbine, the valves are controlled to maintain a set turbine speed. The turbine speed is measured by three (triple redundant) proximity type speed probes, which count the passage of teeth on a toothed wheel mounted on the turbine shaft. These signals are sent to the speed control portion of the electronic control system where they are compared to a speed setpoint, which is set by the operator at the turbine generator control panel insert. The steam valves are then adjusted, as necessary, to maintain the proper speed.

After the generator has been synchronized to the transmission line, its speed is, more or less, fixed by the frequency of the line. At this time, the turbine control system switches to the load control mode. In this mode, the megawatt output of the generator is measured by a transducer and then compared to a load setpoint, which is set by the operator. The steam governor valves are then opened or closed, as necessary, to maintain the desired load.

Generator Control

Generator control is provided through the Automatic Voltage Regulation (AVR) system, which is part of the Fuji turbine control system. The AVR provides a feedback control mechanism for regulating the amount of current supplied to the generator field winding. It is based primarily on the measured generator terminal voltage, but under load conditions the control signal is modified by the amount of reactive current being supplied. A certain level of droop is introduced in the terminal voltage based on the amount of reactive current that the generator is supplying. This is done in order to reach a balance point, where all of the generators on the system will share the reactive power load.

The AVR system is also provided with a manual operating mode. This allows the operator to directly adjust the amount of field current to a desired point and will maintain it there, independent of changes in the terminal voltage. This mode is normally not used; however, the AVR will be automatically switched to this mode under certain upset conditions, in order to stabilize the field current and voltage. The setpoints of the two regulator modes track each other, in order to allow bumpless transfer.

Steam

The main steam system provides a method of connecting the boiler superheater outlet with the turbine inlet trip valve. It is, also, the source of steam for the steam jet air ejectors and the turbine steam seal systems. The steam jet air ejectors remove air from the condenser. Refer to Figure 4-2 for a diagram of Steam flow from the combustors to the turbine.

The main steam system is the pipe from the superheater outlet to the turbine stop valve inlet. The pipe is an alloy with 1.25% chrome to reduce wear and withstand the 900°F steam temperature. It has several branches to supply steam to associated systems. One branch provides steam to a pressure reducing valve in the air removal system, which in turn provides steam to the steam jet air ejectors and the steam seal systems. Another branch drains water from the piping during warm-up periods and is equipped with a air diaphragm operated drain valve. A third branch provides steam sampling. The steam jet air ejectors remove air from the condenser by use of a series of two steam eduction jets, with condensers after each jet. The steam jet system is capable of producing 1.5 in. Hg, vacuum, with a 300 psi steam source.

Control Description

There is no control associated with the main steam system other than the pressure reducing valve which supplies 300 psi steam to the air removal system and the turbine steam seal system. The boiler and turbine load control systems in the plant control system (PCS) utilize the main steam pressure as a control variable to help set the firing rate of the boiler and the control valve position for the turbine.

Extraction Steam

The extraction steam system is the collection of pipes and valves that join the steam turbine extraction nozzles with the feedwater heaters. Each of these lines is provided with a motor operated valve and at least one non-return power operated check valve. These protect the turbine from water induction, in the case of a flooded heater, and from overspeed due to reverse flow of flashing steam in the heater after a turbine trip. Drain line branches are provided to remove any water accumulation. The number three extraction line to the deaerator has two non-return check valves for extra turbine protection from overspeed accidents.

The extraction steam system is controlled through the PCS. Logic is provided to automatically open the extraction steam motor operated valve when turbine load is adequate for service. Isolation valves for heaters 2, 3, 4 and 5 are opened when a 25% load is attained. The isolation valve for heater 1 is not opened until a load of 50% is reached. Besides the turbine load, feedwater heaters must not have high levels and the turbine can not be in a tripped position prior to opening the extraction isolation valves. Heaters will be removed from service and isolation valves closed if individual heater water levels become high, the turbine is tripped or the turbine load is reduced below 25% (or 50% in the case of heater 1). In addition to these controls, the power operated non-return valves are forced closed on high feedwater heater level or turbine trip. They are left free to open when the turbine is reset and the heater levels are normal.

4.2.08 Process Area - Condensate and Feedwater System

Condensate System

The condensate system collects the exhaust vapor from the steam turbine, condenses it to water and returns this water to the boiler via the boiler feedwater system as part of the regenerative cycle. In addition to this basic function, the HCCP condensate system provides cooling for the main generator, steam jet air ejector, gland steam condenser, precombustors swirl dampers and dipper skirts. A functional schematic of the condensate system is shown in Figures 4-13 and 4-14. Figure 4-14-1 is a basic feedwater system flow diagram.

There are several control functions associated with the condensate system. The two primary control loops are the hotwell level control and the deaerator level control. Both the deaerator level control and the hotwell level control draw water from the discharge of the condensate pumps and have been tuned in conjunction with each other.

Feedwater System

The purpose of the feedwater system is to provide the necessary pressure to supply water to the boiler and, concurrently, also provide additional regenerative heating through the high pressure feedwater heaters. The feedwater flow path starts with condensate which flows from the deaerator to the suction of the boiler feedwater pumps. From this point, the feedwater is pumped forward through two feedwater heaters to the economizer. In addition, the feedwater system provides high pressure condensate to control the main steam temperature.

The boiler feed pumps are configured to operate in conjunction with the discharge motor operated valve. The valve first partially opens on starting the initial pump to ensure the piping system is not surged. After a time delay to fill the feedwater piping and heaters, the motor operated valve will completely open. When the boiler feed pump is shut off, the motor operated valve closes to approximately five percent. The pump is then stopped and the motor operated valve closes completely. These valve operations are controlled by the plant control system (PCS).

FIGURE 4-13, SHEET 1
BASIC CONDENSATE SYSTEM FLOW DIAGRAM

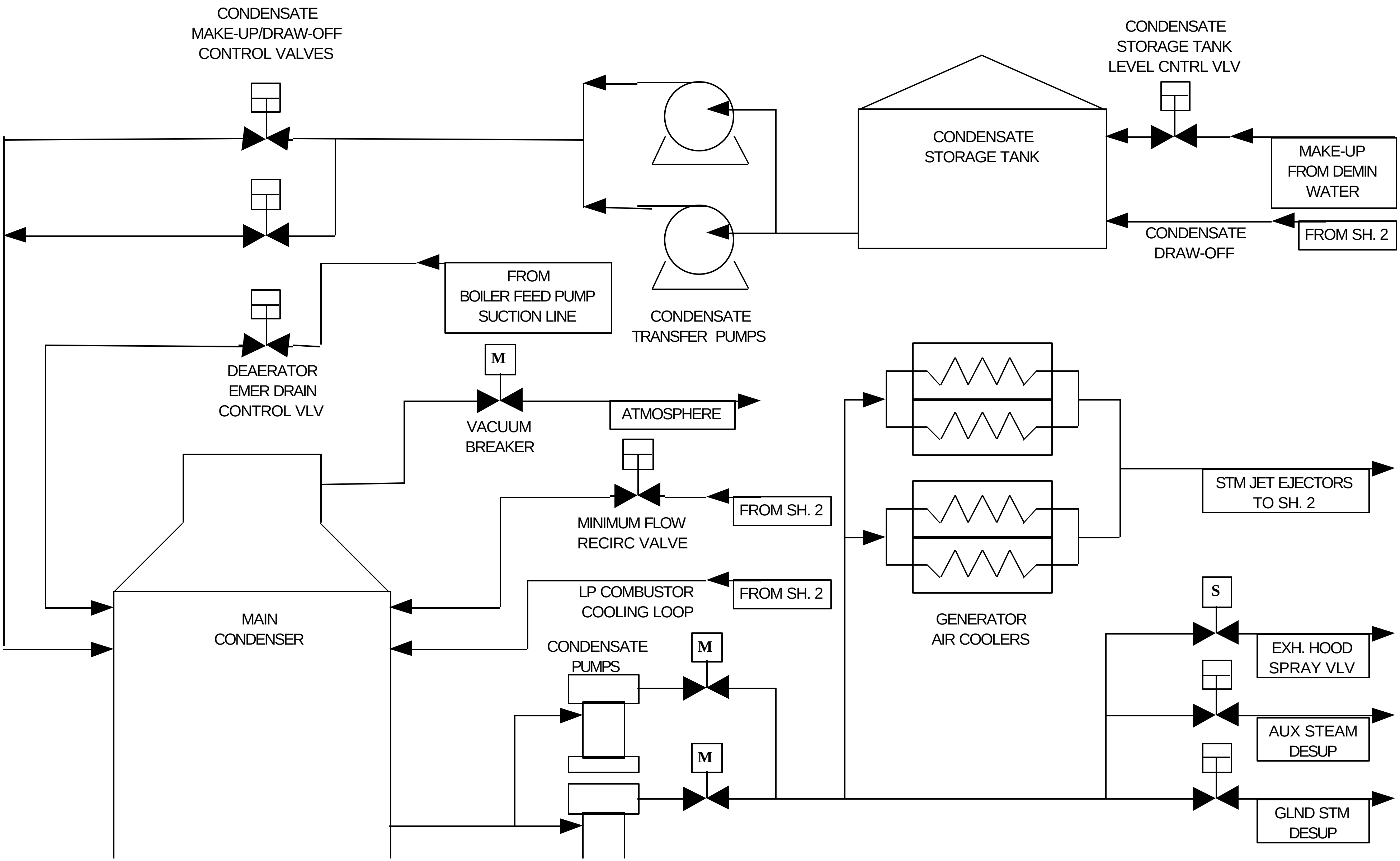


FIGURE 4-14, SHEET 2
BASIC CONDENSATE SYSTEM FLOW DIAGRAM

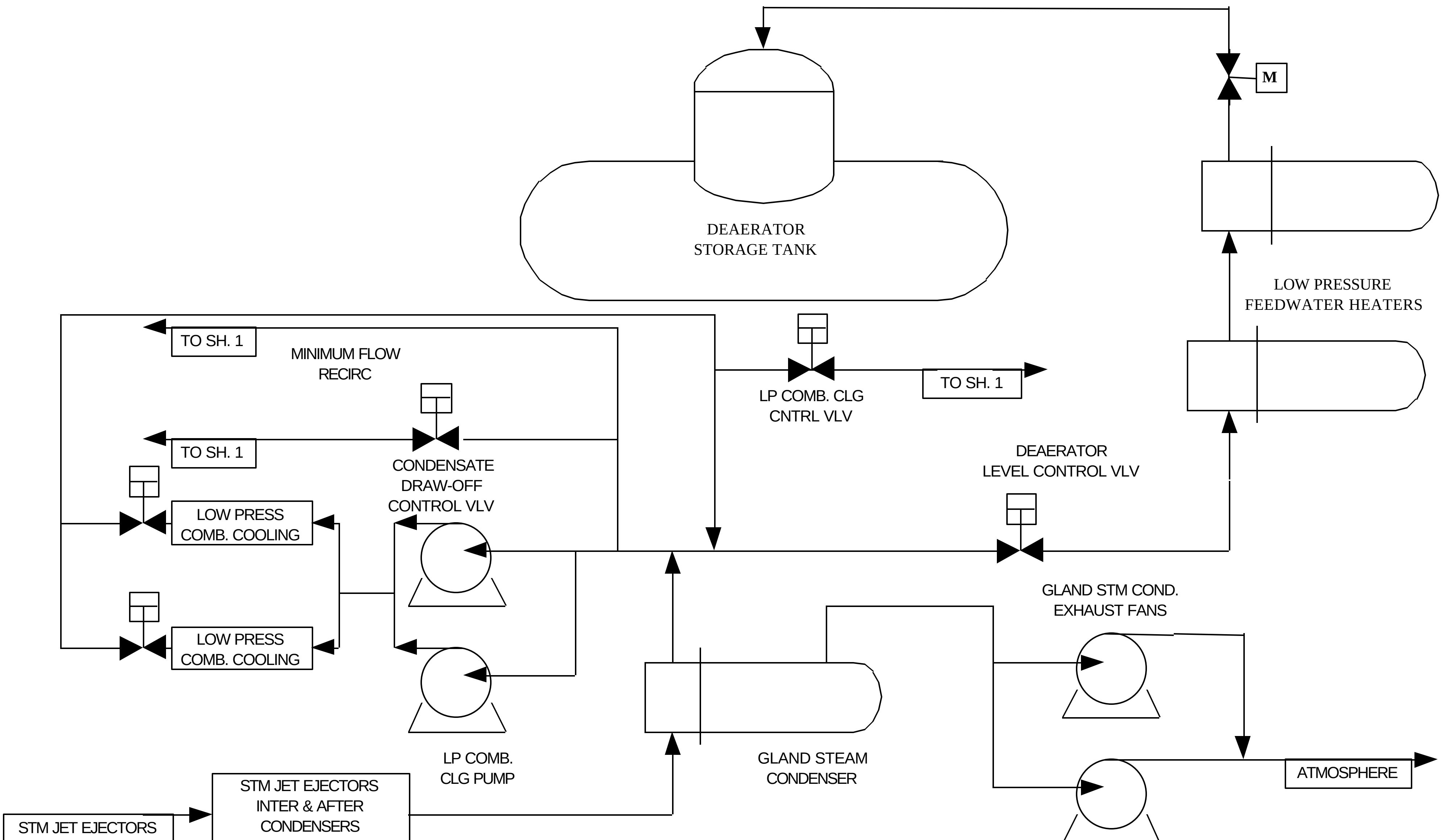
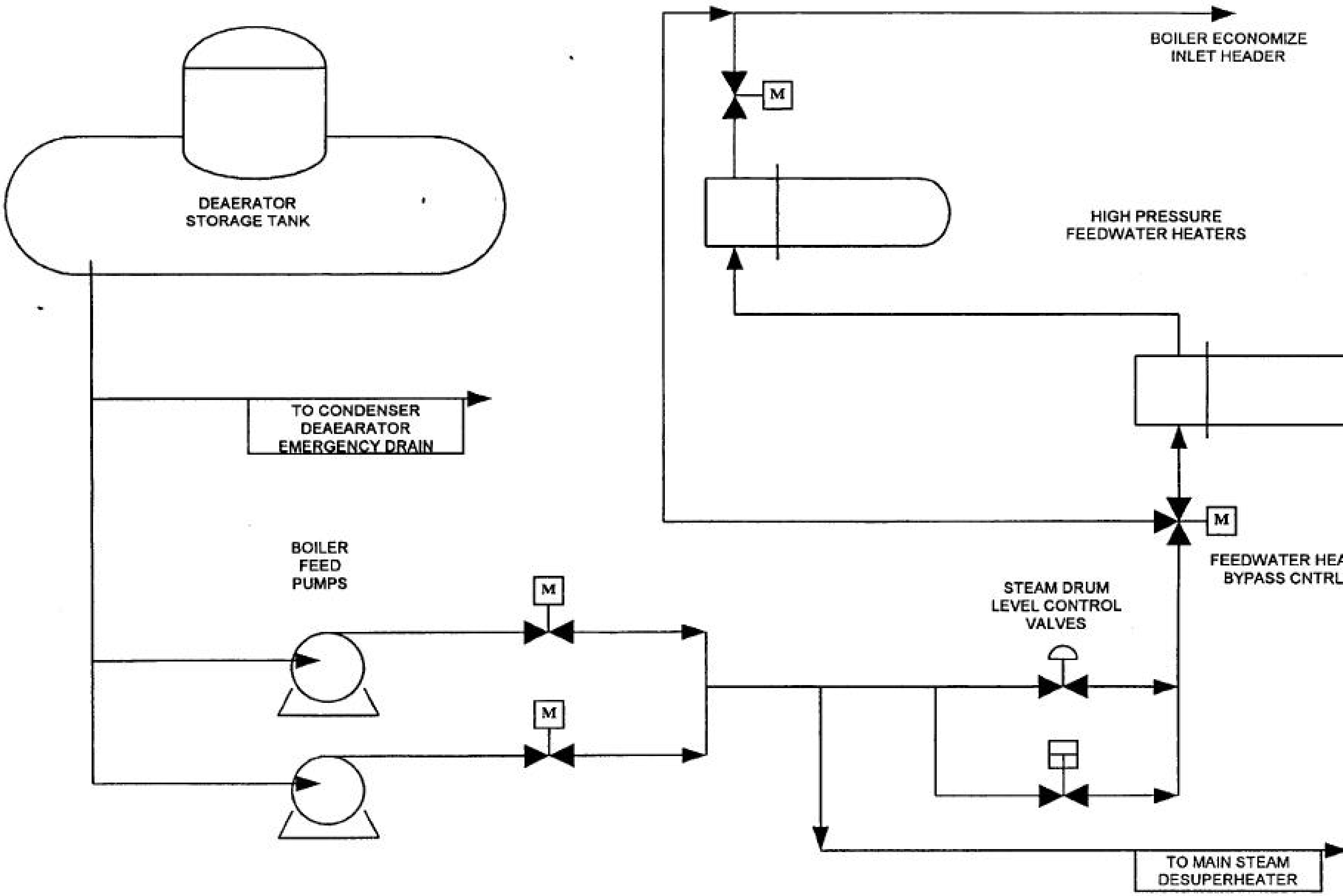


FIGURE 4-14-1
BASIC FEEDWATER SYSTEM FLOW DIAGRAM



4.2.09 Process Area - Circulating Water System

Circulating Water System

The purpose of the circulating water system is to dissipate heat from the HCCP turbine cycle, component cooling water heat exchangers, and the ash water heat exchangers. The once-through system takes in cold water from the Nenana River and discharges the heated water back into the river. A functional schematic of the circulating system is shown in Figure 4-15.

Water is pumped from the intake structure through the main condenser and the cooling water/ash water heat exchangers to return to the river. The system contains two 50% pumps which operate together and are located in the intake structure building.

The circulating water system is controlled from the plant control system (PCS). Various manual valves are used in the circulating water system to control river discharge, recirculation lines and freeze protection measures. These valves are set by the operator and no position indication is provided at the PCS. The circulating water pumps are started and stopped manually through the PCS.

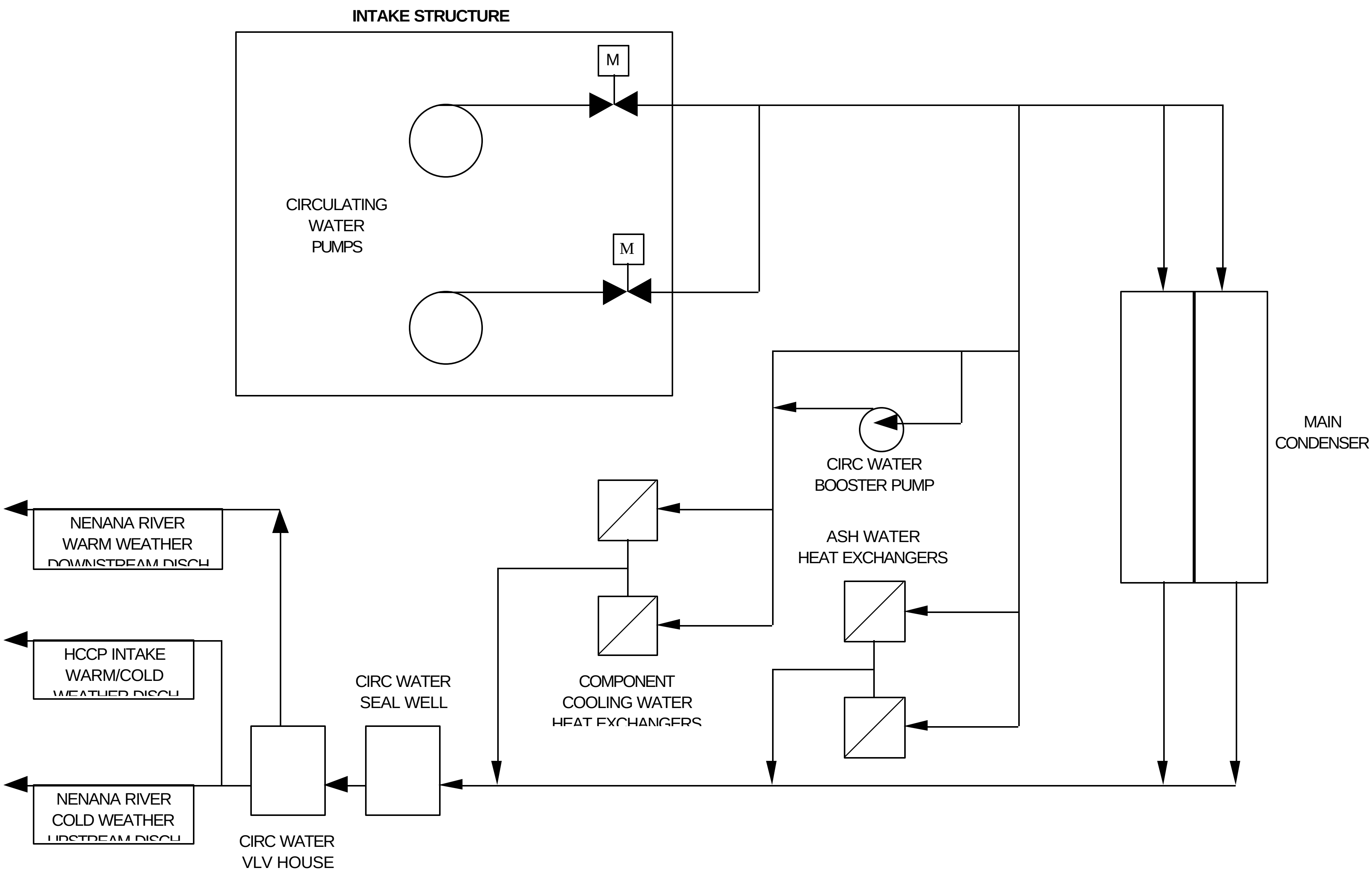
Component Cooling Water System

The purpose of the component cooling water system is to provide an interface system between the circulating water system and various heat sources within the facility. By use of an interface system, many heat exchangers can be kept free of silt and other contaminates in the circulating water system.

Water is pumped by the component cooling water pumps to circulating water heat exchangers and then through a closed loop system to each of the heat sources. The system is provided with a head tank (to provide the net positive suction head required for the pumps), two 100% pumps, a chemical mixing tank, temperature control valve and pressure control valve. The water in the system will be maintained with a corrosion inhibitor residual to reduce or prevent corrosion. Water is made up to the system from the condensate system.

The component cooling water system is controlled from the plant control system (PCS). The PCS provides the control function and monitoring for component cooling equipment.
The component cooling water pumps are 100% capacity controlled from the PCS, with one operating and one on standby. Component cooling water is pumped through a PCS controlled three-way temperature control valve. The PCS monitors the heat exchanger discharge temperature and, as more cooling is needed, the valve directs more flow through the heat exchangers to be cooled by the circulating water.

FIGURE 4-15
BASIC CIRCULATING WATER SYSTEM FLOW DIAGRAM



4.2.010 Process Area - Water and Wastewater Treatment System

The purpose of the water treatment system is to provide the necessary quality water for the various plant water uses and minimize the amount of water that must be disposed of. It consists of four basic systems, each with different water quality requirements. These are:

- Domestic Water - this system provides filtration and chlorination of the well water for domestic use in the plant
- Demineralized Water - this system provides filtration and removal of mineral salts from the well water for use as boiler makeup water.
- Waste Water - this system provides basic filtration and/or pH neutralization of various plant waste water streams to allow reuse of the water, primarily in the ash handling and flue gas desulfurization systems.
- Boiler Water Sampling and Chemical Feed - this system monitors the quality of the steam and water in the boiler/turbine cycle and adds chemicals, as necessary, for oxygen removal and corrosion inhibiting

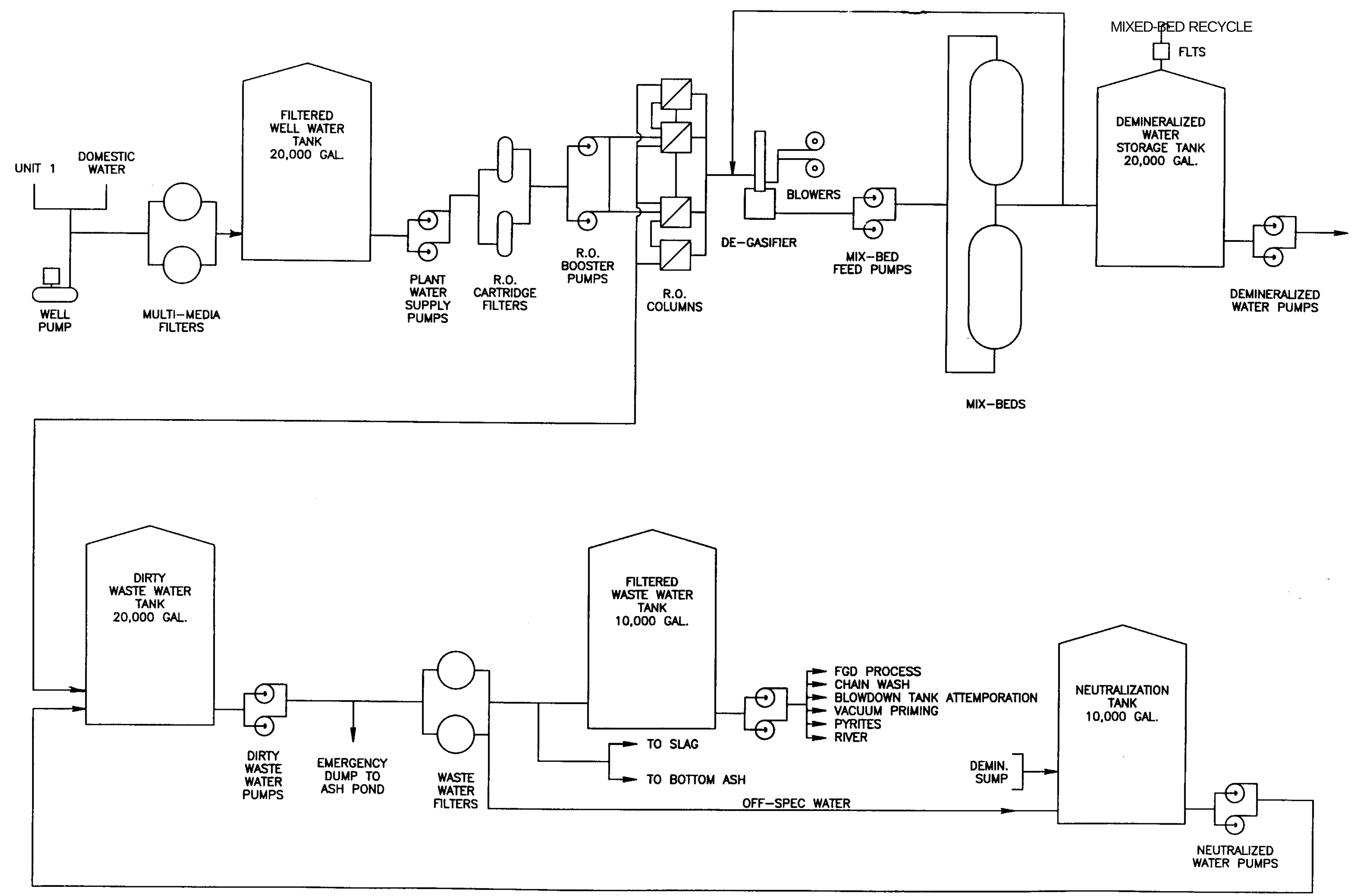
A functional schematic of the demineralized water and wastewater system is shown in Figure 4-16.

HCCP is a zero discharge facility, consequently the water treatment equipment is designed to re-use as much water as possible. The amount of water that must be disposed of is approximately equal to the amount needed to operate the ash disposal and flue gas desulfurization systems, so the normal wastewater streams are reused in these systems.

Control Description

The water treatment system is controlled with an Allen-Bradley PLC 5.60 programmable logic controller (PLC) This device provides the control function and monitoring for all the water treatment systems and subsystems. The water treatment control system (WTCS) interfaces with the plant control system (PCS) for monitoring the control functions. The PCS is able to monitor all of the WTCS parameters and has limited control of some functions. The PCS will not have any functional control unless it is allowed by the PLC permissive switch for a given function.

Figure 4-16 Basic Demineralized & Waste Water Systems



4.2.011 Process Area – Fire Protection System

The HCCP main fire protection system consists of a diesel driven fire pump fed from the Nenana River at the circulating water intake structure, CO_2 bottles, and the piping and equipment to distribute water or CO_2 to the areas protected from fire. A functional schematic of the main fire protection system is shown in Figure 4-17.

The purpose of the main fire protection system is to automatically detect and extinguish fires at the various equipment and areas throughout the plant, as well as, provide manual extinguishing apparatus at selected locations.

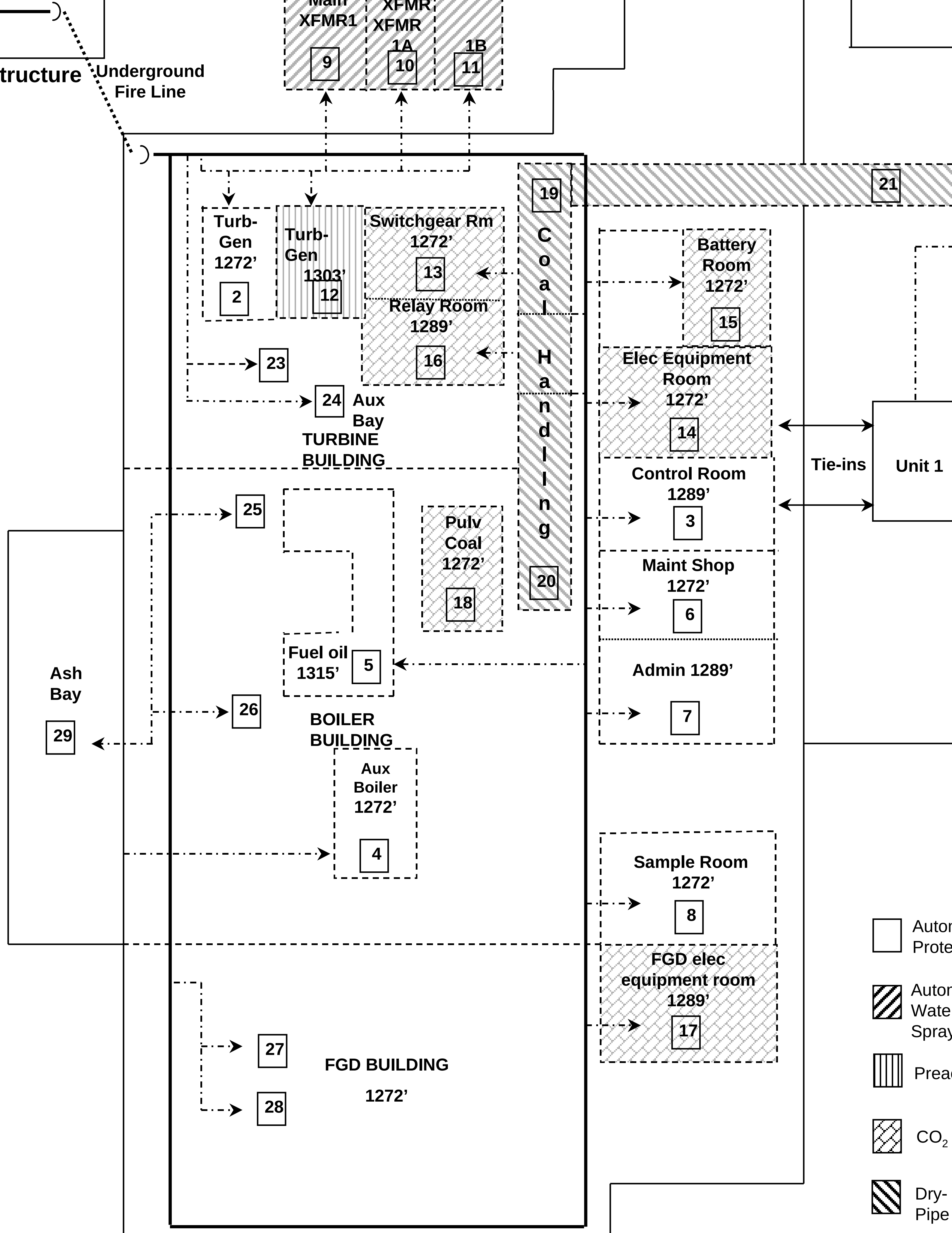
The firewater pumps receive water from the circulating water intake structure and delivering it to the main fire line, a pressurized header forming a loop around the perimeter of the HCCP power plant. This loop is tied into the Unit No. 1 powerhouse main fire loop, so that, each unit may be pressurized from its own fire water pumps or the other unit's fire water pumps. There are various types of coverage for each of the zones. Some zones utilize water and some use CO_2, as the fire extinguishing medium.

Fire Protection Control Panel

A main fire protection control panel (FPCP) for alarm and monitoring of all HCCP fire protection systems and fire pump operation is provided in the main control room. This panel is provided with an output to the plant control system (PCS), which is a general fire alarm contact for PCS alarming and logging. Two additional contact closures for the manual initiation of the coal feed system CO_2 inerting system are provided. These come from push buttons on the FPCP. The signal is sent to the local coal feed system CO_2 fire panel.

Fire Pump Controls

The diesel fire pump is provided with all necessary control and alarm functions for its operation. Most of the controls are located within a UL listed and controller.


Main XFMR1
9
XFMR XFMR 1A
10
1B
11
tructure
Underground Fire Line
19
21
Coal Handling
20
Turb-Gen 1272'
2
Turb-Gen 1303'
12
Switchgear Rm 1272'
13
Relay Room 1289'
16
Battery Room 1272'
15
Elec Equipment Room 1272'
14
23
24
Aux Bay
TURBINE BUILDING
Tie-ins
Unit 1
Control Room 1289'
3
25
Pulv Coal 1272'
18
Maint Shop 1272'
6
Fuel oil 1315'
5
Admin 1289'
7
Ash Bay
29
26
BOILER BUILDING
Aux Boiler 1272'
4
Sample Room 1272'
8
FGD elec equipment room 1289'
17
27
28
FGD BUILDING
1272'
Auton Prote
Auton Wate Spray
Prea
CO_2
Dry-Pipe

4.3.012 Process Area – Plant Controls System

The purpose of the plant control system (PCS) is to provide a reliable and flexible means of controlling and monitoring all of the various plant systems and equipment from a centralized location in the plant control room. It provides the control room operator with both overview and detailed information on the status of the plant from graphic type CRT consoles and allows the operator to start or stop equipment and adjust operating setpoints from these same consoles. It also performs continuous automatic regulation of pressures, temperatures, levels, flow rates, etc., in the various plant systems and provides automated startup or shut down sequences and automatic starting of standby equipment.

Other functions performed by the PCS include:

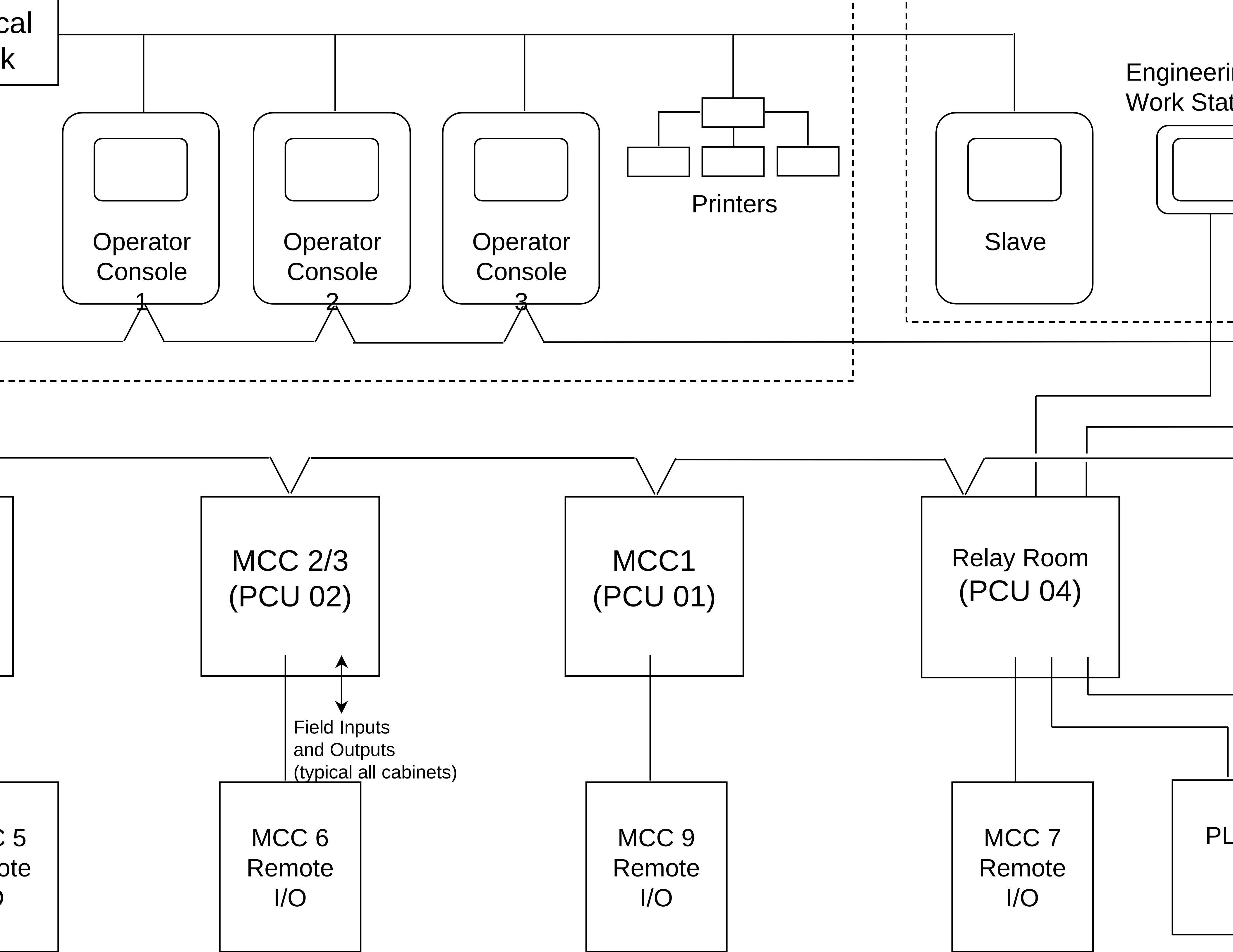
- Trending and historical recording of important plant process variables
- Generating alarms to alert operators of abnormal or dangerous operating conditions
- Producing logs and reports of process conditions, events and operator actions
- Executing on-line performance and heat rate calculations for the major process equipment
- Producing time sequence of event logs during plant trip situations to help diagnose the cause of the trip
- Providing communication interfaces to vendor furnished subsystems having their own stand alone programmable controllers (PLC)
- Performing self diagnostic and trouble shooting routines to assist in maintenance

The plant control system interfaces with the instrumentation and control devices of virtually all of the other plant systems. A functional schematic of the control system is shown in Figure 4-18.

The plant control system is a microprocessor-based distributed control system provided by Bailey Controls which has local process control units (PCU) located at strategic locations throughout the plant. Each of these local processing units contains one or more multifunction processors (MFP). The MFP's are the brains of the systems and perform all of the control strategy and data processing functions. The MFP's are supported by a variety of other types of processing modules which perform specialized functions such as field input and output signal processing and communications with other processors.

The system also has three main graphic CRT type operator interface stations (OIS) located in the main control room and a slave OIS located in the engineering work room. These stations also contain processors which perform such functions as generating graphic displays for the CRT screens, managing and updating the real time process variable data base and storing and retrieving historical data such as trends and logs.

The plant performance computer is a separate DEC VAX computer connected to the data highway through an interface module. This computer utilizes a software package called open data management server (ODMS) to continuously collect data from the control system and store it in a database which can then be accessed by a variety of different performance calculations, emissions calculations or data trending and reporting programs. After a thirty-day period, the data is transferred onto a tape storage unit for archiving purposes.



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MCC 7
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4.2.013 Process Area – Electrical System

The purpose of the HCCP electrical distribution system is to transmit electric power from the generator to the GVEA transmission line system and to provide electrical power (station power) for the auxiliary equipment of the power station. This power is obtained from a point located between the generator breaker and the main transformer at 13.8kV. Two step-down auxiliary transformers (13.8kV to 4.16kV) of 14 MVA capacity feed the heart of the distribution system. A functional schematic of the electrical station power system is shown in Figure 4-19.

The electrical distribution is logically subdivided into voltage-based subsystems. The high voltage system consists of 138kV equipment. The medium voltage system consists of 13.8kV and 4.16kV equipment. The low voltage system consists of 480/277 V, 208/120V, and 240/120V equipment.

The 138kV equipment includes the new HCCP bay in the Healy substation, the overhead line to the power house and the main transformer. This equipment provides HCCP's connection to the GVEA transmission system, stepping the generator output voltage up to the system voltage. The 13.8kV and 4.16kV equipment includes the generator breaker 13.8kV switchgear, the auxiliary transformers and the 4.16kV switchgear. This equipment provides the first level of distribution and connection of the generator to the 13.8kV distribution. The low voltage equipment includes the load centers, motor control centers and power panels. This equipment provides the second, third and fourth level of power distribution to the auxiliary equipment in the plant.

Control Description

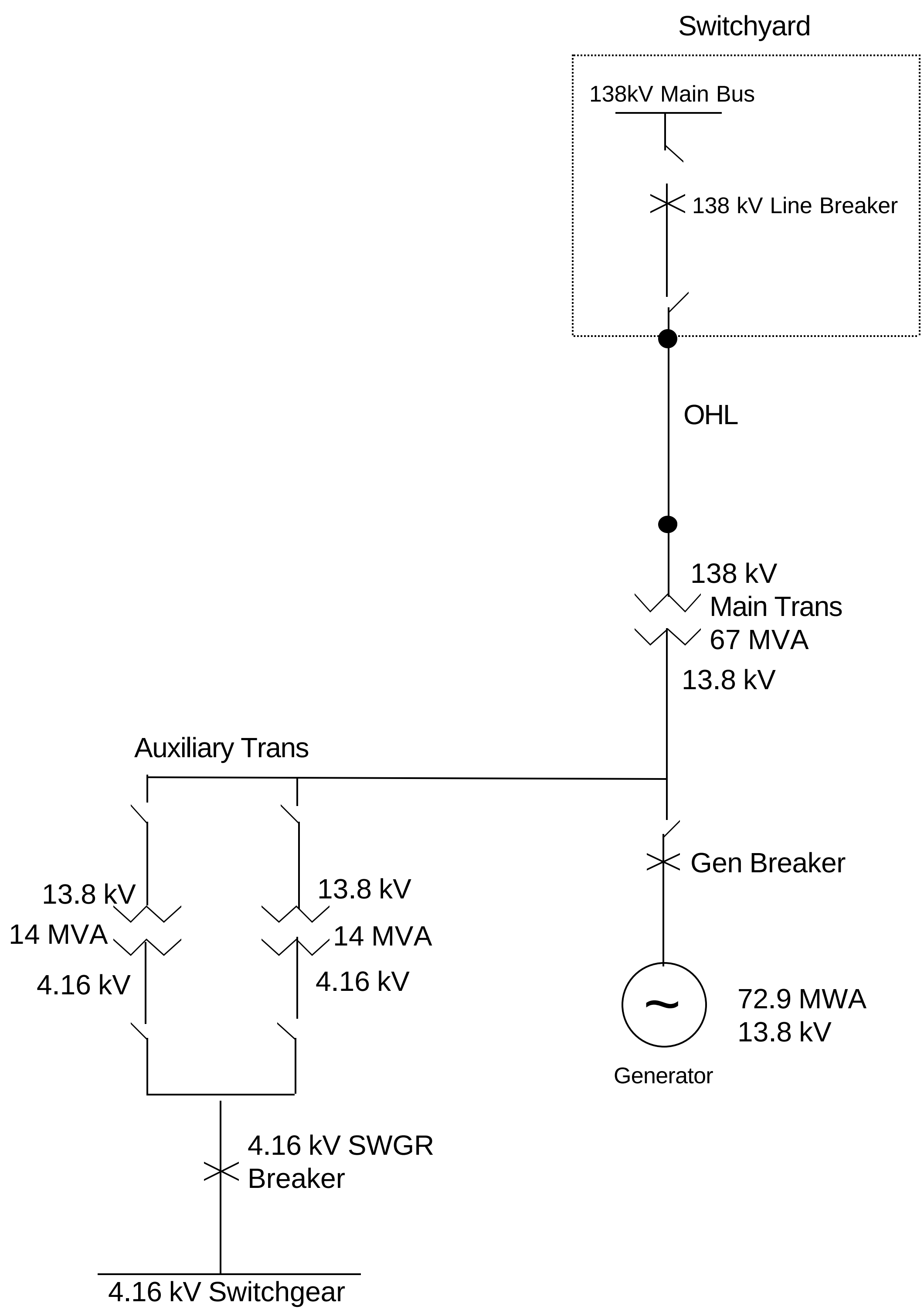
The components of the electrical distribution system are controlled both locally and remotely, as well as, manually and automatically. However, control action is infrequently performed on this equipment. The distribution system is static, being continuously energized unless de-energized deliberately for lock-out or tag-out, or automatically for protection.

The 138kV line breaker is controlled locally at the control cabinet in the switchyard or remotely by either the control room operator, the system dispatcher or a protective relay. GVEA system operations operating protocol requires that the breaker be primarily operated by dispatch, unless breaker tripping urgency dictates action by the control room operator.

The main and auxiliary transformers have no control features. They do, however, have several monitoring devices (and adjustable secondary no load tap changers). The monitoring devices supervise the condition of the transformers and provide alarms and trips as required.

The generator breaker switchgear connects and disconnects the generator from the 13.8kV distribution system. The control of this breaker is performed remotely by the control room operator or by protective relay.

Figure 4-19 -- Diagram of Station Power



4.2.013 Process Area – Balance of Plant

This section contains an overview of the important building and balance of plant systems not previously addressed in the prior sections.

HVAC System

There are three basic plant areas which have different design uses and, therefore, different HVAC requirements. These areas are:

- Main control room, administration and office area, locker room area, electrical and instrument shops, and relay and electrical switchgear rooms
- Boiler, turbine generator, SDA, ash silo, and water treatment areas
- Miscellaneous isolated or outlying areas such as, intake structure enclosure, stack sampling enclosure, circulating water valve house, and feeder breaker enclosure

The first set of areas are intended for continuous occupancy and/or have temperature sensitive equipment. These areas are provided with a central air handling system with heating, ventilating, air conditioning, and humidity controls, to maintain relatively constant temperatures year-round.

The second set of areas are intended for operating equipment and occasional occupancy. These areas are provided with supply and exhaust fans, for continuous ventilation and, with steam unit heaters, to maintain minimum winter- time operating temperatures and to prevent freezing.

The last set of areas are, also, intended for equipment operation and occasional occupancy. Because of their isolated location, they are provided with their own ventilation fans and electric unit heaters, for maintaining minimum temperatures.

Domestic Hot Water

The domestic hot water system utilizes cold water from the Unit No. 1 raw water pumps as a water source and passes it through the 865 gallon domestic hot water heater located behind HCCP. The water is heated by steam supplied from HCCP building heating steam flowing through a closed loop tube bundle inside the water heater tank, which returns as condensate to the HCCP building condensate return.

The water in the tank is continuously circulated through the heat exchanger coils, at all times, by a small circulating pump to assure uniform heating.

The temperature of the water in the tank is controlled by a temperature control valve, which regulates the flow of steam to the heating coils based on the measured temperature in the tank. The tank is provided with a relief valve to protect against overheating.

Maintenance Equipment (Cranes & Hoists)

The plant cranes and hoists are located over pieces of heavy plant equipment, which may have to be removed from time to time for service or maintenance work. These cranes provide lift capabilities commensurate with the associated equipment and allow moving of the equipment to a laydown space, where it can either be worked on or removed from the plant via truck or other means.

The cranes are either of the movable bridge type with a traversing trolley for movement in all four directions, or of the fixed rail type with trolley movement in only two directions, depending on the requirements. Also, some of the cranes are electric motor operated, while others are hand operated by chain. The electric operated cranes have a hanging pendant push-button station for operator control of the crane movement.

Plant Security System

The plant security system consists of a motor operated gate at the main plant entrance, which can be used to limit access to the plant. This gate can be activated in two ways. One is via a push button code access unit outside of the gate for normal plant personnel. The second is via a push button station in the main control room, which can be activated by an operator for visitor access.

Plant Lighting System

The plant lighting system is designed to provide each area of the plant with a level of light intensity and reliability commensurate with its usage. In general areas, such as the control room, offices, electronic equipment rooms, labs, and shops, which require close up work or reading, are designed for a lighting level of 80 to 100 foot candles. Other indoor areas generally have 20 to 50 foot candles and outdoor areas, 0.2 to 10 foot candles.

Emergency lighting, powered by either the 125 VDC plant battery or by local battery packs, is provided along all egress routes and at all exits, in accordance with the requirements of the uniform building code (UBC).

4.2.1 Process Flow Diagrams

Figures 4-1 through 4-19 are process flow diagrams for all major systems.

4.2.2 and 4.2.3 Energy and Material Balances

An overall energy and material balance prepared by Stone & Webster Engineering Corporation (Stone & Webster) in March, 1998 is provided in the following pages for 65% waste and 35% ROM coal and 50% waste and 50% ROM coal.

OVERALL HEAT AND MATERIAL BALANCE

HEALY CLEAN COAL PROJECT
HEALY, ALASKA

Alaska Industrial Development
and Export Authority

Prepared by

Stone & Webster

March 1998

CASE 1

65% WASTE / 35% WASTE R.O.M. COAL

Date March 6, 1998
Revision Number 0

Heat and Material Balances for the Healy Clean Coal Project

Alaska Industrial Development and Export Authority

Stone and Webster Engineering Corporation

Contents

Disclaimers

The Heat and Material Balance data presented herein is based on the best available information with regard to systems and equipment purchased for this project. It must be recognized, however, that due to the experimental nature of this project that performance is estimated and can not be guaranteed. Therefore, none of the results presented herein are to be construed as guaranteed values by the Owner and/or Engineer.

The heat balance software, FCYCLE, is used herein and it is licensed for use by Stone and Webster Engineering Corporation (SWEC) on behalf of the Alaska Industrial Development and Export Authority (AIDEA) for the Healy Clean Coal Project (HCCP). This software may not be used by unathorized personnel.

This report was prepared by SWEC solely for the benefit of AIDEA. Neither SWEC nor AIDEA, nor any other person contributing to its input (a) makes any warranty, expressed or implied, with respect to the use of any information or methods disclosed in this report; or (b) assumes any liability with respect to the use of any information or methods disclosed in this report. Any recipient of this report, by their acceptance or reliance on, or use of this report, releases SWEC, AIDEA, and any person contributing to this report from liability for any direct, indirect, consequential or special loss or damage whether arising in contract, tort (including negligence) or otherwise. Any study, report, or information furnished hereunder shall not be used or referred to in connection with offering of securities or other offerings.

General Description of Calculations

This calculation is done using Excel spreadsheets and FCYCLE heat balance software. FCYCLE is used to predict the performance of the power cycle as shown on Figure 1. The Excel 4.0 spreadsheets are used for calculating and depiction of the rest of the mass and energy balances as shown on Figures 2 through 5.

The breaks between the diagrams, Figures 2 through 5, were chosen because they represented what was judged to be the smoothest transition points between the major connecting systems. Subsystems (Ex. FCM Recycle) are included entirely on the respective major system diagrams. Input variables are indicated in bold italics.

FCYCLE must be run separately from the spreadsheets since there is no link possible between these versions of FCYCLE and Excel. The user must be aware of any effects that changing of a variable will have on the FCYCLE results. The items to be aware of are: boiler duty, glycol air heater duty, circulating water temperature and the need for auxiliary steam from Unit 1. Some iteration between FCYCLE and the spreadsheets may be necessary to ensure that the interties between the two have converged to the point where they are judged in agreement by a competent user. This judgement can be made when it can be seen that the small disagreement between intertie values will not make any signifigant difference in the results sought after by the user.

Once the above convergence is satisfied, spreadsheet variables such as coal blend, excess air, air heater outlet temperature, etc. can be input as desired and the result will automatically be displayed on the four diagrams and three tables for presentation.

Note that FCYCLE calculation assumes zero auxiliary power and 100 percent boiler efficiency. These are calculated and applied external to FCYCLE and are presented in Table 1 - Summary of Results.

Case Description: 65% Waste/35% R.O.M. Coal

Table 1: Summary of Results

Gross Turbine Generation	kW	61,885
Estimated Auxiliary Power Use	kW	7,762
Heat to Turbine Cycle	MMBtu/Hr	523.05
Boiler Efficiency	%	78.55
Heat Input from Coal	MMBtu/Hr	665.86
Net Plant Output	kW	54,123
Net Plant Heat Rate	Btu/kWHr	12,303
Coal Consumption	Lb/Hr	99,331
Limestone Consumption	Lb/Hr	1081
Auxiliary Steam Consumption	Lb/Hr	3,250
Consumptive Water Uses	Lb/Hr	50,270
Dry Waste Solids	Lb/Hr	19,922
Water with Waste Soilds	Lb/Hr	16,982
Emissions:		
Sulphur Dioxide	Lb/Hr	57
Oxides of Nitrogen (as NO2)	Lb/Hr	233
Particulates	Lb/Hr	11

Table 2: List of Major Assumptions:

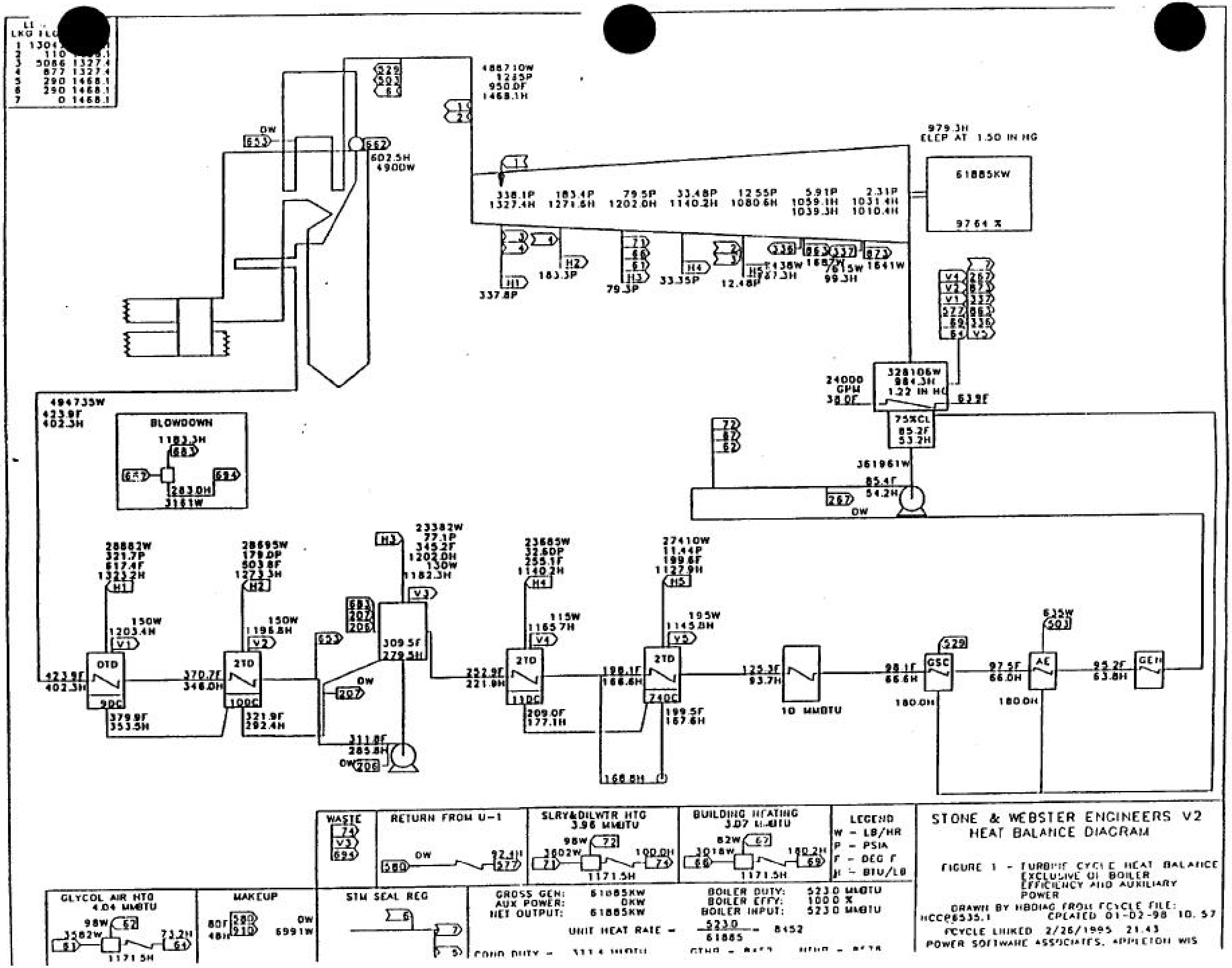
1. Ambient air:	Temperature, F	27.00
	Relative Humidity, %	60.00
2. Circulating water:	Temperature, F	38.00
3. Coal blend:	% Waste	65
	% R.O.M.	35
4. Limestone:	Purity, %	90.00
	Reactive $CaCO_3$, %	80.00
5. Slag recovery:	% of ash in coal to combustors.	70.00
6. NOx (as NO_2):	Lb/MMBtu coal fired.	0.35
7. Coal moisture:	% at the mill outlets.	11.00
8. Flyash:	% recovered from boiler bank hoppers	10
	% recovered from air heater hoppers.	10
	% recovered in SDA/Fabric Filter hoppers	80
9. Sulphur Dioxide:	% overall removal requred	80.00
	% captured in furnace	10.00
	% of remainder removed in FGD system	77.78
10. SDA slurry:	Temperature, F	180.00
	% solids by weight	45
11. SDA Outlet solids:	% routed to Fabric Filter	95
	% routed through bottom hopper	5
12.SDA approach	Temperature, F	30.00
13. Fabric Filter:	Bag Material	Teflon Coated Fiberglass
	Emission guarantee, Lb/MMBtu	0.015
	Approximate % removal efficiency	99.95
14. Ash systems water:	Wt % at Flyash pugmill unloader	15
	Wt % at Drag chains	25
	Wt % at Bottom ash silo	20
15. Sluice for Unit 1 Bottom Ash	Sluice water flow, GPM	000
	Unit 1 bottom ash added, Lb/Hr	0

Table 3: Itemized Auxiliary Power

Medium Voltage Loads Mark No.	Equipment Name	Equipment Unit Load, BHP	Units Operating	Motor Efficiency, Decimal	Power Required, Kilowatts
2FC-FN1A&B	Mill Exhausters	590	2	0.93	947
2FC-PLV1A&B	Coal Pulverizers	319	2	0.93	512
2AP-C1A, B&C	Air Compressors	270	2	0.941	428
2FW-P1A&B	Boiler Feed Pumps	1227	1	0.931	983
2FG-FN1	Induced Draft Fan	1318	1	0.959	1,025
2BW-P1A&B	Boiler Circ Pumps	255	2	0.92	414
2JT-ATZ1	FGD Atomizer	270	1	0.92	219
2BA-FN1	Forced Draft Fan	1870	1	0.963	1,449
2CW-P1A&B	Circulating Water Pumps	218	2	0.92	354
	Subtotal				6,329

Low Voltage Loads					LDC Power in kW
2ED-LDC1	480 v Load Center 1				552
2ED-LDC1	480 v Load Center 1				382
2ED-LDC1	480 v Load Center 1				87
2ED-LDC1	480 v Load Center 1				158
2ED-LDC1	480 v Load Center 1				63
	Subtotal				1,241

		Transformer Losses in kW			
2EE-T1	Main Transformer Losses	160	1		160
2EE-T2	Auxiliary Transformer Losses	31	1		31
	Subtotal	191			191
	Total				7,762


STONE & WEBSTER ENGINEERS V2
HEAT BALANCE DIAGRAM
FIGURE 1 - TURBINE CYCLE HEAT BALANCE EXCLUSIVE OF BOILER EFFICIENCY AND AUXILIARY POWER
DRAWN BY HBDIAG FROM PCYCLE FILE: HCCP6535.1 UPDATED 01-02-98 10.57
PCYCLE LINKED 2/26/1995 21.43
POWER SOFTWARE ASSOCIATES, APPLETON WIS
LEGEND
W - LB/HR
P - PSIA
F - DEG F
H - BTU/LB
GROSS GEN: 61885KW
AUX POWER: 0KW
NET OUTPUT: 61885KW
BOILER DUTY: 523.0 MMBTU
BOILER EFFY: 100.0 %
BOILER INPUT: 523.0 MMBTU
UNIT HEAT RATE = 523.0 / 61885 = 8452
WASTE
RETURN FROM U-1
SLRY&DILWTR HTG 3.96 MMBTU
BUILDING HEATING 3.07 MMBTU
GLYCOL AIR HTG 4.04 MMBTU
MAKEUP
STM SEAL REG
BLOWDOWN
61885KW
97.64 %
979.3H
ELEP AT 1.50 IN HG
488710W
1235P
950.0F
1468.1H
328106W
984.3H
1.22 IN HG
24000 GPM
38.0F
75%CL
85.2F
53.2H
361961W
494735W
423.9F
402.3H
10 MMBTU
GSC
AE
GEN
DTD
2TD

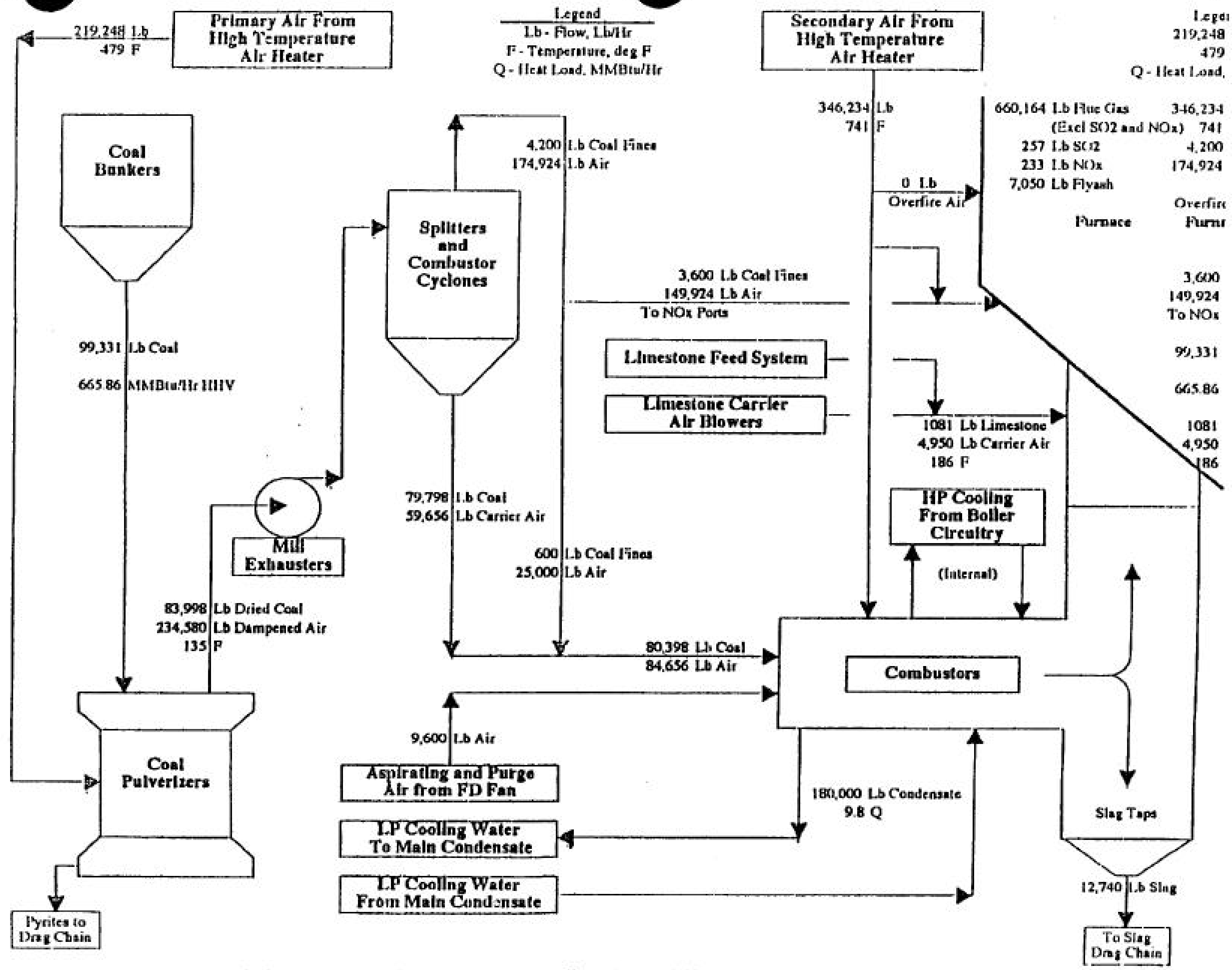


Figure 2 - Combustors, Coal and Limestone Feed

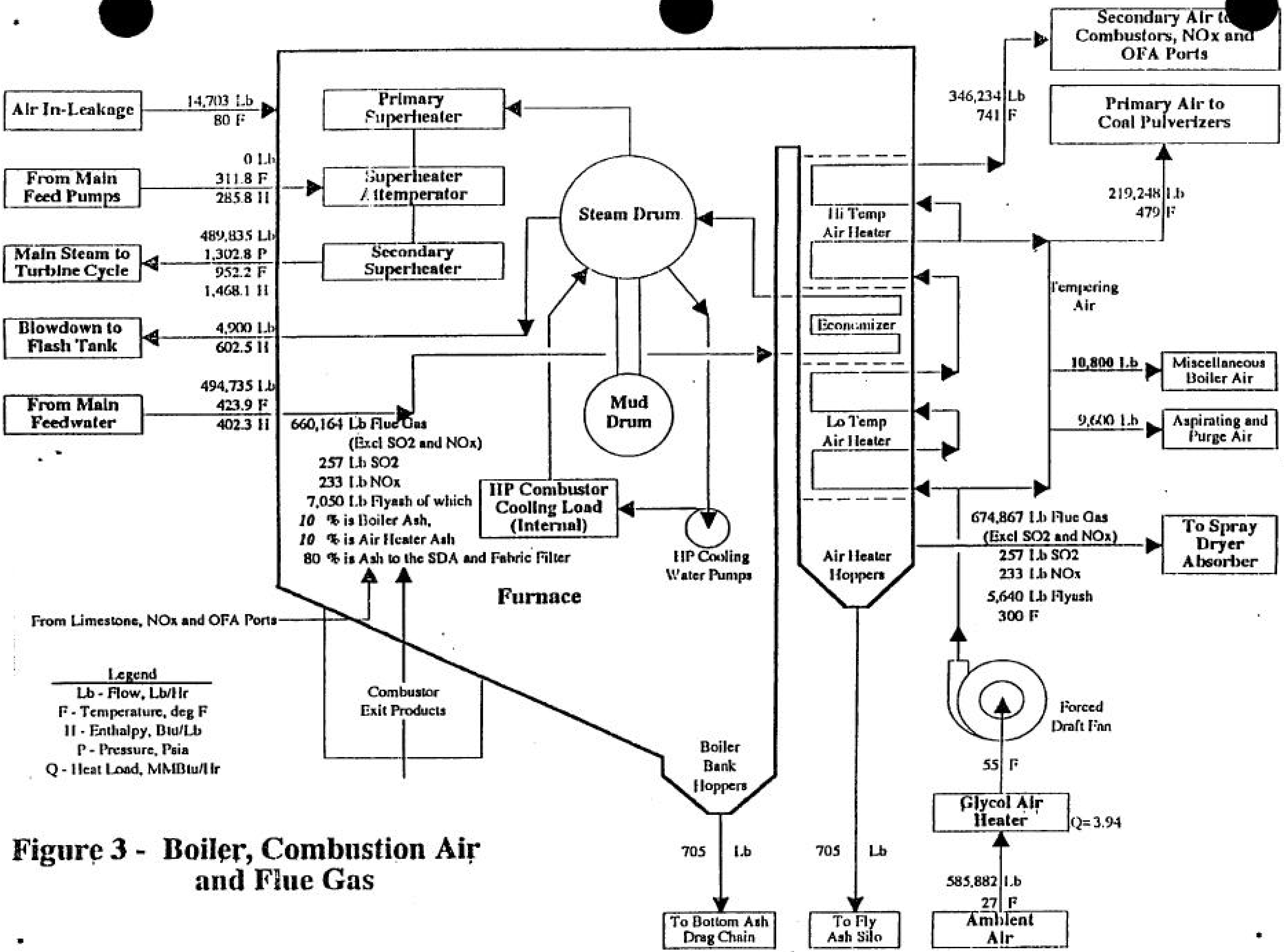


Figure 3 - Boiler, Combustion Air and Flue Gas

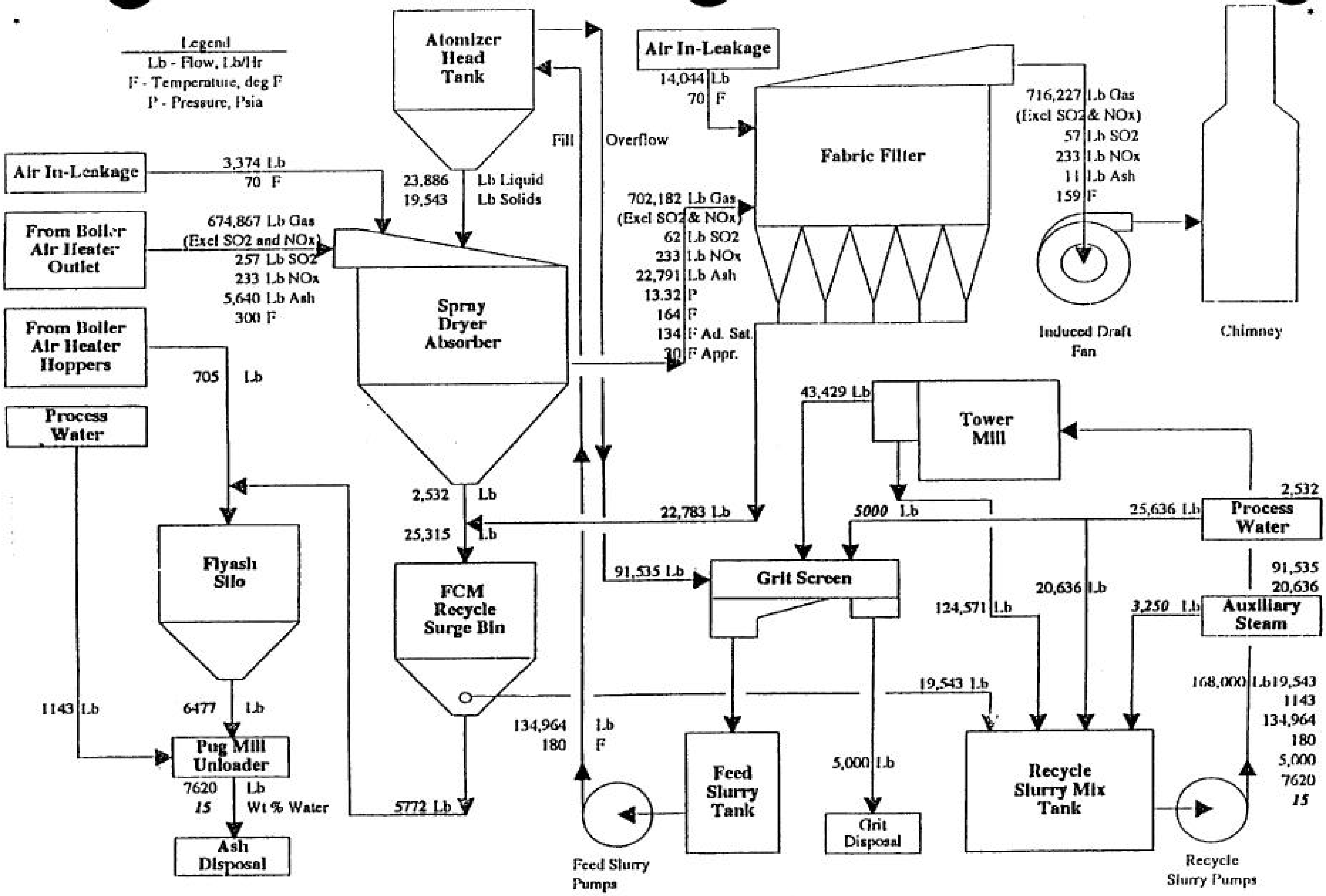


Figure 4 - Flue Gas Desulphurization, Fabric Filter, Flyash and Stack Gas

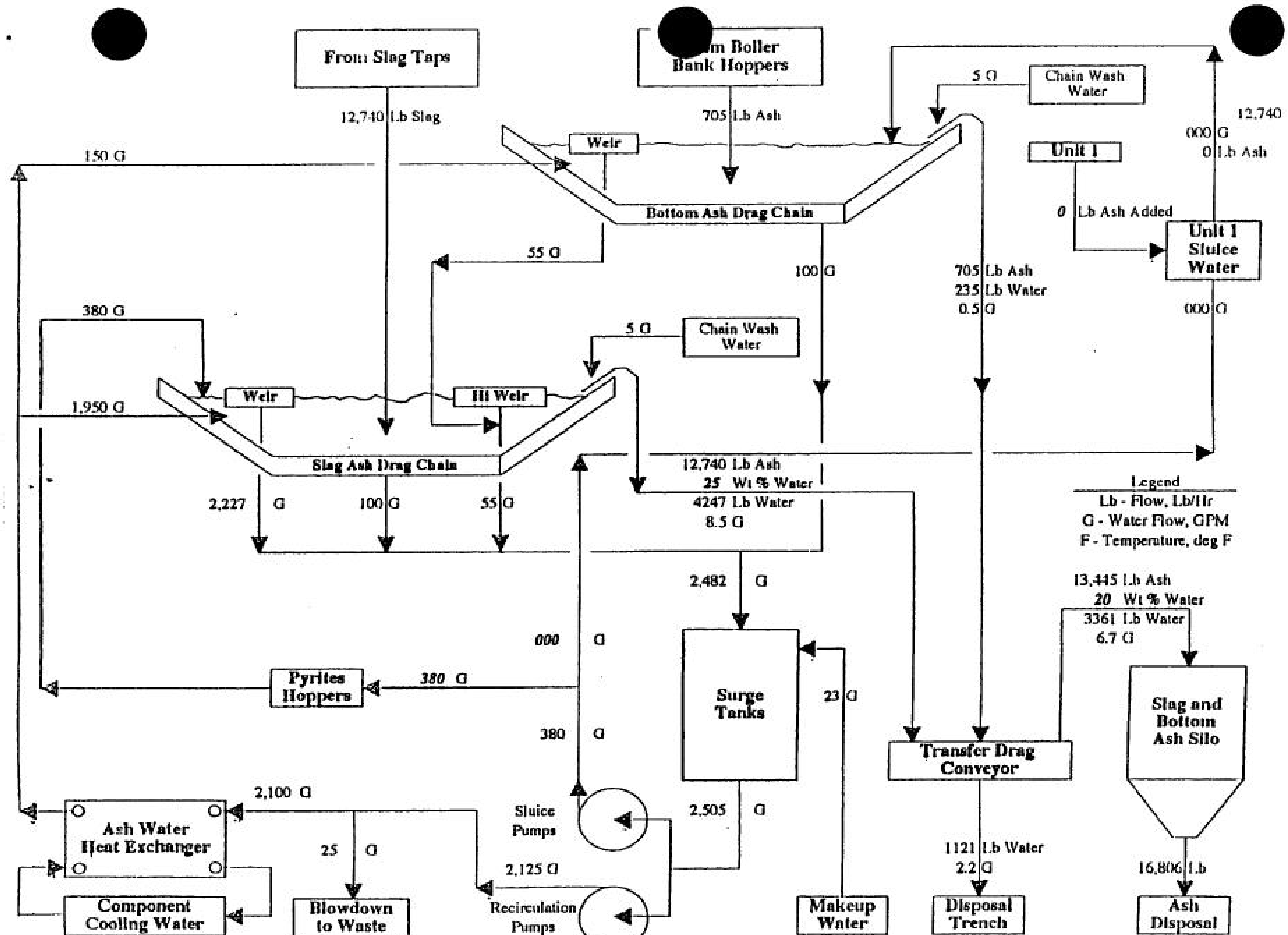


Figure 5 - Slag Ash and Bottom Ash

CASE 2

50% WASTE / 50% WASTE R.O.M. COAL

Case Description: 50% Waste/50% R.O.M. Coal

Table 1: Summary of Results

Gross Turbine Generation	kW	61,885
Estimated Auxiliary Power Use	kW	7,762
Heat to Turbine Cycle	MMBtu/Hr	523.05
Boiler Efficiency	%	79.11
Heat Input from Coal	MMBtu/Hr	661.13
Net Plant Output	kW	54,123
Net Plant Heat Rate	Btu/kWHr	12,215
Coal Consumption	Lb/Hr	94,990
Limestone Consumption	Lb/Hr	1149
Auxiliary Steam Consumption	Lb/Hr	3,250
Consumptive Water Uses	Lb/Hr	49,382
Dry Waste Solids	Lb/Hr	16,745
Water with Waste Soilds	Lb/Hr	16,229
Emissions:		
Sulphur Dioxide	Lb/Hr	57
Oxides of Nitrogen (as NO2)	Lb/Hr	231
Particulates	Lb/Hr	11

Table 2: List of Major Assumptions:

1. Ambient air:	Temperature, F	27.00
	Relative Humidity, %	60.00
2. Circulating water:	Temperature, F	38.00
3. Coal blend:	% Waste	50
	% R.O.M.	50
4. Limestone:	Purity, %	90.00
	Reactive CaCO3, %	80.00
5. Slag recovery:	% of ash in coal to combustors.	70.00
6. NOx (as NO2):	Lb/MMBtu coal fired.	0.35
7. Coal moisture:	% at the mill outlets.	11.00
8. Flyash:	% recovered from boiler bank hoppers	10
	% recovered from air heater hoppers.	10
	% recovered in SDA/Fabric Filter hoppers	80
9. Sulphur Dioxide:	% overall removal requred	80.00
	% captured in furnace	10.00
	% of remainder removed in FGD system	77.78
10. SDA slurry:	Temperature, F	180.00
	% solids by weight	45
11. SDA Outlet solids:	% routed to Fabric Filter	95
	% routed through bottom hopper	5
12.SDA approach	Temperature, F	30.00
13. Fabric Filter:	Bag Material	Teflon Coated Fiberglass
	Emission guarantee, Lb/MMBtu	0.015
	Approximate % removal efficiency	99.95
14. Ash systems water:	Wt % at Flyash pugmill unloader	15
	Wt % at Drag chains	25
	Wt % at Bottom ash silo	20
15. Sluice for Unit 1 Bottom Ash	Sluice water flow, GPM	000
	Unit 1 bottom ash added, Lb/Hr	0

Table 3: Itemized Auxiliary Power

Medium Voltage Loads

Mark No.	Equipment Name	Equipment Unit Load, BHP	Units Operating	Motor Efficiency, Decimal	Power Required, Kilowatts
2FC-FN1A&B	Mill Exhausters	590	2	0.93	947
2FC-PLV1A&B	Coal Pulverizers	319	2	0.93	512
2AP-C1A, B&C	Air Compressors	270	2	0.941	428
2FW-P1A&B	Boiler Feed Pumps	1227	1	0.931	983
2FG-FN1	Induced Draft Fan	1318	1	0.959	1,025
2BW-P1A&B	Boiler Circ Pumps	255	2	0.92	414
2JT-ATZ1	FGD Atomizer	270	1	0.92	219
2BA-FN1	Forced Draft Fan	1870	1	0.963	1,449
2CW-P1A&B	Circulating Water Pumps	218	2	0.92	354
	Subtotal				6,329

Low Voltage Loads

Mark No.	Equipment Name	LDC Power in kW
2ED-LDC1	480 v Load Center 1	552
2ED-LDC1	480 v Load Center 1	382
2ED-LDC1	480 v Load Center 1	87
2ED-LDC1	480 v Load Center 1	158
2ED-LDC1	480 v Load Center 1	63
	Subtotal	1,241

Mark No.	Equipment Name	Transformer Losses in kW	Units Operating	Power Required, Kilowatts
2EE-T1	Main Transformer Losses	160	1	160
2EE-T2	Auxiliary Transformer Losses	31	1	31
	Subtotal	191		191
	Total			7,762

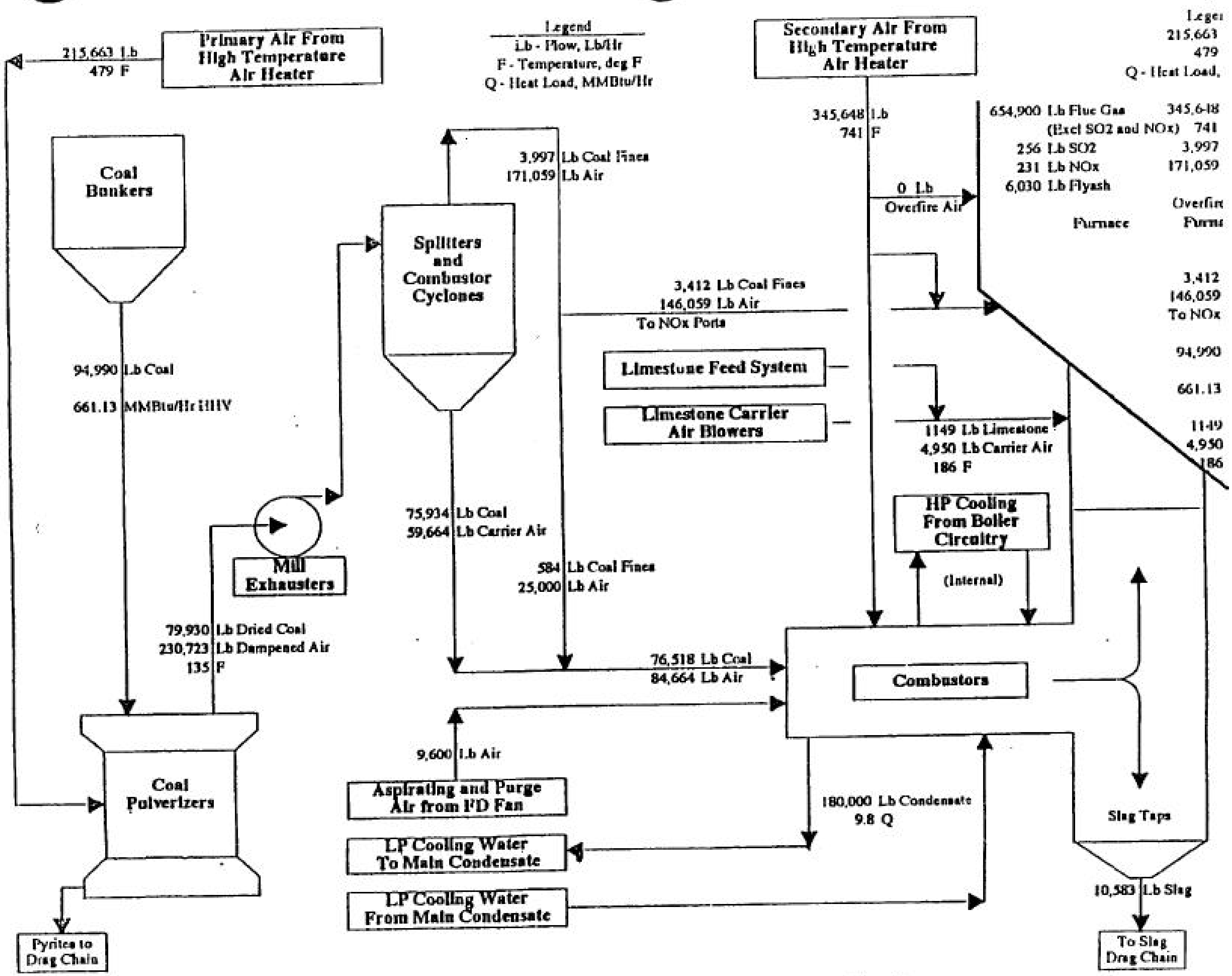


Figure 2 - Combustors, Coal and Limestone Feed

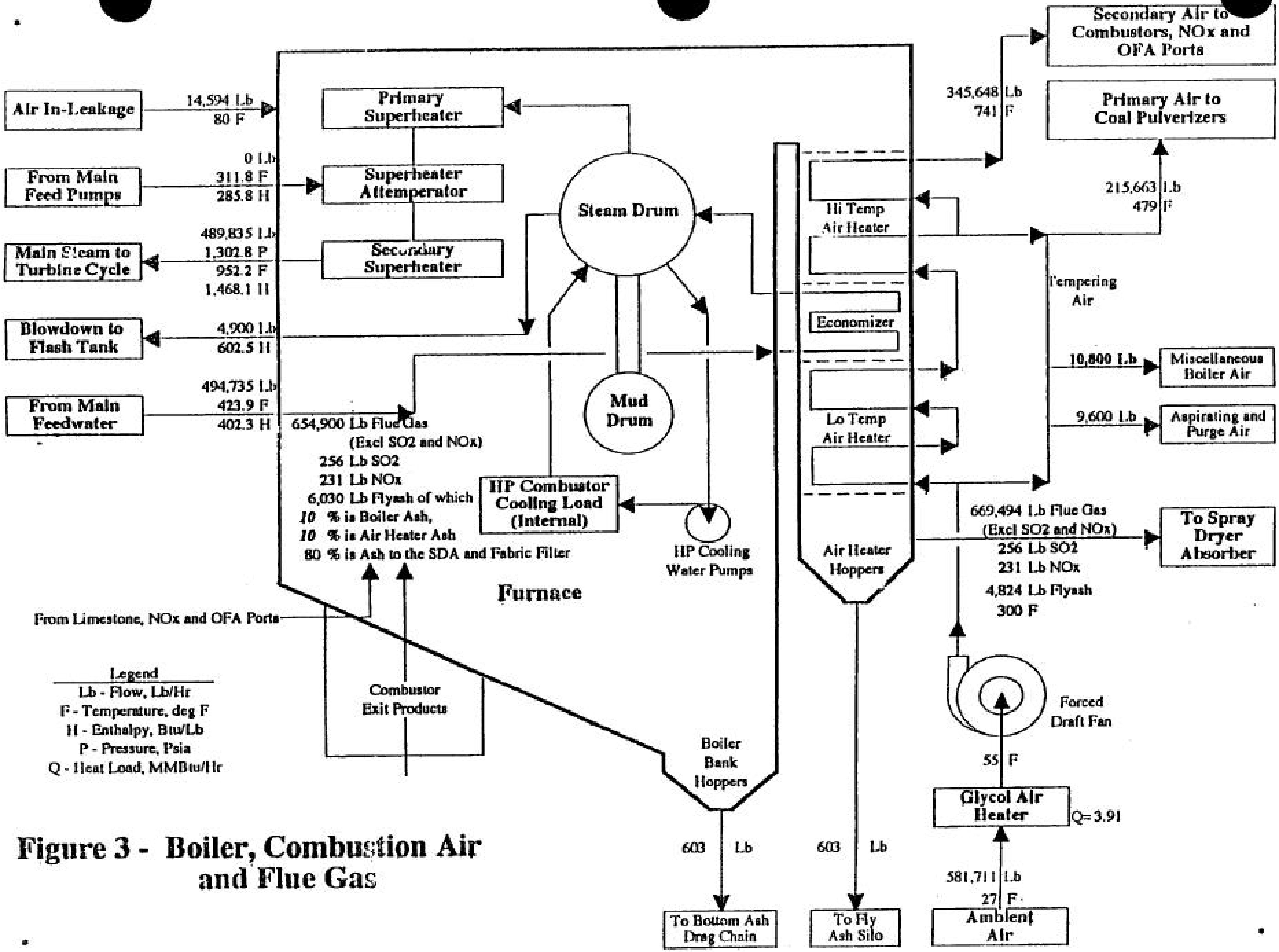


Figure 3 - Boiler, Combustion Air and Flue Gas

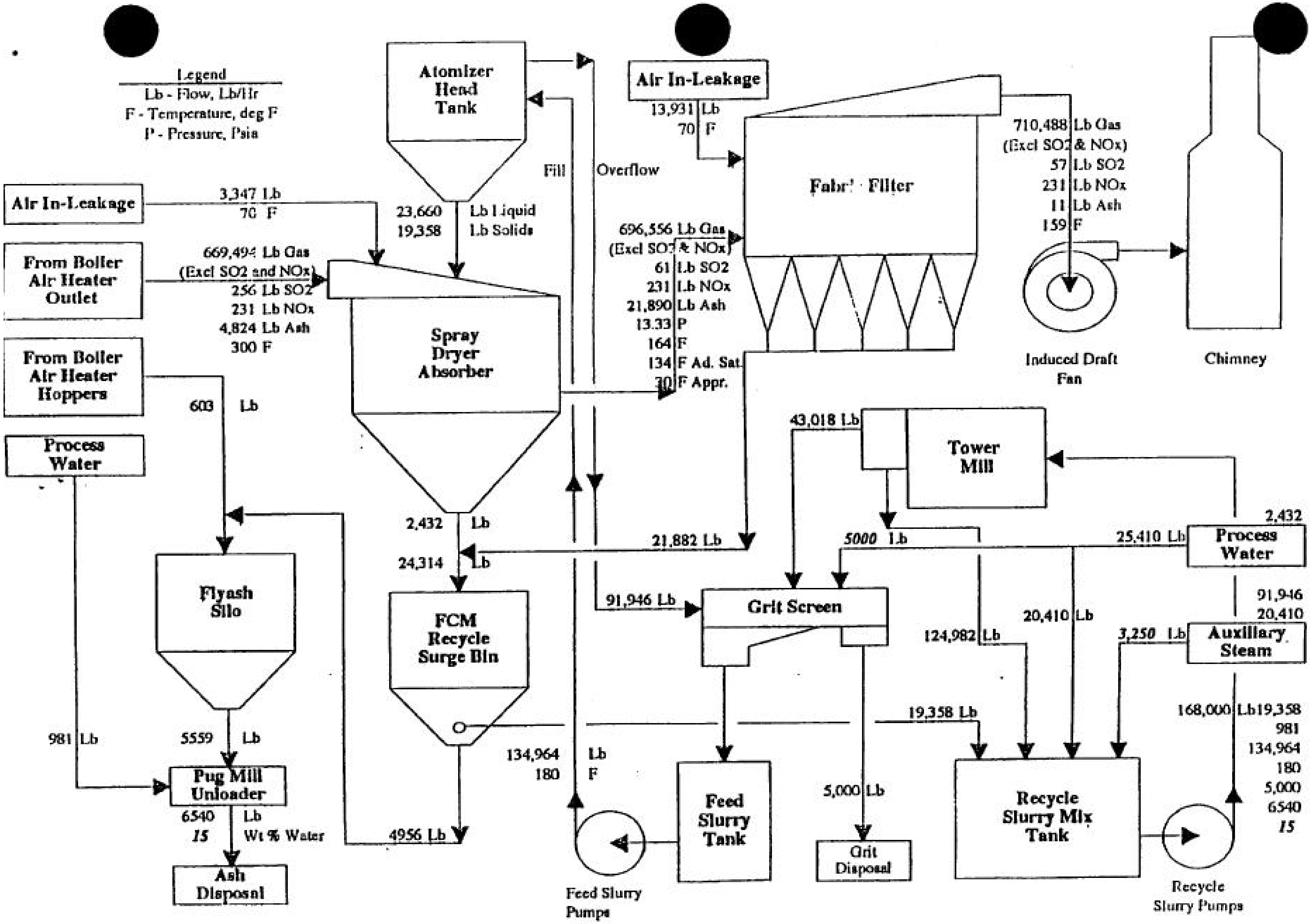


Figure 4 - Flue Gas Desulphurization, Fabric Filter, Flyash and Stack Gas

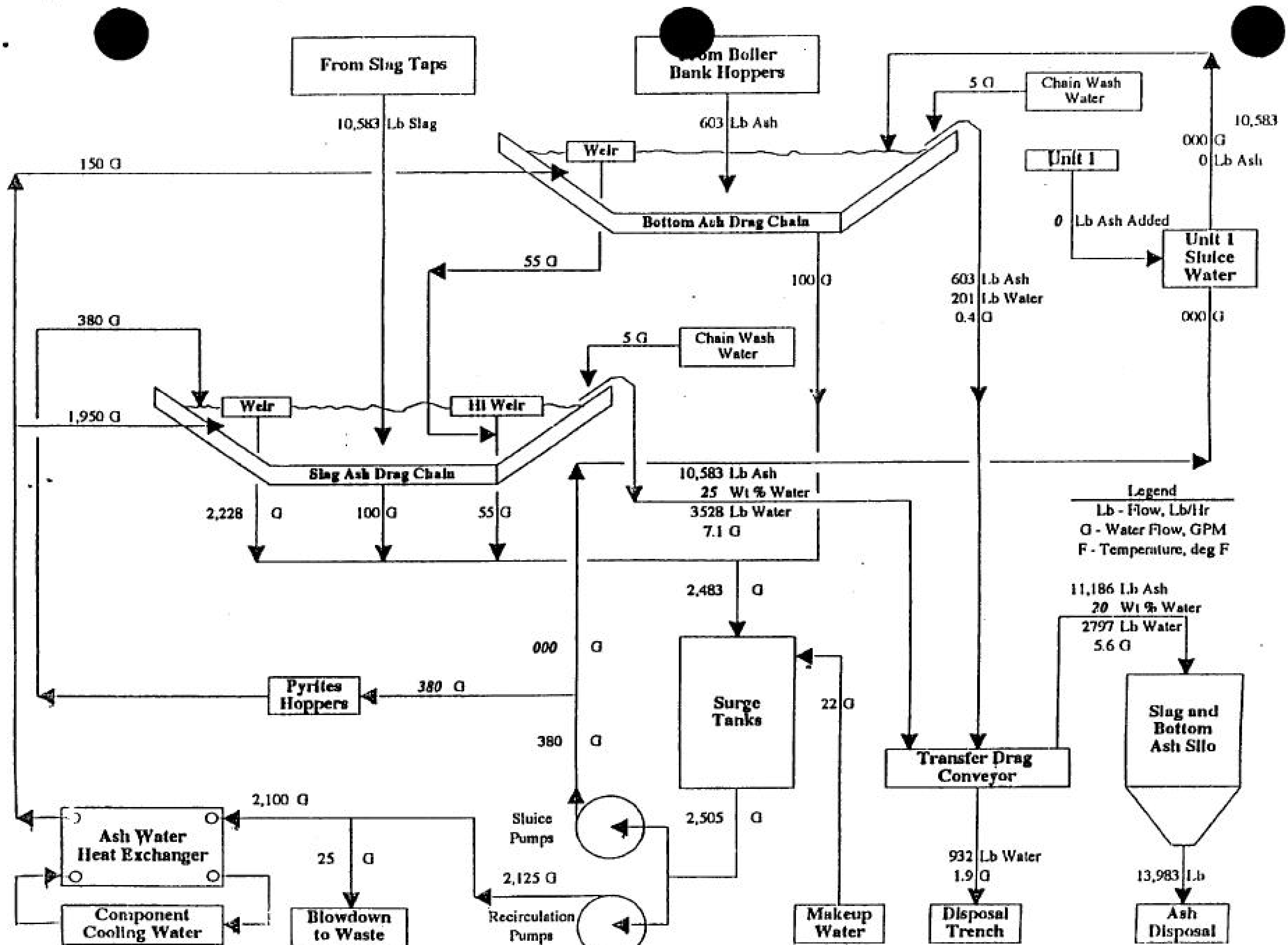


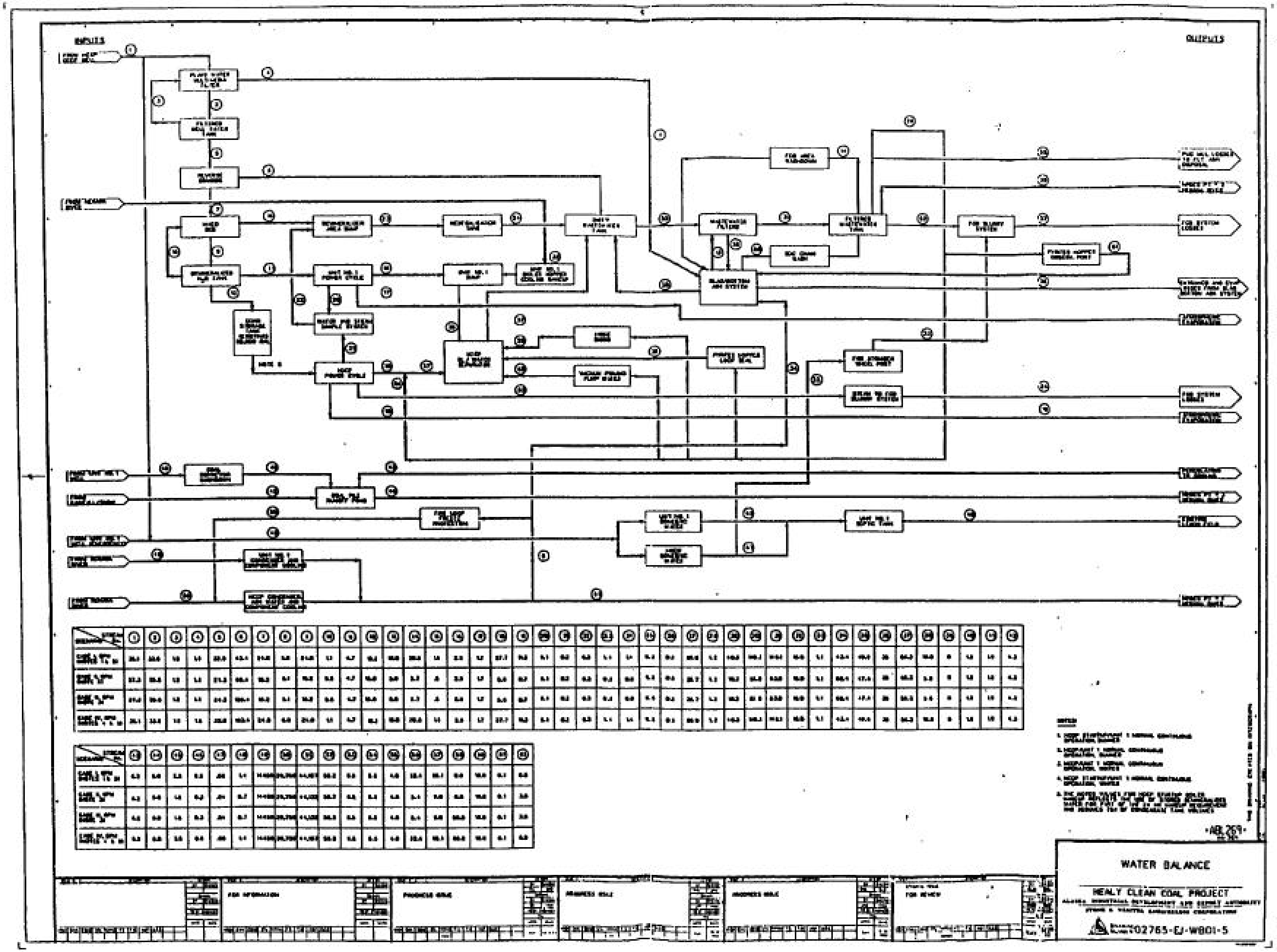
Figure 5 - Slag Ash and Bottom Ash

4.2.4 Process and Instrument Diagrams

Process and Instrument Diagrams are not being provided because they can not be legibly reproduced in the required size. The process flow diagrams in Section 4, sufficiently describe the process. The Process and Instrument Diagrams are also too detailed and complex to be of much value without more detailed knowledge of the plant design and operation.

4.3 Waste Streams

A plant water balance, prepared by Stone & Webster in March, 1998, is provided on the following page.



INPUTS
OUTPUTS
WATER BALANCE
HEALY CLEAN COAL PROJECT
02765-EJ-WB01-5

Figure 4-3-1

4.4 Equipment List

Equipment data is provided in the performance parameter section for each major process. Additionally an equipment list is provided in Appendix A.

5.0 Process Capital Cost

5.1 General

The final completed cost can be looked at several ways depending on what costs are included in the estimate. The final cost was impacted by pilot projects, DOE demonstration, start-up, GVEA/AIDEA dispute and litigation costs, environmental delays, design changes, and contractor overruns. These costs are described in this Section. The final completed HCCP process capital cost, therefore, has been projected at completion for three conditions. These are:

- $292,300,000 total estimated costs to complete inclusive of all demonstration, start-up, and dispute and litigation costs.

- $282,300,000 total estimated costs to complete exclusive of GVEA/AIDEA dispute and litigation costs.

- $240,100,000 total estimated costs to complete exclusive of pilot projects (Capistrano pre-combustor test, TRW coal flow modeling, Boiler Firing Model, Joy-Niro atomizer tests, and AIDEA's involvement in TRW's "Cleveland" test.), DOE demonstration (described in detail in the Topical Report: Combustion System Operation), start-up (described in Table 6-2), and GVEA/AIDEA dispute and litigation costs. This cost includes costs resulting from design changes, cost overruns, and environmental delays. When costs due to environmental delays are excluded, the total cost is $225,100,000.

Section 5.0 of the Public Design Report (PDR) Participant Guidance Document No. 3 defines the costs to be included and the format for the Process Capital Cost. DOE guidelines call for exclusion of start-up costs as a capital cost.

Table 5-1 (see list of Tables page 110) provides the process capital cost for the HCCP exclusive of the pilot, DOE proposal, demonstration, start-up, and GVEA/AIDEA dispute and litigation costs. The process capital costs are segregated into process areas including balance of plant, installation, and engineering and home office costs.

These costs from Table 5-1 (see list of Tables page 110) are:

Process Plant	$ 92,400,000
Installation	$106,900,000
Engineering and Home Office	$ 40,800,000
Total Process Cost	$240,100,000

The process plant areas are as defined in Section 4.2 of the PDR. The HCCP was constructed under a primary general installation contract and therefore only the actual total installation cost is provided, not the installation cost per process area or unit. The engineering and home office costs do not include start-up costs, which are provided as a separate part of Section 6.0 Estimated

Section 5.0 Process Capital Cost
Table 5-1

Item No.	Sub Item No.	Procurement or Contract No.	Process Area	Number of Units	Total Cost $	Procurement Year
2	**Process Plant**					
2.1			**Main Boiler**			
	2.11	HCP-009	Boiler Supply	1	17,108,586	1991
	2.12	HCP-060	Water Lances	2	203,888	1998
			Boiler Total		17,312,474	
2.2			**Combustor**			
	2.21	HCP-008	TRW Engineering		13,384,632	1992
	2.22	P201X	TRW Combustors	2	17,244,660	1993
	2.23	HCP-055	Spare Exhauster Fan Rotors	2	100,267	1998
			Combustor Total		30,729,559	
2.3			**FGD**			
	2.31	HCP-007	Flue Gas	1	7,533,872	1991
			Total Flue Gas		7,533,872	
2.4			**Materials Handling**			
	2.41	P231B	Coal Handling	1	1,362,548	1992
	2.42	HCP-046	Coal Scan	1	19,911	1997
			Total Materials Handling		1,382,459	
2.5			**Ash Handling**			
	2.51	P241D	Fly/Middle Ash	1	1,059,005	1992
	2.51	P241G	Bottom Ash	1	2,531,962	1992
			Total Ash Handling		3,590,967	
2.6			**Pre/Post Combustion Air**			
	2.61	C003M	CEMS	1	211,053	1993
	2.62	P212C	ID Fan	1	308,846	1992
	2.63	P221C	Glycol Heaters	2	100,000	1992
	2.64	P231F	Glycol Air Heaters	2	164,138	1992
	2.65	HCP-059	ID Fan Silencer	1	100,476	1998
			Total Pre/Post Combustion Air		884,513	
2.7			**Turbine Generator and Steam**			
	2.71	P101J	Lube Oil Conditioner	1	46,930	1993
	2.72	HCP-013	Turbine Generator	1	11,100,349	1991
			Total Turbine Generator		11,147,279	
2.8			**Condensate and Feedwater**			

	2.81	H103A	Condensate Pumps	2	113,191	1993
	2.82	P111A	Condenser	1	634,635	1993
	2.83	P221A	Deaerator	1	91,055	1992
	2.84	P224A	Feedwater Pumps	2	416,811	1993
	2.85	P221C	Feedwater Heaters	4	415,334	1992
			Total Condensate and Feedwater		1,671,026	
2.9			**Circulating Water**			
	2.91	H103A	Circulating Water Pumps	2	208,000	1993
			Total Circulating Water		208,000	
2.1			**Water and Wastewater**			
	2.101	W013D	Water & Steam Sampling	1	242,151	1992
	2.102	W014S	Oil/Water Seperator	1	35,305	1992
	2.103	W014Z	Water/Wastewater Treatment	1	1,158,165	1992
	2.104	HCP-051	Repair Work		49,201	1997
			Total Water/Wastewater Treatment		1,484,822	
2.11			**Fire Protection**			
	2.111	P402D	Fire Pump	1	66,699	1992
			Total Fire Protection		66,699	
2.12			**Plant Controls**			
	2.121	C092A	Control and Relay Panels	6	166,692	1993
	2.122	C092L	Plant Control System	1	2,469,178	1992
			Total Plant Controls		2,635,870	
2.13			**Electrical**			
	2.131	E011A	Transformers	3	987,658	1993
	2.132	E015E	Med. Voltage Switchgear	2	453,754	1993
	2.133	E015N	480 Volt Load Centers	6	312,084	1993
	2.134	E022D	Phase Bus	1	180,215	1993
	2.135	E034Z	Uninterruptible Power Supply	1	159,679	1993
	2.136	E121B	138 KV Circuit Breaker	1	78,968	1993
	2.137	E121C	Generator Circuit Breaker	1	78,732	1993
			Total Electrical		2,251,090	
2.14			**Balance of Plant**			
	2.141	C052A	Safety and Relief Valves	51	49,592	1992
	2.142	C052B	Air Control Valves	32	242,864	1992
	2.143	P251B	Turbine Crane	1	355,941	1992
	2.144	P261D	Rotary Compressors	3	219,025	1992
	2.145	P302N	Extraction Non Return Valves	4	81,504	1992
	2.146		Contributions (includes GVEA, et.al.)		10,514,449	1996
			Total Balance of Plant		11,463,375	
			Total Process Plant		92,362,005	
3			**Installation and Contractor Supplied Equipment**			
	3.1	HCP-030	Prime Contract		105,454,938	1995
	3.2	HCP-032	Raytheon		35,209	1994

3.3	HCP-043	Claims Counsel	414,422	1997
3.4	HCP-058	Completion Constructon	1,000,000	1998
		Total Installation	106,904,569	

Total Process Plant Installed 199,266,574

4 **Engineering and Home Office**

4.1		Engineering		1990
4.101	USGS-1	Water Inventory	48,500	1990
4.102	USGS-2	Water Inventory	8,400	1990
4.103	USGS-4	Water Inventory	113,200	1991
4.104	HCP-015	SWEC Engineering	9,039,185	1993
4.105	HCP-015A	SWEC Engineering	13,105,928	1991
4.106	HCP-016	Sierra Energy	497,988	1993
4.107	HCP-023	GVEA Oversight and Material	-890,250	
		Total Engineering	21,922,951	
4.2		Enviromental		1993
4.201	HCP-028	Environmental Management	484,300	1993
4.202	HCP-029	Air Quality	49,822	1997
4.203	HCP-040	CEMS Support	19,268	
		Total Environmental	553,390	
4.3		Construction Management		1996
4.301	HCP-015SA2	CM SWEC	1,559,118	1993
4.302	HCP-027	Argetsinger	19,503	1994
4.303	HCP-031	Construction Management	4,490,024	1994
4.304	HCP-033A	Expedition Software	9,000	1994
4.305	HCP-033B	Expedition Training	2,830	1994
4.306	HCP-033C	Expedition Software	3,300	1995
4.307	HCP-33D	Expedition Training	4,074	1994
4.308	HCP-034A	Disputes Board	33,840	1994
4.309	HCP-034B	Disputes Board	41,844	1994
4.31	HCP-034C	Disputes Board	67,221	1994
4.311	HCP-035	Office Specialists	336,938	1996
4.312	HCP-036	Const. Mgmt.	43,431	1995
4.313	Letter 1	Partnering	0	1997
4.314	HCP-044	Joy Flyash	90,000	1998
4.315	HCP-054	Computer Suppport	30,379	1998
4.316	HCP-056	Computer Support	144,748	1995
4.317	AIDEA CM	Office Costs	244,975	1996
		Total Const. Mgmt.	7,121,225	
4.4		Home Office		1989
4.401	HCP-001	Financial feasibiliy	126,861	1990
4.402	HCP-014	Financial Reports	162,743	1990
4.403	HCP-022	Insurance Broker	425,000	1992
4.404	HCP-024	Usibelli	49,234	1996

4.405	HCP-037	Legal	0	1996
4.406	HCP-038	Consulting	0	1995
4.407	AIDEA PM	Project Management	10,488,079	
		Total Home Office	11,251,917	
Total Engineering and Home OfficeOwner Costs			40,849,483	
Grand Total			240,116,057	

Cost Deletions

1 Demonstration operations- 2 years
2 Start Up-(Will be a separate breakdown as per DOE instructions
3 Pilot Plants of TRW, Joy, and GVEA and AIDEA oversight
4 DOE Proposal
5 Environmental monitoring caused by being near Denali
6 GVEA 1998 Settlement equipment and 1998 and 1999 Litigation

Operating Costs. The total process cost includes costs resulting from design changes, cost overruns, and environmental delays.

5.2 Schedule Impacts

The conceptual feasibility studies related to the HCCP and proposal to DOE were started in 1989. DOE selected HCCP in 1989 as part of Round III of the Clean Coal Technology Program. Between 1989 and 1991, AIDEA negotiated and established the project participant roles, established the funding sources for the HCCP, collected environmental background data, negotiated the Power Sales Agreement with GVEA, and obtained the Alaska Public Utilities Commission approval of the Agreement. The technology suppliers conducted pilot plant programs and developed conceptual designs.

In late 1991, critical contracts were agreed on with Stone & Webster, Foster Wheeler, TRW, and B&W/Joy. The Stone & Webster contract was for engineering, the Foster Wheeler contract was for the boiler supply and installation, the TRW contract was for the combustors, and the Joy contract was for the SDA system. At this time, the Environmental Impact Statement (EIS) and the Prevention of Significant Deterioration (PSD) air quality permits were being prepared. To minimize any financial risk during this period, AIDEA limited the technology suppliers to only engineering work. No fabrication was released.

During 1992 and 1993 the National Park Service (NPS) and the Trustees for Alaska (Trustees) raised considerable objection to the HCCP particularly regarding potential visibility impacts on the Denali National Park boundary, approximately 12 kilometers from the site. The Trustees filed legal actions to prevent the HCCP from proceeding. To overcome these objections, numerous and detailed studies were performed, visibility and air quality monitoring of current conditions was conducted, and conservative elements were included in the design to minimize any impact on the environment. In early 1994 final agreements were reached with all parties allowing the HCCP to proceed. The environmental actions resulted in a two-year delay in the project. As a result of the environmental delays approximately $15,000,000 of additional costs were incurred.

Suppliers were released for fabrication in 1994 and the prime construction contract was awarded in late 1994. The prime contractor provided much of the small equipment and all of the erection material such as cable, steel, pipe, etc. Groundwork commenced in late spring 1995. Earthworks, substructure and partial steel construction were completed in 1995. In 1996 and 1997 equipment and material were installed. The installation was completed in November 1997

Construction testing and start-up commenced in July 1997. With the exception of coal firing, all start-up activities were completed in 1997. The Demonstration Test Program commenced in January 1998 and was completed in December 1999. Coal firing and start-up of the associated coal firing equipment was completed in March 1998 as part of the Demonstration Test Program. As past of the Demonstration Test Program and as a requirement of the Power Sales Agreement, a 90-day Commercial Acceptance test was run during late 1999. An Independent Engineer established the test protocol and reviewed and monitored the test. The results were deemed inconclusive by the Independent Engineer primarily due to their concerns that the test was run with a coal blend having a heating value slightly above the design specification, and that excess staffing was on on-site during the test

As a result of this determination, GVEA and AIDEA after dispute and some litigation actions agreed on a staged retrofit program by GVEA. This includes full retrofit to low NO_x burners and possibly conventional limestone scrubbing or a limited retrofit, which includes the correction of deficiencies to the new technology identified by the Independent Engineer during the 90-day test. If unable to obtain regulatory approval for the full retrofit, either a limited retrofit would be undertaken by GVEA or the HCCP would be returned to AIDEA for operation or decommissioning.

5.3 Design Changes

The HCCP design concept was developed in the Round III DOE proposal. Pilot projects were conducted at TRW's Cleveland test facility and Joy-Niro's test facility in Sweden. The HCCP developed as proposed with the exception of four significant design changes. These were:

- The DOE had originally intended a demonstration of the TRW technology at an Orange & Rockland plant. This project was cancelled. As a result TRW and AIDEA agreed to fund and build a full size pre-combustor at TRW's Capistrano facility for testing. The precombustor test was successful. In addition, pilot tests were conducted at TRW's Cleveland test facility and Joy's test facility in Sweden.

- Due to space considerations at HCCP, the boiler was fired by the combustors vertically from the boiler bottom as opposed to horizontally from the boiler side. Flow modeling testing was performed by Foster Wheeler of this firing arrangement resulting in boiler tube configuration changes.

- The original TRW design included an indirect coal feed system. An indirect coal system is considered to not be prudent utility practice since it includes enclosed coal storage, which is a fire hazard. After much consideration by TRW, Foster Wheeler, GVEA, and AIDEA, it was decided to modify the system to a conventional direct coal feed system. This required changes to the coal feed system including the addition of pulverizer exhauster fans.

- The original TRW design was based upon an approximate 7-foot diameter slag tap opening at the bottom of the main combustor. Due to the nature of the coal and concerns for bridging over the slag tap opening, the opening was increased to approximately 9 feet. This required a redesign of the main combustor and decreased boiler efficiency.

These were the major design changes to the HCCP, which impacted performance and cost. These changes increased the HCCP cost by approximately $11,200,000.

5.4 Total Process Capital Cost Impacts

The 1991 estimate of the HCCP cost, inclusive of one year of demonstration testing, was $190,400,000. In 1991 one year of demonstration testing was assumed to be approximately $15,800,000. Thus the 1991 capital cost of HCCP without demonstration testing was

$174,600,000. If the design change cost impacts ($11,200,000) are added, the cost becomes $185,800,000, excluding costs of environmental delays. This compares to the current projected cost of $225,100,000, which also excludes costs due to environmental delays. The difference ($39,300,000 or 17.5%) is attributable to inflation and technology supplier and installation contractor overruns.

6.0 Estimated Operating Cost

6.1 Fixed Operating Cost

The estimated operating cost for HCCP is segregated into the format provided in Exhibit 4 of Section 6 of the General Guidelines for the PDR. These include annual fixed and variable operating costs. The annual fixed operating costs include operating labor, maintenance labor, maintenance material, and administrative and support labor. The costs do not include demonstration testing. The estimated operating costs are provided in Table 6-1 (see list of Tables page 110).

The annual fixed operating costs are estimated from the data collected during 1999, particularly the data collected during the 90-day test. Operating costs include the shift and day personnel who provide the operating services for HCCP. These are operations supervisors, shift leaders, operators, plant technicians, and control room operators.

The Independent Engineer determined from timesheets that approximately 28 GVEA full time operating and maintenance personnel, and 15 full time technical, operating, and maintenance AIDEA personnel were assigned to HCCP during the 90-day test. A total of 43 personnel were concluded by the Independent Engineer to be the staffing during the 90-day test. As well as operating and maintenance labor, these included some day personnel such as lab technicians, storeroom clerks, and supervisors. During the 90-day test, HCCP was run as an independent unit with no sharing of personnel between Unit No. 1 and was run in a testing mode of operation. The Independent Engineer, after taking these conditions into consideration as well as the impact of future training and familiarity with HCCP, concluded that approximately 36 operating personnel were needed for the long-term staffing of HCCP. While AIDEA believes the long-term staffing requirement would be 29 personnel, the conservative estimate of the Independent Engineer was used for this cost estimate.

GVEA’s previous budget estimate split operations and maintenance labor to approximately 2/3 operating personnel and 1/3 maintenance personnel. An average rate for 1999 GVEA operating and maintenance labor services was used to determine the total operating and maintenance labor cost. The results are a total operating and maintenance labor cost of approximately $6,795,000 per year or 1.83 cents per kWh.

Maintenance material costs for 1999 were estimated from the actual invoices for material purchased by GVEA and AIDEA’s maintenance contractor invoices. Administrative and support costs were determined from AIDEA’s cost records for 1999. These costs include staff and travel, insurance, environmental monitoring, vehicles, and office costs.

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Section 6
Table 6-1
Summary of Estimated Operating Cost

Base Year 2000

ANNUAL FIXED OPERATING COST

	Operating Labor Cost Details	
	Number of Operators per Shift	5
	Number of Shifts(50 hours) per Week	4
	Operating Pay Rate per Hour	$72.60
		Cost, $/yr.
1	Total Annual Operating Labor Cost	4,530,240
2	Total Annual Maintenance Labor Cost	2,265,120
3	Total Annual Maintenance Material Cost	800,930
4	Total Annual Administative and Support Cost	744,390
5	**TOTAL ANNUAL FIXED O&M COST**	**8,340,680**

VARIABLE OPERATING COST

Commmodity	Unit	$/Unit	Quantity/hr.	Cost/hr.
Coal	tons	16.48	43.7	720
Fuel Oil	gallons	0.69	43.5	30
Limestone	tons	120	0.333	40
Ash Disposal	tons	5.49	7.29	40
TOTAL VARIABLE OPERATING COST				**830**
TOTAL HOURS FOR OPERATION PER YEAR				**7450**

Assumptions:

1 Coal burned 7000 BTU/lb., 16.6% ash, and $16.49/ton
2 Limestone 90% $CaCO_3$, $120/ton
3 Ash disposal $5.49/ton
4 Oil $.69/gallon
5 Maintenance labor 11 personnel (50 hour shift)
6 Administrative and support includes management labor and travel, insurance, office costs, environmental monitoring, vehicles, etc.
7 Debt service excluded
8 Operating and maintenance labor based upon Independent Engineer's assessment during the 90-day Commercial Operaing Test

The total annual operating fixed costs for HCCP are estimated to be approximately $8,341,000 or 2.24 cents per kWh. This compares with GVEA's budget estimate in 1996 of 1.24 cents per kWh. GVEA's estimate was based upon the manpower-loading target of 22 personnel set by Sterling Energy in their training study.

6.2 Variable Operating Cost

Variable operating costs are those which vary with the energy produced by HCCP. These costs include coal, oil, ash disposal, and limestone. The variable operating costs are also provided in Table 6-1 (see list of Tables page 110). Boiler water is generated in the water treatment plant and included as a fixed cost. Auxiliary power is supplied by HCCP through the auxiliary transformer and is therefore accounted for in the variable operating commodity cost.

Coal costs are based upon the Unit No. 1 coal contract. While HCCP has a separate coal contract, it does not start until after commercial operation. This represents a conservative estimate of coal prices since the coal supplied to HCCP for the first 5 years of operation were at a reduced rate and then after 5 years of commercial operation, would become comparable to Unit No. 1 pricing.

Coal quantities were derived from the coal flow rates from the 90- day test. Fuel oil was also calculated from the 90-day test and at a cost from GVEA's fuel oil invoices. Fuel oil is used for initial firing and shutdown of the combustor and boiler and for building heating. The 90-day test ran between August and November 1999 and was deemed to be typical of fuel oil usage.

Limestone was supplied from Seattle spot market suppliers and from a local supplier in Cantwell, AK. The local supplier provided limestone with extremely low $CaCO_3$ content of about 70% and was used only on a limited basis. The design $CaCO_3$ content for the SDA system is 90%. To prevent pluggage of the SDA system and to assure compliance with SO_2 permit requirements, limestone was also supplied from Seattle. This limestone had $CaCO_3$ content in excess of 95% . The weighted average cost for limestone was approximately $120 per ton. Ash disposal was also based upon the Unit No. 1 coal contract also. Bottom, slag, and fly ash were returned to the mine in the empty coal trucks. During the 90-day test coal ash content averaged about 16.6% This quantity of ash was used in the ash disposal cost.

The net variable operating cost for HCCP is estimated to be approximately $830 per hour or about 1.9 cents per kWh. This compares well with the GVEA 1996 budget estimates of 1.70 cents per kWh. The primary difference being the higher cost associated with the Unit No. 1 coal contract, which was utilized on HCCP prior to commercial operation.

6.3 Total Fixed and Variable Operating Cost

The total estimated annual operating cost of HCCP in the year 2000 is $14,524,000 or 3.90 cents per kWh exclusive of debt service. This compares to a 1991 study estimating the operating cost at about $13,336,000 per year or 3.59 cents per kWh, and a GVEA 1996 budget estimate of $11,683,000 or 3.14 cents per kWh, both exclusive of debt service. The differences between the current estimate and GVEA's 1996 and 1991 estimates are staffing labor and coal cost. AIDEA's own estimate of operating costs using AIDEA supplied labor, materials, support services, etc., is 3.22 cents per kwh.

6.4 Start–Up Costs

Start-up costs are provided in the format of Exhibit 4 of the Estimated Operating Costs defined in the General Guidelines for the PDR. These costs are shown in Table 6-2 (see list of Tables page 110). These costs are customarily included in the engineering and home office account of total capital cost but are included separately in accordance with PDR General Guidelines instructions.

These costs cover start-up activities between July 1997 and March 1998. The early phases of start-up commenced in July 1997 and overlapped the completion of construction and construction testing. Oil firing was completed by October 1997. Between October 1997 and January 1998 GVEA delayed start-up due to safety considerations. Since the combustors were new technology and the start-up procedures unverified, coal firing start-up was included as part of the demonstration testing. start-up coal firing was conducted from January 1998 through March 1998. Due to the overlap, these start-up costs include costs associated with the first 3 months of demonstration testing.

During start-up GVEA provided operators and AIDEA provided operations supervision and technical support personnel. In addition to these personnel, technical support labor was provided from critical suppliers during certain periods of the start up. The primary participant was TRW who provided 24-hour services for most of the start-up period. The other major technical support was provided by B&W/Joy for the SDA system and the flyash system, and Foster Wheeler for the boiler.

AIDEA's on site maintenance contractor provided maintenance labor and maintenance material. GVEA also provided maintenance material and some spare parts. AIDEA's prime contractor provided all construction testing and craft labor for start up.

Coal, fuel oil, limestone, ash disposal, and auxiliary power were also required during start-up. Coal and ash disposal were procured from the Usibelli Coal Mine. Limestone was procured from a local Cantwell supplier and from spot market purchases in Seattle. GVEA provided fuel oil and auxiliary power.

The total start-up costs are estimated to be approximately $5,394,000. GVEA's 1996 budget estimate for start-up was $2,460,000 excluding supplier labor from the technology participants, AIDEA labor and administrative and support costs including GVEA training. It these costs are considered in GVEA's start-up estimate, the costs would have been approximately $5,193,000.

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05/03/2000

Section 6
Summary of Estimated Start Up Costs
Table 6-2

Item		Start up Cost Element / Description	Cost $	Year
1	Operations			
	1.1	AIDEA Supervison Labor Cost	180,000	1997
	1.2	GVEA Operators	1,372,800	1997
		Total Operating Cost	1,552,800	
2	Maintenance			
	2.1	Maintenance Labor	437,525	1997
	2.2	Maintenance Material		
		Dekoozian Materials	62,475	1997
		GVEA Materials	137,757	1997
		Total Materials	200,232	
		Total Maintenance Labor and Material Cost	637,757	1997
3	Administrative and Support			
	3.1	AIDEA Technical Labor	422,000	1997
	3.2	Supplier Labor		
		Bailey Controls	51,788	1997
		Sumitomo	171,000	1997
		TRW	475,000	1997
		Foster Wheeler	97,200	1997
		Monitoring Solutions	100,000	1997
		TLT Babcock	12,810	1997
		Ingersoll Dresser	4,551	1997
		Aquatech	93,064	1997
		Johnson March	17,479	1997
		ABB	19,162	1997
		Joy Flyash	134,596	1997
		Amtest	26,347	1997
		Total Supplier Labor	1,202,997	
	3.3	GVEA Labor,Training, Mgnt., and Administration	778,789	1997
	3.4	Hot Testing Insurance	62,500	1997
	3.5	AIDEA and Site Office	85,797	1997
		Total Administrative and Support Cost	2,552,083	
4	Commodity Cost			
	4.1	Coal	518,400	1997
	4.2	Fuel Oil	37,800	1997

4.3 Limestone	29,700	1997
4.4 Ash Disposal	24,449	1997
4.5 Auxiliary Power	41,472	1997
Total Commodity Cost	651,821	
Total Start Up Cost	5,394,461	

Assumptions

1. All run of mine coal burned
2. Unit 1 coal contract pricing
3. Time period from October 1, 1997 through March 31,2000
4. Power sales not included as revenues
5. Power received at $.032/kwh

7.0 Commercial Applications

The HCCP demonstration provides the utility industry with an alternative new unit coal-based power system technology. It also provides utilities a retrofit and repowering technology suitable for use with a wide range of coals and the ability to meet a broad range of emission control requirements.

The TRW Clean Coal Combustion System can be fired using a wide range of coals over a wide range of properties by changing its operating temperatures and stochiometries. HCCP is directed towards a low grade coal (low calorific value, high volatiles, and high moisture) having a high ash fusion temperature. The HCCP combustors were designed to burn 100 percent ROM, 55 percent waste/45 percent ROM, 65 percent waste/35 percent ROM, and performance - 50 percent waste/50 percent ROM coals. The combustors will also be capable of burning 100 percent waste coal blends. A description of these coals is presented in Section 3.0 of this report.

Each of the components and systems used in this project, with the exception of the TRW Clean Coal Combustion System, have been used at a large commercial-scale project. The nature of the components and their interdependence are such that these equipment systems may be refined or specifically tailored to a user's specific fuel, site and environmental requirements but the same basic system as HCCP is expected to be used commercially at future sites.

The HCCP power plant technology is suitable as an integral system for existing facilities in utility and industrial markets. The size range applicability for commercial installation of these integrated technologies ranges from small plants similar to the 50 MW Healy facility to over 750 MW.

The primary distinction between the HCCP and larger future commercial applications will be that multiple SDAs will be utilized commercially as opposed to the single unit. Multiple TRW combustor systems will be required as well on larger future commercial applications. Reverse-air baghouse or ESP particulate collection may be utilized instead of pulse-jet baghouse with higher component capacities, consistent with good engineering practice and experience gained elsewhere.

The use of multiple, large SDAs of up to 49 feet (15 meter) and atomizers of 1200 hp have already been proven in existing utility installations. Therefore multiple train operation and scale up considerations present no problems regarding the broad commercial applications of the power and environmental control technologies.

The following is a brief description of the commercial applications and design impacts:

Utility Market Segment for new electric power capacity, repowering, and retrofit.

Electric utility boilers generally range in capacity from about 500,000 to over 8,000,000 lb./hr steam generation. The combustors demonstrated at HCCP can be used as modules in each boiler.

A retrofit with the TRW Clean Coal Combustion System could be motivated by several factors. Pulverized coal (PC) or stoker-fired boilers could be improved in capability, efficiency, and operating flexibility. Cyclone boilers could achieve both reduced maintenance and improved operation and coal flexibility. Stokers, cyclones, and PC units could all achieve required NO_x and SO_2, emission control levels with reduced CO levels using the proposed technology than with a comparable back end wet scrubber and NO_x control retrofit. The capital and operating costs should be lower.

Acid rain and more vigorous ambient standard legislation may be enacted. This will result in a major construction program to retrofit NO_x and SO_2 emission controls on existing units. High capital and operating costs associated with wet scrubber and SCR technologies would encourage consideration alternate solutions, such as the HCCP's integrated technology approach.

Existing coal-fired boilers of the B&W cyclone furnace design may represent a large acid rain utility retrofit market, which at present does not have a viable, economic approach for reducing NO_x and SO_2 emissions by combustion methods. The TRW combustor size used at the HCCP represents the mid-range size of TRW Clean Coal Combustion System that would be required for this market segment.

There are approximately 1000 cyclone furnaces currently in operation in the United States generating almost 250,000 GWs of electricity annually with a potential for NO_x emissions of 1,220,000 tons/year and a potential for SO_2 emissions of 4,900,000 tons/year. Retrofit of these cyclone furnaces with the demonstrated TRW Clean Coal Combustion System/SDA could provide the following advantages:

- Improved fuel flexibility through reduced convection pass fouling and upper furnace slagging and the ability to satisfactorily tap low, medium, or high sulfur coal ashes with higher T_{250} slag viscosity temperatures.
- Reduced NO_x emissions of as much as 75 percent below current uncontrolled levels.
- Reduced SO_2 emissions of up to 99 percent from the current uncontrolled levels.
- Regain of lost unit boiler capacity or even an increase in unit capability of up to 10 percent.
- Improved combustion efficiency via conversion to pulverized coal firing.
- Lower parasitic power requirements than alternative acid rain control technologies.

The modifications to an existing cyclone furnace designed boiler to implement a TRW Clean Coal Combustion System with limestone injection retrofit will typically consist of the following:

1. Combustion Air System

No changes to the existing boiler forced draft system are required with a TRW retrofit, as the TRW Clean Coal Combustion System and coal pulverizer system will both take their necessary hot air supply from the existing boiler windbox.

2. Coal Supply System

The existing gravimetric coal feeders to each cyclone furnace will be rotated and adjusted in length as required to feed the normal - crushed cyclone furnace coal supply to new, dedicated attrition type coal pulverizer systems located in the boiler house basement. From the mills, the pulverized coal will be separated from the spent mill drying air in high efficiency cyclone separators and discharged to the TRW coal feed system similar to the coal feed system at the HCCP. The spent mill drying air is then vented to the existing boiler furnace via new NO_x ports surrounding the existing cyclone furnace reentrant throats.

Both conventional boilers and cyclone furnaces may have spatial limitations which make retrofit unique.

Industrial Market Segment for new capacity, re-powering, and retrofit for power generation boilers as well as process steam production boilers.

Industrial steam and hot water boilers range in size from a few thousand pounds per hour to over 7,000,000 pounds per hour steam capacity. Operators of oil-fired boilers have limited options if they desire to convert to coal firing. Aside from replacing their existing boilers with new coal-fired equipment, the only practical retrofit technologies currently available are coal/water slurries, micronized coal, and the TRW Clean Coal Combustion System.

Both slurry and micronized coal technologies impose high energy losses in either boiler efficiency or pulverizing costs. Neither technology offers any advantages regarding pollutant emissions, so that additional NO_x, SO_2, and particulate emission controls would be required for almost every application. The HCCP technology, in contrast, requires no boiler aerating and, in fact, may provide up to 10 percent additional capacity over the original boiler rating.

The industrial oil to coal conversion retrofit and repowering market hinges on three major factors:

1) the cost differential between coal and oil fuels
2) the quantity of oil consumed per year to be displaced by coal
3) the total cost of operating and installing the unit.

Operators of existing stoker-fired boilers may wish to convert to PC firing to improve combustion efficiency, operating flexibility, or permit the burning of a wider range of coals. If environmental regulations are additionally imposed, which require operators of stoker, cyclone, or PC boilers to reduce NO_x or SO_2 emissions significantly, the only practical options are to replace the boiler with a new technology such as fluidized bed, low NO_x burners with back end

NO_x controls such as urea injection or Selective Catalytic Reduction (SCR) and SDA systems, or convert to the TRW Clean Coal Combustion System.

Unique considerations about HCCP for extrapolation

The HCCP is unique in many ways in comparison to most commercial applications. All of these unique characteristics of the Healy site and coal warrant special consideration when extrapolating the results to “Lower 48” sites.

The most unique aspect of the HCCP is the coal. High levels of low heating value, low sulfur coal may be fired in HCCP. A thermo-gravimetric analysis indicates a very high reactivity. The coal is highly volatile and prone to auto ignition and dust type explosions.

HCCP is a first-of-a-kind plant. A major fraction of the total cost is related to the design and coupling of two distinctly different but new technologies/processes, one of which has never been built before and both of which have never been applied before in tandem. The plant was built understanding that this would lead to high costs and obstacles. Construction was intended to pave the way for the new technology in other commercial applications.

HCCP is approximately 12 kilometers from Denali National Park and Preserve. This close proximity to a National Park and Preserve lead the EPA, the Park Service, and the Alaska Department of Environmental Conservation (DEC) to set stringent emissions goals and requirements. Numerous costly field studies, monitoring, meteorological, and air quality data collection were required as a part of the project. In addition, the project was delayed for approximately 2 years resulting in considerable additional costs.

HCCP is in a geologically active area. Stringent seismic design and build requirements were incorporated into the plant.

HCCP is in a remote part of Alaska with high construction costs and challenging working conditions. A separate construction camp had to be built to minimize the impact of the construction on the local community.

In its remote location, HCCP is on a relatively isolated power grid and markets for HCCP power are extremely limited.

References

Healy Clean Coal Project: Fabrication and Construction Status, Technical Paper by Shiva K. Ubhayakar, TRW Program Manager

Healy Clean Coal Project: Design Criteria prepared by Stone & Webster Corporation, January, 1992.

Healy Clean Coal Project Turnover Packages

DOE Topical Reports:

- Combustion System Operation
- SDA Performance Test Report
- SDA Demonstration/Characterization Test Report
- Emission Compliance Report
- Boiler Performance Report
- DOE Topical Report 16: Healy Clean Coal Project
- 90-Day Commercial Operation Test and Sustained Operations Report: A Participant Perspective
- 1998 Operations Report
- 1999 Operations Report
- Project Performance and Economics Report – Final Report: Volume 2

List of Figures

List of Tables

ACRONYMS & ABBREVIATIONS

AIDEA	Alaska Industrial Development and Export Authority
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
AVR	Automatic Voltage Regulation
B&W	Babcock & Wilcox
BOP	Balance of Plant
CaO	Calcium Oxide
Ca/S	Calcium Sulfur ratio
$Ca(OH)_2$	Lime
$CaCO_3$	Limestone
CaO	Calcium Oxide
Ca/S	Calcium/Sulfur ratio
$CaSO_4$	Calcium Sulfite
$CaSO_3$	Calcium Sulfate
CEM(S)	Continuous Emissions Monitoring System
CFS	Coal Feed System
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CCTP	Clean Coal Technology Program
CFR	Code of Federal Regulations
CFS	Coal Feed System
CRT	Cathode Ray Tube
DCS	Distributed Control System
DEC	Alaska Department of Environmental Conservation
DEC VAX	Digital Equipment Corporation VAX Workstation
DOE	U.S. Department of Energy
DTP	Demonstration Test Program
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
ESP	Electrostatic Precipitator
ERV	Electromatic relief valve
FCM	Flash Calcined Material
FD	Forced Draft
FPCP	Fire Protection Control Panel
GVEA	Golden Valley Electric Association
HCCP	Healy Clean Coal Project
HGI	Harris Group Inc.
HP	High Pressure

HT	High Temperature
ID	Induced Draft
I/O	Input/Output
LP	Low Pressure
MCR	Maximum Continuous Rating
MFT	Master fuel trip
MFP	Multifunction Processors
Na	Sodium
NEMA	National Electric Manufacturers Association
NFPA	National Fire Prevention Association
NPHR	Net Plant Heat Rate
NPDES	National Pollution Discharge Elimination System
NPS	National Park and Preserve
NSPS	New Source Performance Standards
NH_i and NO, HCN	Nitrogen Species
NO_x	Oxides of Nitrogen
O_2	Oxygen
O&M	Operations and Maintenance
ODMS	Open Data Management Server
OIS	Operator Interface Stations
OSHA	Occupational Safety & Health Administration
PCS	Plant Control System
PC	PreCombustor
P&ID	Process and Instrument Diagrams
PCU	Process Control Units
PDR	Public Design Report
PF	Power Factor
PH	hydrogen Ion Concentration
PLC	Programmable Logic Controller
PM	Particulate Matter
PSA	Power Sales Agreement
PSD	Prevention of Significant Deterioration
ROM	Run-of-Mine
SC	Slagging Combustor
SiO_2	Silica
SO_2	Sulfur Dioxide
SO_3	Sulfur Trioxide
Stone & Webster	Stone & Webster Engineering Corporation
SCR	Selective Catalytic Reduction
SDA	Spray Dryer Absorber
TEFC	Totally Enclosed Fan Cooled
TRW	TRW, Incorporated
UBC	Uniform Building Code
UCM	Usibelli Coal Mines
UL	Underwriters Laboratory
VDC	Volts DC

Vol	Volume
VWO	Valves Wide Open
WTCS	Water treatment control system

LIST OF UNITS

A	Amperes
BTU	British Thermal Unit
Cm	Centimeters
^{0}F	Degrees Fahrenheit
Ft	feet
Fpm	feet per minute
Gpm	gallons per minute
GW	Gigawatts
Hg	inches mercury
HGA	inches mercury absolute
HP	Horsepower
Hz	Hertz
In	Inches
KV	Kilovolts
KW	Kilowatts
lbs.	Pounds
lbs./hr.	Pounds/hour
lbs/ft2	Pounds/square feet
lbs/cf	Pounds per cubic feet
Mho	Electrical conductance
MW	Megawatts
MWH	Megawatt-Hours
ppb	Parts per billion
ppm	Parts per million
psi(a)(g)	Pounds/square inch
BTU/Hr.	British Thermal Unit per Hour
NTU	Turbidity Units
SCF	Standard Cubic feet
Sec	Seconds
T_{250}	Ash Fusion Temperature
tph	Tons per hour
ug/l	Micrograms/liter
V	Volts
wg	Water gauge

Appendix A

LIST OF EQUIPMENT

HEALY CLEAN COAL PROJECT
ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY
MECHANICAL EQUIPMENT LIST
HCP-030, A~~PPENDIX 5A, ADDENDUM~~ H

TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2AB-BE1	BUCKET ELEVATOR	BOTTOM ASH	P241G-036	P241G	HCP-030	
2AB-CNV1	TRANSFER DRAG CONVEYOR	BOTTOM ASH	P241G-036	P241G	HCP-030	
2AB-CNV2	TRANSFER BELT CONVEYOR	BOTTOM ASH	P241G-036	P241G	HCP-030	
2AB-CRN1	ASH SILO HST		P241G-036	P241G	HCP-030	
2AB-E1	ASH WATER HEAT EXCHANGER	ASH WATER	P241G-033	P241G	HCP-030	
2AB-E2	ASH WATER HEAT EXCHANGER	ASH WATER	P241G-033	P241G	HCP-030	
2AB-HOP1	PYRITES HOPPER	ASH WATER/PYR	P241G-032	P241G	HCP-030	
2AB-HOP2	PYRITES HOPPER	ASH WATER/PYR	P241G-032	P241G	HCP-030	
2AB-HPU1	HYDRAULIC POWER UNIT	SLAG ASH SDC	P241G-034	P241G	HCP-030	
2AB-HPU2	HYDRAULIC POWER UNIT	BOTTOM ASH SDC	P241G-034	P241G	HCP-030	
2AB-P4	PYRITES JET PUMP	ASH WTR/PYRITES	P241G-032	P241G	HCP-030	
2AB-P5	PYRITES JET PUMP	ASH WTR/PYRITES	P241G-032	P241G	HCP-030	
2AB-SCN1	VIBRATING SCREEN GRIZZLY	BOTTOM ASH	P241G-036	P241G	HCP-030	
2AB-SCN2	VIBRATING SCREEN GRIZZLY	SLAG ASH	P241G-036	P241G	HCP-030	
2AB-SDC1	DRAG CHAIN CONVEYOR	SLAG ASH	P241G-034	P241G	HCP-030	
2AB-SDC2	DRAG CHAIN CONVEYOR	BOTTOM ASH	P241G-035	P241G	HCP-030	

HEALY CLEAN COAL PROJECT
ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY
MECHANICAL EQUIPMENT LIST
HCP-030, APPENDIX 5A, ADDENDUM H

TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2AB-SL01	BOTTOM ASH STORAGE SILO	BOTTOM ASH	P241G-036	P241G	HCP-030	
2AB-TK1A	ASH WATER SURGE TANK	WATER	P241G-030	P241G	HCP-030	
2AB-TK1B	ASH WATER SURGE TANK	WATER	P241G-030	P241G	HCP-030	
2AB-TK2A	HYDR TANK	BOTTOM ASH SILO GATE ACT	P241G-036	P241G	HCP-030	
2AB-TK2B	FAIL SIZE ACCUM	BOTTOM ASH SILO GATE ACT	P241G-036	P241G	HCP-030	
2AB-VBN1A	MECHANICAL VIBRATOR	BOTTOM ASH SILO	P241G-036	P241G	HCP-030	
2AB-VBN1B	MECHANICAL VIBRATOR	BOTTOM ASH SILO	P241G-036	P241G	HCP-030	
2AB-VBN1C	MECHANICAL VIBRATOR	BOTTOM ASH SILO	P241G-036	P241G	HCP-030	
2AB-VBN1D	MECHANICAL VIBRATOR	BOTTOM ASH SILO	P241G-036	P241G	HCP-030	
2AB-VBN1E	MECHANICAL VIBRATOR	BOTTOM ASH SILO	P241G-036	P241G	HCP-030	
2AF-AL1	PRI COLL AIR LOCK	FLY ASH	P241D-002	P241D	HCP-030	
2AF-AL2	SEC COLL AIR LOCK	FLY ASH	P241D-002	P241D	HCP-030	
2AF-BWR1A	FLY ASH PRESSURE BLOWER	FLY ASH	P241D-001	P241D	HCP-030	
2AF-BWR1B	FLY ASH PRESSURE BLOWER	FLY ASH	P241D-001	P241D	HCP-030	
2AF-BWR2A	VACUUM BLOWER	FLY ASH	P241D-002	P241D	HCP-030	
2AF-BWR2B	VACUUM BLOWER	FLY ASH	P241D-002	P241D	HCP-030	

HEALY CLEAN COAL PROJECT
ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY
MECHANICAL EQUIPMENT LIST
HCP-030, APPENDIX 5A, ADDENDUM H

TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2AF-BWR4A	SILO AERATION BLOWER	FLY ASH	P241D-002	P241D	HCP-030	
2AF-BWR4B	SILO AERATION BLOWER	FLY ASH	P241D-002	P241D	HCP-030	
2AF-DC1	PRIMARY COLLECTOR	FLY ASH	P241D-002	P241D	HCP-030	
2AF-DC2	SECONDARY COLLECTOR	FLY ASH	P241D-002	P241D	HCP-030	
2AF-EJ1A	INL FLX VIBR JOINT	FLY ASH PRESSURE BLOWER	P241D-001	P241D	HCP-030	
2AF-EJ1B	INL FLX VIBR JOINT	FLY ASH PRESSURE BLOWER	P241D-001	P241D	HCP-030	
2AF-EJ2A	OUT FLX VIBR JOINT	FLY ASH PRESSURE BLOWER	P241D-001	P241D	HCP-030	
2AF-EJ2B	OUT FLX VIBR JOINT	FLY ASH PRESSURE BLWR 1B	P241D-001	P241D	HCP-030	
2AF-EJ3	FLX VIBR JOINT	PRESS LINE @ MIXING TEE	P241D-001	P241D	HCP-030	
2AF-EJ4A	INL FLX VIBR JOINT	FLY ASH VAC BLWR 2A	P241D-002	P241D	HCP-030	
2AF-EJ4B	INL FLX VIBR JOINT	FLY ASH VAC BLWR 2B	P241D-002	P241D	HCP-030	
2AF-EJ5A	OUT FLX VIBR JOINT	FLY ASH VACUUM BLOWER 2A	P241D-002	P241D	HCP-030	
2AF-EJ5B	OUT FLX VIBR JOINT	FLY ASH VACUUM BLWR 2B	P241D-002	P241D	HCP-030	
2AF-EJ6A	INL FLX VIBR JOINT	FLY ASH SILO AER BLWR 4A	P241D-002	P241D	HCP-030	
2AF-EJ6B	INL FLX VIBR JOINT	FLY ASH SILO AER BLWR 4B	P241D-002	P241D	HCP-030	
2AF-EJ7A	OUT FLX VIBR JOINT	FLY ASH SILO AER BLWR 4A	P241D-002	P241D	HCP-030	

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HCP-030, APPENDIX 5A, ADDENDUM H

TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2AF-EJ7B	OUT FLX VIBR JOINT	FLY ASH SILO AER BLWR 4B	P241D-002	P241D	HCP-030	
2AF-EJ8	EXPANSION JOINT	2AF-FN1 EXHAUST	P241D-002	P241D	HCP-030	
2AF-FDR1	PUGMILL VAR SPEED FEEDER	FLY ASH	P241D-002	P241D	HCP-030	
2AF-FLT1A	INLET FILTER	FLY ASH PRESS BLWR 1A	P241D-001	P241D	HCP-030	
2AF-FLT1B	INLET FILTER	FLY ASH PRESS BLWR 1B	P241D-001	P241D	HCP-030	
2AF-FLT2	BIN VENT FILTER	FLY ASH SILO	P241D-002	P241D	HCP-030	
2AF-FLT4A	INLET FILTER	FLY ASH SILO AER BLWR 4A	P241D-002	P241D	HCP-030	
2AF-FLT4B	INLET FILTER	FLY ASH SILO AER BLWR 4B	P241D-002	P241D	HCP-030	
2AF-FN1	DRY DUST UNLDR EXH FAN	FLY ASH	P241D-002	P241D	HCP-030	
2AF-H1	AIR HEATER	FLY ASH AERATION	P241D-002	P241D	HCP-030	
2AF-SIL1A	INLET SILENCER	FLY ASH PRESSURE BLWR 1A	P241D-001	P241D	HCP-030	
2AF-SIL1B	INLET SILENCER	FLY ASH PRESSURE BLWR 1B	P241D-001	P241D	HCP-030	
2AF-SIL2A	DSCH SILENCER	FLY ASH PRESSURE BLWR 1A	P241D-001	P241D	HCP-030	
2AF-SIL2B	DISCH SILENCER	FLY ASH PRESSURE BLWR 1B	P241D-001	P241D	HCP-030	
2AF-SIL3A	DSCH SILENCER	FLY ASH VAC BLOWER 2A	P241D-002	P241D	HCP-030	
2AF-SIL3B	DSCH SILENCER	FLY ASH VAC BLWR 2B	P241D-002	P241D	HCP-030	

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HCP-030, APPENDIX 5A, ADDENDUM H

TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2AF-SIL4A	INLET SILENCER	FLY ASH AER BLWR 4A	P241D-002	P241D	HCP-030	
2AF-SIL4B	INLET SILENCER	FLY ASH AER BLWR 4B	P241D-002	P241D	HCP-030	
2AF-SIL5A	DISCH SILENCER	FLY ASH AER BLWR 4A	P241D-002	P241D	HCP-030	
2AF-SIL5B	DISCH SILENCER	FLY ASH AER BLWR 4B	P241D-002	P241D	HCP-030	
2AF-SL01	FLY ASH SILO	FLY ASH	P241D-002	P241D	HCP-030	
2AF-UL1	DRY DUST UNLOADER	FLY ASH	P241D-002	P241D	HCP-030	
2AF-UL2	PUGMILL UNLOADER	FLY ASH	P241D-002	P241D	HCP-030	
2AP-C1A	AIR COMPRESSOR	PLANT AIR	P261D-001	P261D	HCP-030	
2AP-C1B	AIR COMPRESSOR	PLANT AIR	P261D-001	P261D	HCP-030	
2AP-C1C	AIR COMPRESSOR	PLANT AIR	P261D-001	P261D	HCP-030	
2AP-STR1	STRAINER	AIR RECEIVER	EJ-AP01	HCP-030	HCP-030	
2AP-TK1	AIR RECEIVER		EJ-AP01	P261D	HCP-030	
2AP-TRP1	TRAP	AIR RECEIVER	EJ-AP01	P261D	HCP-030	
2AR-EJ1A	COND AIR REM EX JOINT		EJ-MS01	HCP-030	HCP-030	
2AR-EJ1B	COND AIR REM EX JOINT		EJ-MS01	HCP-030	HCP-030	
2AR-J1	STM JET AIR EJECTOR	CONDENSER	EJ-MS01	P111A	HCP-030	

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HCP-030, APPENDIX 5A, ADDENDUM H

TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2AR-STR1	INLET STRAINER	SJAE AND GLAND STEAM	EJ-MS01	HCP-030	HCP-030	
2AR-STR2	INTCOND TRP STR		EJ-MS01	HCP-030	HCP-030	
2AR-TRP1	INTCOND SJAE DRAIN TRP		EJ-MS01	P111A	HCP-030	
1AS-STR1	STRAINER	U.1 CONDENSATE RETURN	EJ-AS01	HCP-030	HCP-030	
1AS-STR2	STRAINER	U.1 CONDENSATE RETURN	EJ-AS01	HCP-030	HCP-030	
1AS-TRP1	TRAP	CONDENSATE RETURN	EJ-AS01	HCP-030	HCP-030	
1AS-TRP2	TRAP	CONDENSATE RETURN	EJ-AS01	HCP-030	HCP-030	
2AS-B1	HCCP AUXILIARY BOILER	AUXILIARY STEAM	EJ-AS01	HCP-030	HCP-030	
2AS-DSH1	DESUPERHEATER	AUXILIARY STEAM	EJ-AS01	HCP-030	HCP-030	
2AS-EJ1	EXPANSION JOINT	AUX STM BOILER STACK	EJ-AS01	HCP-030	HCP-030	
2AS-STR3	STRAINER	CONDENSER SPARGER	EJ-AS02	HCP-030	HCP-030	
2AS-STR5A	STRAINER	PULVERIZER INERTING STEAM	P201W-236	HCP-009	HCP-030	
2AS-STR5B	STRAINER	PULVERIZER INERTING STEAM	P201W-236	HCP-009	HCP-030	
2AS-TRP3	TRAP	CONDENSER SPARGER	EJ-AS02	HCP-030	HCP-030	
2AS-TRP5A	CONDENSATE TRAP	PULVERIZER INERTING STEAM	P201W-236	HCP-009	HCP-030	
2AS-TRP5B	CONDENSATE TRAP	PULVERIZER INERTING STEAM	P201W-236	HCP-009	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2AW-P1A	ASH WATER RECIRC PUMP	ASH WATER	P241G-031	P241G	HCP-030	
2AW-P1B	ASH WATER RECIRC PUMP	ASH WATER	P241G-031	P241G	HCP-030	
2AW-P2A	ASH WATER SLUICING PUMP	ASH WATER	P241G-031	P241G	HCP-030	
2AW-P2B	ASH WATER SLUICING PUMP	ASH WATER	P241G-031	P241G	HCP-030	
2AW-STR1A	AUTO STRAINER	ASH WATER RECIRC	P241G-031	P241G	HCP-030	
2AW-STR1B	AUTO STRAINER	ASH WATER RECIRC	P241G-031	P241G	HCP-030	
2AW-STR2A	AUTO STRAINER	ASH WATER SLUICE	P241G-031	P241G	HCP-030	
2AW-STR2B	AUTO STRAINER	ASH WATER SLUICE	P241G-031	P241G	HCP-030	
2BA-EJ1	EXPANSION JOINT	TEMPERING AIR	P201W-006	HCP-009	HCP-009	D
2BA-EJ2	EXPANSION JOINT	TEMPERING AIR	P201W-006	HCP-009	HCP-009	D
2BA-EJ3	EXPANSION JOINT	PRIMARY AIR	P201W-006	HCP-009	HCP-009	D
2BA-EJ5	EXPANSION JOINT	PULV 1A PRIMARY AIR	P201W-007	HCP-009	HCP-009	
2BA-EJ6	EXPANSION JOINT	PULV 1A PRIMARY AIR	P201W-007	HCP-009	HCP-009	
2BA-EJ7	EXPANSION JOINT	PULV 1B PRIMARY AIR	P201W-007	HCP-009	HCP-009	
2BA-EJ8	EXPANSION JOINT	PULV 1B PRIMARY AIR	P201W-007	HCP-009	HCP-009	
2BA-EJ9	EXPANSION JOINT	PRIMARY AIR	P201W-006	HCP-009	HCP-009	D

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2BA-EJ10A	EXPANSION JOINT	FD FAN INLET	P201W-006	HCP-009	HCP-009	
2BA-EJ10B	EXPANSION JOINT	FD FAN INLET	P201W-006	HCP-009	HCP-009	
2BA-EJ11	EXPANSION JOINT	PRIMARY AIR	P201W-006	HCP-009	HCP-009	
2BA-EJ12	EXPANSION JOINT	PRIMARY AIR	P201W-006	HCP-009	HCP-009	
2BA-EJ14	EXPANSION JOINT	PULV 1B PRIMARY AIR	P201W-007	HCP-009	HCP-009	
2BA-EJ15	EXP JOINT	SEC AIR TO PC1A	P201B-019	P201X	HCP-009	
2BA-EJ16	EXP JOINT	SEC AIR TO PC1A	P201B-019	P201X	HCP-009	
2BA-EJ17	EXPANSION JOINT	SECONDARY AIR	P201W-006	HCP-009	HCP-009	
2BA-EJ18	EXPANSION JOINT	SECONDARY AIR	P201W-006	HCP-009	HCP-009	
2BA-EJ19	EXPANSION JOINT	SECONDARY AIR	P201W-006	HCP-009	HCP-009	
2BA-EJ20	EXP JOINT	SEC AIR TO PC1B	P201B-019	P201X	HCP-009	
2BA-EJ21	EXP JOINT	SEC AIR TO PC1B	P201B-019	P201X	HCP-009	
2BA-EJ23	EXP JOINT	SEC AIR TO PC1A MIX ANUL	P201B-019	P201X	HCP-009	
2BA-EJ24	EXP JOINT	SEC AIR TO PC1A MIX ANUL	P201B-019	P201X	HCP-009	
2BA-EJ25	EXP JOINT	SEC AIR TO PC1A MIX ANUL	P201B-019	P201X	HCP-009	
2BA-EJ26	EXP JOINT	SEC AIR TO PC1B MIX ANUL	P201B-019	P201X	HCP-009	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2BA-EJ27	EXP JOINT	SEC AIR TO PC1B MIX ANUL	P201B-019	P201X	HCP-009	
2BA-EJ28	EXPANSION JOINT	SECONDARY AIR	P201W-006	HCP-009	HCP-009	
2BA-EJ29	EXPANSION JOINT	SECONDARY AIR	P201W-006	HCP-009	HCP-009	
2BA-EJ30	EXPANSION JOINT	SECONDARY AIR	P201W-006	HCP-009	HCP-009	
2BA-EJ31	EXPANSION JOINT	SECONDARY AIR	P201W-006	HCP-009	HCP-009	
2BA-EJ32	EXPANSION JOINT	SECONDARY AIR	P201W-006	HCP-009	HCP-009	
2BA-EJ33	EXPANSION JOINT	SECONDARY AIR	P201W-006	HCP-009	HCP-009	
2BA-EJ100A	EXPANSION JOINT	FD FAN INLET	P201W-006	HCP-030	HCP-030	
2BA-EJ100B	EXPANSION JOINT	FD FAN INLET	P201W-006	HCP-030	HCP-030	
2BA-FLT1A	AIR FILTER	PC1A FLAME SCANNER	P201B-090	P201X	HCP-009	
2BA-FLT1B	AIR FILTER	PC1B FLAME SCANNER	P201B-091	P201X	HCP-009	
2BA-FLT2A	AIR FILTER	PC1A FLAME SCANNER	P201B-090	P201X	HCP-009	
2BA-FLT2B	AIR FILTER	PC1B FLAME SCANNER	P201B-091	P201X	HCP-009	
2BA-FLT3A	AIR FILTER	SC2A FLAME SCANNER	P201B-090	P201X	HCP-009	
2BA-FLT3B	AIR FILTER	SC2B FLAME SCANNER	P201B-091	P201X	HCP-009	
2BA-FLT4A	AIR FILTER	SC2A FLAME SCANNER	P201B-090	P201X	HCP-009	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2BA-FLT4B	AIR FILTER	SC2B FLAME SCANNER	P201B-091	P201X	HCP-009	
2BA-FLX1	FLEX HOSE	PULV 1A ROLLER PURGE AIR	P201W-007	HCP-009	HCP-009	
2BA-FLX2	FLEX HOSE	PULV 1A ROLLER PURGE AIR	P201W-007	HCP-009	HCP-009	
2BA-FLX3	FLEX HOSE	PULV 1A ROLLER PURGE AIR	P201W-007	HCP-009	HCP-009	
2BA-FLX4	FLEX HOSE	PULV 1A ROLLER PURGE AIR	P201W-007	HCP-009	HCP-009	
2BA-FLX5	FLEX HOSE	PULV 1A ROLLER PURGE AIR	P201W-007	HCP-009	HCP-009	
2BA-FLX6	FLEX HOSE	PULV 1A ROLLER PURGE AIR	P201W-007	HCP-009	HCP-009	
2BA-FLX7	FLEX HOSE	PULV 1B ROLLER PURGE AIR	P201W-007	HCP-009	HCP-009	
2BA-FLX8	FLEX HOSE	PULV 1B ROLLER PURGE AIR	P201W-007	HCP-009	HCP-009	
2BA-FLX9	FLEX HOSE	PULV 1B ROLLER PURGE AIR	P201W-007	HCP-009	HCP-009	
2BA-FLX10	FLEX HOSE	PULV 1B ROLLER PURGE AIR	P201W-007	HCP-009	HCP-009	
2BA-FLX11	FLEX HOSE	PULV 1B ROLLER PURGE AIR	P201W-007	HCP-009	HCP-009	
2BA-FLX12	FLEX HOSE	PULV 1B ROLLER PURGE AIR	P201W-007	HCP-009	HCP-009	
2BA-FN1	FD FAN		P201W-006	HCP-009	HCP-009	
2BA-SIL1A	SILENCER	FD FAN INLET	P201W-006	HCP-009	HCP-009	
2BA-SIL1B	SILENCER	FD FAN INLET	P201W-006	HCP-009	HCP-009	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2BB-TK1	CONT. BOILER BLOWDOWN TK	-	EJ-BD01	HCP-030	HCP-030	
2BC-BNR1A	PRECOMBUSTOR A		P201B-088	P201X	HCP-009	
2BC-BNR1B	PRECOMBUSTOR B		P201B-089	P201X	HCP-009	
2BC-BNR2A	SLAGGING COMBUSTOR A		P201B-088	P201X	HCP-009	
2BC-BNR2B	SLAGGING COMBUSTOR B		P201B-089	P201X	HCP-009	
2BD-TK1	BOILER BLOW-OFF TANK		EJ-BD01	HCP-030	HCP-030	
2BD-VH1	VENT HOOD	BOILER BLOW-OFF TANK	EJ-BD01	HCP-030	HCP-030	
2BS-B1	HCCP MAIN BOILER		P201W-005	HCP-009	HCP-009	
2BS-DSH1	MAIN STEAM ATTEMPERATOR	ATTEMPERATING	P201W-005	HCP-009	HCP-009	
2BS-SB21	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB22	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB23	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB24	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB25	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB26	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB27	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2BS-SB28	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB29	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB30	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB31	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB32	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB33	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB34	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB35	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB36	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB37	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB38	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB39	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB40	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB41	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB42	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB43	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2BS-SB44	STEAM SOOT BLWR	BOILER	P201W-231	HCP-009	HCP-009	
2BS-SB45	STEAM SOOT BLWR	ECONOMIZER	P201W-231	HCP-009	HCP-009	
2BS-SB46	STEAM SOOT BLWR	ECONOMIZER	P201W-231	HCP-009	HCP-009	
2BS-SB47	STEAM SOOT BLWR	ECONOMIZER	P201W-231	HCP-009	HCP-009	
2BS-SB48	STEAM SOOT BLWR	ECONOMIZER	P201W-231	HCP-009	HCP-009	
2BW-E1A	HEAT EXCH	COMB CIRC PUMP 1A	P201B-309	P201X	HCP-009	
2BW-E1B	HEAT EXCH	COMB CIRC PUMP 1B	P201B-309	P201X	HCP-009	
2BW-P1A	HP CMBSTR CIRC WTR PMP	SLAGGING COMBUSTOR	P201B-309	P201X	HCP-009	
2BW-P1B	HP CMBSTR CIRC WTR PMP	SLAGGING COMBUSTOR	P201B-309	P201X	HCP-009	
2CA-P1A	AUX COND XFER PUMP		EJ-CA01	HCP-030	HCP-030	
2CA-P1B	AUX COND XFER PUMP		EJ-CA01	HCP-030	HCP-030	
2CA-STR1	STRAINER	FROM AUX STREAM	EJ-AS01	HCP-030	HCP-030	
2CA-STR2	STRAINER	FROM AUX STEAM	EJ-AS02	HCP-030	HCP-030	
2CA-STR3	STRAINER	FROM AUX STEAM	EJ-CA01	HCP-030	HCP-030	
2CA-STR4	STRAINER	FROM AUX STEAM	EJ-CA01	HCP-030	HCP-030	
2CA-STR5	STRAINER	FROM AUX STEAM	EJ-CA01	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2CA-STR6	STRAINER	FROM AUX STEAM	EJ-CA01	HCP-030	HCP-030	
2CA-STR7	STRAINER	FROM AUX STEAM	EJ-CA01	HCP-030	HCP-030	
2CA-STR8	STRAINER	FROM AUX STEAM	EJ-AS01	HCP-030	HCP-030	
2CA-STR9	STRAINER	FROM AUX STEAM	EJ-AS02	HCP-030	HCP-030	
2CA-STR10A	STRAINER	P1A SUCTION	EJ-CA01	HCP-030	HCP-030	
2CA-STR10B	STRAINER	P1B SUCTION	EJ-CA01	HCP-030	HCP-030	
2CA-STR11	STRAINER	XFER PUMP BYPASS	EJ-CA01	HCP-030	HCP-030	
2CA-STR12	STRAINER	FROM AUX COND REC	EJ-CA01	HCP-030	HCP-030	
2CA-TK1	AUX COND. RECVR TANK		EJ-CA01	HCP-030	HCP-030	
2CA-TRP1	TRAP	FROM 2AS-010-14	EJ-AS01	HCP-030	HCP-030	
2CA-TRP2	TRAP	FROM 2AS-004-19	EJ-AS02	HCP-030	HCP-030	
2CA-TRP3	TRAP	FROM AUX STEAM	EJ-CA01	HCP-030	HCP-030	
2CA-TRP4	TRAP	FROM AUX STEAM	EJ-CA01	HCP-030	HCP-030	
2CA-TRP5	TRAP	FROM AUX STEAM	EJ-CA01	HCP-030	HCP-030	
2CA-TRP6	TRAP	FROM AUX STEAM	EJ-CA01	HCP-030	HCP-030	
2CA-TRP7	TRAP	FROM AUX STEAM	EJ-CA01	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2CA-TRP8	TRAP	FROM AUX STEAM	EJ-CA01	HCP-030	HCP-030	
2CA-TRP9	TRAP	FROM AUX STEAM	EJ-CA01	HCP-030	HCP-030	
2CC-E1A	COMP CLG WTR HX		EJ-CC01	HCP-030	HCP-030	
2CC-E1B	COMP CLG WTR HX		EJ-CC01	HCP-030	HCP-030	
2CC-P1A	COMP COOLING WTR PMP		EJ-CC01	HCP-030	HCP-030	
2CC-P1B	COMP COOLING WTR PMP		EJ-CC01	HCP-030	HCP-030	
2CC-STR1A	STRAINER	COMP COOLG WTR PMP INLET	EJ-CC01	HCP-030	HCP-030	
2CC-STR1B	STRAINER	COMP COOLG WTR PMP INLET	EJ-CC01	HCP-030	HCP-030	
2CC-TK1	COMP COOLING WTR SURGE TK		EJ-CC01	HCP-030	HCP-030	
2CC-TK2	CHEM ADDITION TANK		EJ-CC01	HCP-030	HCP-030	
2CF-CC1A	CALIBRATION CYLINDER	SULF ACID (SKD MTD)	W014Z-006	W014Z	W014Z	
2CF-CC1B	CALIBRATION CYLINDER	SULF ACID (SKD MTD)	W014Z-006	W014Z	W014Z	
2CF-CC2A	CALIBRATION CYLINDER	SODIUM HYDRO (SKD MTD)	W014Z-006	W014Z	W014Z	
2CF-CC2B	CALIBRATION CYLINDER	SODIUM HYDRO (SKD MTD)	W014Z-006	W014Z	W014Z	
2CF-CC3	ANTI SCAL MTRG CAL CYL	(SKD MTD)	W014Z-007	W014Z	W014Z	
2CF-CC4	BISULFITE MTRG CAL CYL	(SKD MTD)	W014Z-007	W014Z	W014Z	

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HCP-030, APPENDIX 5A, ADDENDUM H

TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2CF-CC5	PLNT HYRO MTRG CAL CYL	(SKD MTD)	W014Z-007	W014Z	W014Z	
2CF-CC6	RO ACID MTRG CAL CYL	(SKD MTD)	W014Z-007	W014Z	W014Z	
2CF-CC7	POLYMER MTRG CAL CYL	(SKD MTD)	W014Z-007	W014Z	W014Z	
2CF-CC8A	OX SCAV MTRG CAL COLUMN	(SKD MTD)	W014Z-008	W014Z	W014Z	
2CF-CC8B	OX SCAV MTRG CAL COLUMN	(SKD MTD)	W014Z-008	W014Z	W014Z	
2CF-CC9A	AMINE MTRG CAL COLUMN	(SKD MTD)	W014Z-008	W014Z	W014Z	
2CF-CC9B	AMINE MTRG CAL COLUMN	(SKD MTD)	W014Z-008	W014Z	W014Z	
2CF-CC9C	AMINE MTRG CAL COLUMN	(SKID MOUNTED)	W014Z-008	W014Z	W014Z	
2CF-E1	SODIUM HYDROXIDE DILUTION	WATER HEAT EXCH (SKD MTD)	W014Z-006	W014Z	W014Z	
2CF-H1	SODIUM HYDROXIDE BULK TK	HEATER (IN TANK TK2)	W014Z-006	W014Z	W014Z	
2CF-MIX1	ANTISCALANT MIXER	TANK AGITATION (ON TANK)	W014Z-007	W014Z	W014Z	
2CF-MIX2	SOD BISULFITE MIXER	TANK AGITATION (ON TANK)	W014Z-007	W014Z	W014Z	
2CF-MIX3	PLANT WTR SOD HYPO MIXER	TANK AGITATION (ON TANK)	W014Z-007	W014Z	W014Z	
2CF-MIX4	POLYMER FEED TK MIXER	TANK AGITATION (ON TANK)	W014Z-007	W014Z	W014Z	
2CF-P1A	SULFURIC ACID FEED PMP	MIXED BED REGEN (SKD MTD)	W014Z-006	W014Z	W014Z	
2CF-P1B	SULFURIC ACID FEED PUMP	MIXED BED REGEN (SKD MTD)	W014Z-006	W014Z	W014Z	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2CF-P2A	SODIUM HYDROXIDE FEED PMP	MIXED BED REGEN (SKD MTD)	W014Z-006	W014Z	W014Z	
2CF-P2B	SODIUM HYDROXIDE FEED PMP	MIXED BED REGEN (SKD MTD)	W014Z-006	W014Z	W014Z	
2CF-P3A	RO ANTISCALING FEED PMP	(SKID MOUNTED)	W014Z-007	W014Z	W014Z	
2CF-P3B	RO ANTISCALING FEED PMP	(SKID MOUNTED)	W014Z-007	W014Z	W014Z	
2CF-P4A	RO BISULFITE FEED PMP	(SKID MOUNTED)	W014Z-007	W014Z	W014Z	
2CF-P4B	RO BISULFITE FEED PMP	(SKID MOUNTED)	W014Z-007	W014Z	W014Z	
2CF-P5A	PLANT HYPOCL FEED PMP	(SKID MOUNTED)	W014Z-007	W014Z	W014Z	
2CF-P5B	PLANT HYPOCL FEED PMP	(SKID MOUNTED)	W014Z-007	W014Z	W014Z	
2CF-P6A	POLYMER FEED PUMP	(SKID MOUNTED)	W014Z-007	W014Z	W014Z	
2CF-P6B	POLYMER FEED PUMP	(SKID MOUNTED)	W014Z-007	W014Z	W014Z	
2CF-P8A	OXYGEN SCAV FEED PUMP	(SKID MOUNTED)	W014Z-008	W014Z	W014Z	
2CF-P8B	OXYGEN SCAV FEED PUMP	(SKID MOUNTED)	W014Z-008	W014Z	W014Z	
2CF-P9A	AMINE FEED PUMP	(SKID MOUNTED)	W014Z-008	W014Z	W014Z	
2CF-P9B	AMINE FEED PUMP	(SKID MOUNTED)	W014Z-008	W014Z	W014Z	
2CF-P10A	RO ACID FEED PUMP	(SKID MOUNTED)	W014Z-007	W014Z	W014Z	
2CF-P10B	RO ACID FEED PUMP	(SKID MOUNTED)	W014Z-007	W014Z	W014Z	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2CF-P11	AMINE FEED DRUM PUMP	DEMIN MKUP TO CN STOR TK	EJ-CN03	HCP-030	HCP-030	
2CF-PD1	ACID MTRG PULS DAMP	(SKID MOUNTED)	W014Z-006	W014Z	W014Z	
2CF-PD2	SOD HYPOCL MTRG PULS DAMP	(SKID MOUNTED)	W014Z-006	W014Z	W014Z	
2CF-PD3	OX SCAVENGER PULS DAMPEN	(SKID MOUNTED)	W014Z-008	W014Z	W014Z	
2CF-PD4	AMINE FEED PULS DAMPENER	(SKID MOUNTED)	W014Z-008	W014Z	W014Z	
2CF-SKD1	OXYGEN SCAVENGER SKID	WATER TREATMENT SYS	W014Z-008	W014Z	HCP-030	
2CF-SKD2	AMINE FEED SKID	WATER TREATMENT SYS	W014Z-008	W014Z	HCP-030	
2CF-SKD3	POLYMER FEED SKID	WATER TREATMENT SYS	W014Z-007	W014Z	HCP-030	
2CF-SKD4	CAUSTIC REGEN SKID	WATER TREATMENT SYS	W014Z-006	W014Z	HCP-030	
2CF-SKD5	ACID REGEN SKID	WATER TREATMENT SYS	W014Z-006	W014Z	HCP-030	
2CF-SKD6	ANTI SCALANT FEED SKID	WATER TREATMENT SYS	W014Z-007	W014Z	HCP-030	
2CF-SKD7	RO ACID FEED SKID	WATER TREATMENT SYS	W014Z-007	W014Z	HCP-030	
2CF-SKD8	SODIUM HYPOCHLORITE SKID	WATER TREATMENT SYS	W014Z-007	W014Z	HCP-030	
2CF-SKD9	SODIUM BISULFITE SKID	WATER TREATMENT SYS	W014Z-007	W014Z	HCP-030	
2CF-STR1A	MB REGEN PMP STRAINER	(SKID MOUNTED)	W014Z-006	W014Z	W014Z	
2CF-STR1B	MB REGEN PMP STRAINER	(SKID MOUNTED)	W014Z-006	W014Z	W014Z	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2CF-STR2A	MB REGEN PMP STRAINER	(SKID MOUNTED)	W014Z-006	W014Z	W014Z	
2CF-STR2B	MB REGEN PMP STRAINER	(SKID MOUNTED)	W014Z-006	W014Z	W014Z	
2CF-STR3A	SCALE INH FD PMP STRAINER	(SKID MOUNTED)	W014Z-007	W014Z	W014Z	
2CF-STR3B	SCALE INH FD PMP STRAINER	(SKID MOUNTED)	W014Z-007	W014Z	W014Z	
2CF-STR4A	RO BISUFITE MTRG STRAINER	(SKID MOUNTED)	W014Z-007	W014Z	W014Z	
2CF-STR4B	RO BISUFITE MTRG STRAINER	(SKID MOUNTED)	W014Z-007	W014Z	W014Z	
2CF-STR5A	RO HYPOCHL MTRG STRAINER	(SKID MOUNTED)	W014Z-007	W014Z	W014Z	
2CF-STR5B	RO HYPOCHL MTRG STRAINER	(SKID MOUNTED)	W014Z-007	W014Z	W014Z	
2CF-STR6A	POLYMER MTRG STRAINER	(SKID MOUNTED)	W014Z-007	W014Z	W014Z	
2CF-STR6B	POLYMER MTRG STRAINER	(SKID MOUNTED)	W014Z-007	W014Z	W014Z	
2CF-STR8A	OXYGEN SCAV FEED STRAINER	(SKID MOUNTED)	W014Z-008	W014Z	W014Z	
2CF-STR8B	OXYGEN SCAV FEED STRAINER	(SKID MOUNTED)	W014Z-008	W014Z	W014Z	
2CF-STR9A	AMINE FEED STRAINER	(SKID MOUNTED)	W014Z-008	W014Z	W014Z	
2CF-STR9B	AMINE FEED STRAINER	(SKID MOUNTED)	W014Z-008	W014Z	W014Z	
2CF-STR9C	AMINE FEED STRAINER	(SKID MOUNTED)	W014Z-008	W014Z	HCP-030	
2CF-STR10A	RO ACID MTRG STRAINER	(SKID MOUNTED)	W014Z-007	W014Z	W014Z	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2CF-STR10B	RO ACID MTRG STRAINER	(SKID MOUNTED)	W014Z-007	W014Z	W014Z	
2CF-TK1	SUFURIC ACID BULK TK		W014Z-006	W014Z	HCP-030	
2CF-TK2	SODIUM HYDROXIDE BULK TK		W014Z-006	W014Z	HCP-030	
2CF-TK3	ANTISCALANT FEED TK	(SKD MTD)	W014Z-007	W014Z	W014Z	
2CF-TK4	SODIUM BISULFITE	FEED TANK (SKD MTD)	W014Z-007	W014Z	W014Z	
2CF-TK5	PLANT WATER SODIUM HYPO	FEED TANK (SKD MTD)	W014Z-007	W014Z	W014Z	
2CF-TK6	POLYMER FEED TANK	(SKD MTD)	W014Z-007	W014Z	W014Z	
2CF-TK8	OXYGEN SCAV FEED TK		W014Z-008	HCP-023	HCP-023	E
2CF-TK9	AMINE FEED TK		W014Z-008	HCP-023	HCP-023	E
1CH-AT25	COAL ASH ANALYZER	COAL	P231B-017	P231B	HCP-030	
1CH-AT26	COAL ASH ANALYZER	COAL	P231B-017	P231B	HCP-030	
1CH-CNV1	COAL CONVYR	(EXISTING/MODIFIED)	P231B-017	P231B	HCP-030	
1CH-CNV2	COAL CONVEYOR	(EXISTING/MODIFIED)	P231B-017	P231B	HCP-030	
1CH-CRH1	CRUSHER (EXISTING/MODIF)	COAL HOPPER	P231B-017	P231B	HCP-030	
1CH-CRH2	CRUSHER (EXISTING/MODIF)	COAL HOPPER	P231B-017	P231B	HCP-030	
1CH-FDR1	TROUGHED BLT FEED	COAL	P231B-017	P231B	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
1CH-FDR2	TROUGHED BLT FEED	COAL	P231B-017	P231B	HCP-030	
1CH-FDR3	FEEDER/BREAKER W/INLET	COAL YARD (USIBELLI C.M.)	P231B-017	N/A	HCP-030	
1CH-HOP1	ROM COAL HOPPER	COAL	P231B-017	HCP-030	HCP-030	E
1CH-HOP2	WASTE COAL HOPPER	COAL	P231B-017	HCP-030	HCP-030	E
1CH-MOV24	FLOP GATE	(FEEDER BREAKER)	P231B-017	P231B	HCP-030	
1CH-MOV27A	DIVERTER GATE	(CONV 1CH-CNV1)	P231B-017	P231B	HCP-030	
1CH-MOV27B	DIVERTER GATE	(CONV 1CH-CNV2)	P231B-017	P231B	HCP-030	
1CH-SCA1	BELT SCALE	COAL	P231B-017	P231B	HCP-030	
1CH-SMP1	U.1 SAMPLING SYSTEM	(EXISTING/MODIFIED)	P231B-017	N/A	HCP-030	
1CH-SPM1	MAGNETIC SEPARATOR	COAL	P231B-017	P231B	HCP-030	
2CH-AT25	COAL MOIST ANALYZER	COAL	P231B-017	P231B	HCP-030	
2CH-BE1	BUCKET ELEVATOR	COAL	P231B-017	P231B	HCP-030	
2CH-CNV3	COAL CONVEYOR	COAL	P231B-017	P231B	HCP-030	
2CH-CNV4	COAL CONVEYOR	COAL	P231B-017	P231B	HCP-030	
2CH-MOV28	DIVERTER GATE	(CONV 2CH-CNV3)	P231B-017	P231B	HCP-030	
2CH-SLO1A	COAL SILO 1A	PLANT COAL	P231B-017	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2CN-SL01B	COAL SILO 1B	PLANT COAL	P231B-017	HCP-030	HCP-030	
2CN-CND1	CONDENSER		EJ-CN01	P111A	HCP-013	
2CN-DA3	DEAERATOR		EJ-CN02	P221A	HCP-030	
2CN-E1	LP FEEDWATER HTR NO. 1		EJ-CN02	P221E	HCP-030	
2CN-E2	LP FEEDWATER HTR NO. 2		EJ-CN02	P221E	HCP-030	
2CN-EJ1A	EXPANSION JOINT	CONDENSATE PUMP INLET	EJ-CN01	HCP-030	HCP-030	
2CN-EJ1B	EXPANSION JOINT	CONDENSATE PUMP INLET	EJ-CN01	HCP-030	HCP-030	
2CN-FLX1A	FLEX HOSE	2BC-BNR01A SWIRL DMP INL	P201B-016	P201X	HCP-009	
2CN-FLX1B	FLEX HOSE	2BC-BNR01B SWIRL DMP INL	P201B-016	P201X	HCP-009	
2CN-FLX2A	FLEX HOSE	2BC-BNR01A SWIRL DMP OUT	P201B-016	P201X	HCP-009	
2CN-FLX2B	FLEX HOSE	2BC-BNR01B SWIRL DMP OUT	P201B-016	P201X	HCP-009	
2CN-FLX3A	FLEX HOSE	2BC-BNR01A SWIRL DMP INL	P201B-016	P201X	HCP-009	
2CN-FLX3B	FLEX HOSE	2BC-BNR01B SWIRL DMP INL	P201B-016	P201X	HCP-009	
2CN-FLX4A	FLEX HOSE	2BC-BNR01A SWIRL DMP OUT	P201B-016	P201X	HCP-009	
2CN-FLX4B	FLEX HOSE	2BC-BNR01B SWIRL DMP OUT	P201B-016	P201X	HCP-009	
2CN-FLX9A	FLEX HOSE	2BC-BNR01A LIMST INJ INL	P201B-016	P201X	HCP-009	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2CN-FLX9B	FLEX HOSE	2BC-BNR01B LIMST INJ INL	P201B-016	P201X	HCP-009	
2CN-FLX10A	FLEX HOSE	2BC-BNR01A LIMST INJ OUT	P201B-016	P201X	HCP-009	
2CN-FLX10B	FLEX HOSE	2BC-BNR01B LIMST INJ OUT	P201B-016	P201X	HCP-009	
2CN-P1A	CONDENSATE PUMP		EJ-CN01	H103A	HCP-030	
2CN-P1B	CONDENSATE PUMP		EJ-CN01	H103A	HCP-030	
2CN-P2A	LP COMBUSTOR COOLING PMP	LP COOLING	EJ-CN02	HCP-030	HCP-030	
2CN-P2B	LP COMBUSTOR COOLING PMP	LP COOLING	EJ-CN02	HCP-030	HCP-030	
2CN-STR1A	STRAINER	CONDENSATE PUMP INLET	EJ-CN01	HCP-030	HCP-030	
2CN-STR1B	STRAINER	CONDENSATE PUMP INLET	EJ-CN01	HCP-030	HCP-030	
2CN-STR2A	STRAINER	COMB COOLING PMP	EJ-CN02	HCP-030	HCP-030	
2CN-STR2B	STRAINER	COMB COOLING PMP	EJ-CN02	HCP-030	HCP-030	
2CO-H1	CARBON DIOXIDE HEATER	CO2 INERTING	P201B-268	HCP-030	HCP-030	
2CW-EJ1A	EXPANSION JOINT	CIRC WATER PUMP DISCH	EJ-CW01	HCP-030	HCP-030	
2CW-EJ1B	EXPANSION JOINT	CIRC WATER PUMP DISCH	EJ-CW01	HCP-030	HCP-030	
2CW-EJ4A	EXPANSION JOINT	CONDENSER INLET	EJ-CW02	HCP-030	HCP-030	
2CW-EJ4B	EXPANSION JOINT	CONDENSER INLET	EJ-CW02	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2CW-EJ5A	EXPANSION JOINT	CONDENSER OUTLET	EJ-CW02	HCP-030	HCP-030	
2CW-EJ5B	EXPANSION JOINT	CONDENSER OUTLET	EJ-CW02	HCP-030	HCP-030	
2CW-P1A	CIRCULATING WATER PUMP		EJ-CW01	H103A	HCP-030	
2CW-P1B	CIRCULATING WATER PUMP		EJ-CW01	H103A	HCP-030	
2CW-P2	BOOSTER PUMP	COMP COOL/ASH WTR HT EXCH	EJ-CW02	HCP-030	HCP-030	
2CW-STR2	STRAINER	BOOSTER PUMP	EJ-CW01	HCP-030	HCP-030	
1DC-DC2	DUST COLLECTOR	(YARD HOPPER AREA)	P231B-060	P231B	HCP-030	
1DC-DP1A	DUST COLL DAMPER	CONVEYOR	P231B-060	P231B	HCP-030	
1DC-DP1B	DUST COLLECTION DAMPER	COAL CONVEYOR INLET	P231B-060	P231B	HCP-030	
1DC-DP2A	DUST COLL DAMPER	COAL FEEDER 1	P231B-060	P231B	HCP-030	
1DC-DP2B	DUST COLL DAMPER	COAL FEEDER 2	P231B-060	P231B	HCP-030	
1DC-DP3	DUST COLL DAMPER	COAL HOPPER	P231B-060	P231B	HCP-030	
1DC-DP4	DUST COLL DAMPER	COAL HOPPER	P231B-060	P231B	HCP-030	
1DC-DP5	BACKDRAFT DAMPER	YARD AREA	P231B-060	P231B	HCP-030	
1DC-DP6	INLET DAMPER	DUST COLL EXH FN/ YD AREA	P231B-060	P231B	HCP-030	
1DC-FDR2	ROTARY AIRLOCK	(YARD HOPPER AREA)	P231B-060	P231B	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
1DC-FLT4	INLET FILTER	FILTER CLEANING BLOWER	P231B-060	P231B	HCP-030	
1DC-FN3	DUST COLL FAN	(YARD HOPPER AREA)	P231B-060	P231B	HCP-030	
1DC-FN4	FLTR CLEAN BLOWER	(YARD HOPPER AREA)	P231B-060	P231B	HCP-030	
1DC-H1	HEATER	DUST COLL SILO HEATER	P231B-060	P231B	HCP-030	
1DC-MD1	MANIFOLD DRIVE	DUST COLLECTOR 1DC-DC2	P231B-060	P231B	HCP-030	
1DC-SC2	SCREW CONVEYER	(YARD HOPPER AREA)	P231B-060	P231B	HCP-030	
1DC-SIL4	DISCHARGE SILENCER	FILTER CLEANING BLOWER	P231B-060	P231B	HCP-030	
1DC-T[illegible]1	[illegible] RECEIVER TANK	FILTER CLEANING	P231B-060	P231B	HCP-030	
2DC-DC1	DUST COLLECTOR	(HCCP AREA)	P231B-061	P231B	HCP-030	
2DC-DP1	DUST COLL DAMPER	CONVEYOR 1CH-CNV2	P231B-061	P231B	HCP-030	
2DC-DP2	DUST COLL DAMPER	CONVEYOR 1CH-CNV2	P231B-061	P231B	HCP-030	
2DC-DP3	DUST COLL DAMPER	BKT ELEV	P231B-061	P231B	HCP-030	
2DC-DP4	DUST COLL DAMPER	BKT ELEV	P231B-061	P231B	HCP-030	
2DC-DP6	DUST COLL DAMPER	HCCP CNVYR 3	P231B-061	P231B	HCP-030	
2DC-DP7	DUST COLL DAMPER	COLLECTOR BACK DRAFT	P231B-061	P231B	HCP-030	
2DC-DP8	COAL SILO 1A DAMPER	SILO LCH-SLO1A	P231B-061	P231B	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2DC-DP9A	DUST COLL DAMPER	HCCP CNVYR 4	P231B-061	P231B	HCP-030	
2DC-DP9B	DUST COLL DAMPER	INLET 2CH-CNV4	P231B-061	P231B	HCP-030	
2DC-DP10	COAL SILO 1B DAMPER	SILO 2CH-SLO1A	P231B-061	P231B	HCP-030	
2DC-DP11	INLET DAMPER	EXHAUST FAN 2DC-FN1	P231B-061	P231B	HCP-030	
2DC-DP12	BUNKER DUST COLL DAMPER	CONVEYOR 1CH-CNV1	P231B-061	P231B	HCP-030	
2DC-DP13	DUST COLL DAMPER	BKT ELEV	P231B-061	P231B	HCP-030	
2DC-DP14	DUST COLL DAMPER	HCCP CNVYR 3	P231B-061	P231B	HCP-030	
2DC-DP15	DUST COLL DAMPER	HCCP CNVYR 4	P231B-061	P231B	HCP-030	
2DC-DP17	MOTOR OPERATED DAMPER	DUST COLL	P231B-061	P231B	HCP-030	
2DC-DP18A	DUST COLL DAMPER	CONV 1CH-CNV2 LOADER HOOD	P231B-061	P231B	HCP-030	
2DC-DP18B	DUST COLL DAMPER	CONV 1CH-CNV2 BACK HOOD	P231B-061	P231B	HCP-030	
2DC-FDR1	ROTARY AIRLOCK	(HCCP AREA)	P231B-061	P231B	HCP-030	
2DC-FN1	DUST COLLCT FAN	(HCCP AREA)	P231B-061	P231B	HCP-030	
2DC-MD1	MANIFOLD DRIVE	(HCCP AREA)	P231B-061	P231B	HCP-030	
2DC-SC1	SCREW CONVEYER	(HCCP AREA)	P231B-061	P231B	HCP-030	
2DC-TK1	AIR RECEIVER TANK	FILTER CLEANING	P231B-061	P231B	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
1DP-P2	SUMP PUMP	U.1 BLR AREA (NEW)	EJ-DP01	HCP-030	HCP-030	
1DP-SSP2	SURGE SUPRESSOR	U.1 BUILDING SUMP PUMP	EJ-DP01	HCP-030	HCP-030	
2DP-P1	WASTE OIL SUMP PUMP		EJ-DP01	HCP-030	HCP-030	
2DP-P3	PORTABLE SUMP PUMP	PUMP-OUT SUMPS	EJ-DP01	HCP-030	HCP-030	
2DP-P7	PORTABLE PUMP	OIL/WATER SEPARATOR	EJ-DP01	HCP-030	HCP-030	
2DP-P8A	LIFT PUMP	FLOOR AND EQUIPMENT DRAIN	EJ-DP01	HCP-030	HCP-030	
2DP-P8B	LIFT PUMP	FLOOR AND EQUIPMENT DRAIN	EJ-DP01	HCP-030	HCP-030	
2DP-SEP1	OIL/WATER SEPARATOR		EJ-DP01	W014S	HCP-030	
2DP-SSP1	SURGE SUPRESSOR	WASTE OIL SUMP PUMP	EJ-DP01	HCP-030	HCP-030	
2DP-SSP8A	SURGE SUPRESSOR	FLR AND EQPT DRN LIFT PMP	EJ-DP01	HCP-030	HCP-030	
2DP-SSP8B	SURGE SUPRESSOR	FLR AND EQPT DRN LIFT PMP	EJ-DP01	HCP-030	HCP-030	
1DW-BFP1	BACK FLOW PREVENTER	U.1 PROCESS USES	EJ-DW01	HCP-030	HCP-030	
1DW-FLT1A	CARTRIDGE FILTER	DOMESTIC WATER (SKD MTD)	EJ-DW01	W014Z	W014Z	
1DW-FLT1B	CARTRIDGE FILTER	DOMESTIC WATER (SKD MTD)	EJ-DW01	W014Z	W014Z	
1DW-SKD1	DOM WTR HYPOCHLORITE SKID	WATER TREATMENT SYS	W0142-007	W014Z	HCP-030	
1DW-SKD2	DOM. WATER CART FILT SKID	WATER TREATMENT SYS	EJ-DW01	W014Z	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
1DW-TK1	HYDROPNEUMATIC TK	DOMESTIC WATER	EJ-DW01	HCP-030	HCP-030	
2DW-BFP1	BACK FLOW PREVENTER	SDA ATOMIZER WHEEL	EJ-DW01	HCP-030	HCP-030	
2DW-CC1	DOMESTIC WTR CAL CYL	WATER TRMT SYS	W014Z-007	W014Z	HCP-030	
2DW-H1	WATER HEATER	DOMESTIC HOT WATER	EJ-DW01	HCP-030	HCP-030	
2DW-MIX3	DW SODIUM HYPOCHL MIXER	(SKD MTD)	W014Z-007	W014Z	W014Z	
2DW-P1A	DW HYPOCHLORITE FEED PMP	(SKD MTD)	W014Z-007	W014Z	W014Z	
2DW-P1B	DW HYPOCHLORITE FEED PMP	(SKD MTD)	W014Z-007	W014Z	W014Z	
2DW-P2	CIRCULATING PUMP	WATER HEATER	EJ-DW01	HCP-030	HCP-030	
2DW-P3	AW SLUICE SEAL WATER PUMP		P241G-031	HCP-030	HCP-030	E
2DW-STR1A	DW HYPOCHL FEED STRAINER	(SKD MTD)	W014Z-007	W014Z	W014Z	
2DW-STR1B	DW HYPOCHL FEED STRAINER	(SKD MTD)	W014Z-007	W014Z	W014Z	
2DW-TK3	DOM WATER SODIUM HYPOCHL	FEED TANK (SKD MTD)	W014Z-007	W014Z	W014Z	
2FC-CYC1A	PRECOMBUSTER CYCLONE		P201B-268	P201X	HCP-009	
2FC-CYC1B	PRECOMBUSTER CYCLONE		P201B-267	P201X	HCP-009	
2FC-CYC2A	SLAG COMBUSTER CYCLONE		P201B-268	P201X	HCP-009	
2FC-CYC2B	SLAG COMBUSTER CYCLONE		P201B-267	P201X	HCP-009	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2FC-E1A	LUBE OIL COOLER	PULVERIZER GEARBOX LO SYS	P201W-236	HCP-009	HCP-009	
2FC-E1B	LUBE OIL COOLER	PULVERIZER GEARBOX LO SYS	P201W-236	HCP-009	HCP-009	
2FC-EJ2A	EXP JOINT	PULV TO SPLITTER	P201B-268	P201X	HCP-009	
2FC-EJ2B	EXP JOINT	PULV. TO SPLITTER	P201B-267	P201X	HCP-009	
2FC-EJ3A	EXP JOINT	CYCLONE VENT AIR	P201B-167	P201X	HCP-009	
2FC-EJ3B	EXP JOINT	CYCLONE VENT AIR	P201B-168	P201X	HCP-009	
2FC-EJ4A	EXP JOINT	CYCLONE VENT AIR	P201B-167	P201X	HCP-009	
2FC-EJ4B	EXP JOINT	CYCLONE VENT AIR	P201B-168	P201X	HCP-009	
2FC-FDR1A	GRAVIMETRIC COAL FEEDER		P201W-007	HCP-009	HCP-009	
2FC-FDR1B	GRAVIMETRIC COAL FEEDER		P201W-007	HCP-009	HCP-009	
2FC-FLT1A	INLET FILTER	FLAME SCANNER P/C 1A COAL	P201B-090	P201X	HCP-009	
2FC-FLT1A	PULV LUBE OIL FILTER	PULVERIZER GEARBOX LO SYS	P201W-236	HCP-009	HCP-009	D
2FC-FLT1B	INLET FILTER	FLAME SCANNER P/C 1B COAL	P201B-091	P201X	HCP-009	
2FC-FLT1B	PULV LUBE OIL FILTER	PULVERIZER GEARBOX LO SYS	P201W-236	HCP-009	HCP-009	
2FC-FLT1B	PULV LUBE OIL FILTER	PULVERIZER GEARBOX LO SYS	P201W-236	HCP-009	HCP-009	
2FC-FLX1A	PULV/SKD I/CONN FLEX HOSE	PULVERIZER GEARBOX LO SYS	P201W-236	HCP-009	HCP-009	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2FC-FLX1B	PULV/SKD I/CONN FLEX HOSE	PULVERIZER GEARBOX LO SYS	P201W-236	HCP-009	HCP-009	
2FC-FLX2A	PULV/SKD I/CONN FLEX HOSE	PULVERIZER GEARBOX LO SYS	P201W-236	HCP-009	HCP-009	D
2FC-FLX2B	PULV/SKD I/CONN FLEX HOSE	PULVERIZER GEARBOX LO SYS	P201W-236	HCP-009	HCP-009	D
2FC-FN1A	MILL EXHAUSTER FAN	NORTH PULVERIZER	P201W-007	HCP-009	HCP-009	
2FC-FN1B	MILL EXHAUSTER FAN	SOUTH PULVERIZER	P201W-007	HCP-009	HCP-009	
2FC-P1A	PULV LUBE OIL PUMP	PULVERIZER GEARBOX LO SYS	P201W-236	HCP-009	HCP-009	
2FC-P1B	PULV LUBE OIL PUMP	PULVERIZER GEARBOX LO SYS	P201W-236	HCP-009	HCP-009	
2FC-PLV1A	COAL PULVERIZER	NORTH COMBUSTOR	P201W-007	HCP-009	HCP-009	
2FC-PLV1B	COAL PULVERIZER	SOUTH COMBUSTOR	P201W-007	HCP-009	HCP-009	
2FC-SPL1A	VARIABLE SPLITTER	COAL TO CYCLONES "A"	P201B-268	P201X	HCP-009	
2FC-SPL1B	VARIABLE SPLITTER	COAL TO CYCLONES "B"	P201B-267	P201X	HCP-009	
2FC-SPL2A	SLAG COMBUSTER SPLITTER		P201B-167	P201X	HCP-009	
2FC-SPL2B	SLAG COMBUSTER SPLITTER		P201B-168	P201X	HCP-009	
2FG-EJ1	EXPANSION JOINT	BOILER DISCHARGE	P214W-009	HCP-030	HCP-030	
2FG-EJ2	EXPANSION JOINT	BOILER DISCHARGE	P214W-009	HCP-030	HCP-030	
2FG-EJ3	EXPANSION JOINT	BAGHOUSE BYPASS DISCH	P214W-009	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2FG-EJ4	EXPANSION JOINT	BAGHOUSE DISCHARGE	P214W-009	HCP-030	HCP-030	
2FG-EJ5	EXPANSION JOINT	ID FAN INLET	P214W-009	HCP-030	HCP-030	
2FG-EJ6	EXPANSION JOINT	ID FAN INLET	P214W-009	HCP-030	HCP-030	
2FG-EJ7	EXP JOINT	ID FN OUTLET	P214W-009	P212C	HCP-030	
2FG-EJ8	EXPANSION JOINT	STACK INLET	P214W-009	HCP-030	HCP-030	
2FG-EJ9	EXPANSION JOINT	BOILER DISCHARGE	P214W-009	HCP-030	HCP-030	
2FG-EJ10	EXPANSION JOINT	BAGHOUSE DISCHARGE	P214W-009	HCP-030	HCP-030	
2FG-FN1	INDUCED DRAFT FAN		P214W-009	P212C	HCP-030	
2FO-AF2	FLAME ARRESTOR	FIRE PUMP DAY TK	EJ-F001	HCP-030	HCP-030	
2FO-FLX1A	FLEX HOSE	IGNITOR OIL SUPPLY	P201B-088	P201X	HCP-009	
2FO-FLX1B	FLEX HOSE	IGNITOR OIL SUPPLY	P201B-089	P201X	HCP-009	
2FO-FLX2A	FLEX HOSE	IGNITOR OIL SUPPLY	P201B-088	P201X	HCP-009	
2FO-FLX2B	FLEX HOSE	IGNITOR OIL SUPPLY	P201B-089	P201X	HCP-009	
2FO-FLX3A	FLEX HOSE	IGNITOR OIL SUPPLY	P201B-088	P201X	HCP-009	
2FO-FLX3B	FLEX HOSE	IGNITOR OIL SUPPLY	P201B-089	P201X	HCP-009	
2FO-FLX4A	FLEX HOSE	IGNITOR OIL SUPPLY	P201B-088	P201X	HCP-009	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2FO-FLX4B	FLEX HOSE	IGNITOR OIL SUPPLY	P201B-089	P201X	HCP-009	
2FO-H2	IN-LINE FUEL OIL HEATER		EJ-F001	HCP-030	HCP-030	
2FO-IGN1A	PC1A IGNITOR	IGNITOR OIL SUPPLY	P201B-088	P201X	HCP-009	
2FO-IGN1B	PC1B IGNITOR	IGNITOR OIL SUPPLY	P201B-089	P201X	HCP-009	
2FO-IGN2A	MC2A IGNITOR	IGNITOR OIL SUPPLY	P201B-088	P201X	HCP-009	
2FO-IGN2B	MC2B IGNITOR	IGNITOR OIL SUPPLY	P201B-089	P201X	HCP-009	
2FO-P1A	TRANSFER PUMP	FUEL OIL	EJ-F001	HCP-030	HCP-030	
2FO-P1B	TRANSFER PUMP	FUEL OIL	EJ-F001	HCP-030	HCP-030	
2FO-SSP1	SURGE SUPRESSOR	FUEL OIL	EJ-F001	HCP-030	HCP-030	
2FO-SSP2	SURGE SUPRESSOR	FUEL OIL	EJ-F001	HCP-030	HCP-030	
2FO-STR1	STRAINER	FUEL OIL	EJ-F001	HCP-030	HCP-030	
2FO-STR3A	Y-STRAINER	IGNITOR OIL SUPPLY	P201B-088	P201X	HCP-009	
2FO-STR3B	Y-STRAINER	IGNITOR OIL SUPPLY	P201B-089	P201X	HCP-009	
2FO-STR4A	Y-STRAINER	IGNITOR OIL SUPPLY	P201B-088	P201X	HCP-009	
2FO-STR4B	Y-STRAINER	IGNITOR OIL SUPPLY	P201B-089	P201X	HCP-009	
2FO-TK2	DIESEL DAY TANK	FIRE PMP DIESEL DAY TNK	EJ-F001	P402D	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2FP-E1	DIESEL PMP HEAT EXCHANGER	FIRE PROT DIESEL PUMP	EJ-FP01	P402D	HCP-030	
2FP-EJ1	FLEXIBLE CONNECTOR	DIESEL FIRE PUMP EXHAUST	EJ-FP01	P402D	HCP-030	
2FP-ENG1	FIRE PUMP DIESEL ENG	FIRE PUMP	EJ-F001	P402D	HCP-030	
2FP-FDC1	FIRE DEPT CNX	FIRE PROTECTION	EJ-FP01	HCP-030	HCP-030	
2FP-FDC2	FIRE DEPT CNX	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FH1	WALL HYDRANT	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FH2	WALL HYDRANT	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FH3	WALL HYDRANT	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FH4	WALL HYDRANT	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS1	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS2	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS3	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS4	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS5	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS6	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS7	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2FP-FHS8	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS9	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS10	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS11	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS12	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS13	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS14	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS15	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS16	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS17	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS18	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS20	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS21	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS22	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS23	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-FHS30	FIRE HOSE STATION	FIRE PROTECTION	EJ-FP02	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2FP-P1	MAIN FIRE WATER PMP	FIRE PROTECTION	EJ-FP01	P402D	HCP-030	
2FP-P2	FIRE MAIN CIRCULATING PMP	FREEZE PROTECTION	EJ-FP02	HCP-030	HCP-030	
2FP-SIL1	EXHAUST SILENCER	DIESEL FIRE PUMP EXHAUST	EJ-FP01	P402D	HCP-030	
2FP-STR1	INLET STRAINER	DIESEL FIRE PMP HT EXCHGR	EJ-FP01	P402D	HCP-030	
2FP-STR2	INLET STRAINER	DIESEL FIRE PMP HT EXCHGR	EJ-FP01	P402D	HCP-030	
2FP-STR3	STRAINER	DIESEL FIRE PMP RA GEAR	EJ-FP01	HCP-030	HCP-030	
2FW-E4	HP FEEDWATER HEATER NO 4		EJ-FW01	P221C	HCP-030	
2FW-E5	HP FEEDWATER HEATER NO. 5		EJ-FW01	P221C	HCP-030	
2FW-P1A	BOILER FEED PUMP		EJ-FW01	P224A	HCP-030	
2FW-P1B	BOILER FEED PUMP		EJ-FW01	P224A	HCP-030	
2FW-STR1A	STRAINER	BOILER FEED PUMP	EJ-FW01	HCP-030	HCP-030	
2FW-STR1B	STRAINER	BOILER FEED PUMP	EJ-FW01	HCP-030	HCP-030	
2GA-E1A	GENERATOR AIR COOLER		EJ-CN01	HCP-013	HCP-013	
2GA-E1B	GENERATOR AIR COOLER		EJ-CN01	HCP-013	HCP-013	
2GA-E1C	GENERATOR AIR COOLER		EJ-CN01	HCP-013	HCP-013	
2GA-E1D	GENERATOR AIR COOLER		EJ-CN01	HCP-013	HCP-013	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2HD-P1	HEATER DRAIN PUMP	-	EJ-HD02	HCP-030	HCP-030	
2HD-STR1	STRAINER	HEATER DRAIN PUMP	EJ-HD02	HCP-030	HCP-030	
2HD-STR2	STRAINER	SAMPLE LINE	EJ-HD02	HCP-030	HCP-030	
2HD-STR3	STRAINER	SAMPLE LINE	EJ-HD02	HCP-030	HCP-030	
2HG-CYL1	NITROGEN SUPPLY	GLYCOL SYS PRESSURIZATION	EJ-HG01	HCP-030	HCP-030	
2HG-E1A	STEAM/GLYCOL HEAT EXCH		EJ-HG01	P221C	HCP-030	
2HG-E1B	STEAM/GLYCOL HEAT EXCH		EJ-HG01	P221C	HCP-030	
2HG-E2	GLYCOL/AIR HEAT EXCH	COMB AIR HEATING	EJ-HG01	P231F	HCP-030	
2HG-P1A	GLYCOL CIRCULATING PUMP		EJ-HG01	HCP-030	HCP-030	
2HG-P1B	GLYCOL CIRCULATING PUMP		EJ-HG01	HCP-030	HCP-030	
2HG-STR1A	STRAINER	GLYCOL CIRCULATING PUMP	EJ-HG01	HCP-030	HCP-030	
2HG-STR1B	STRAINER	GLYCOL CIRCULATING PUMP	EJ-HG01	HCP-030	HCP-030	
2HG-TK1	GLYCOL EXPANSION TANK		EJ-HG01	HCP-030	HCP-030	
2HG-TK2	2HG-P2 55 G DRM W/HND PMP	GLYCOL SYS MAKEUP	EJ-HG01	HCP-030	HCP-030	E
1HV-CH5	DUCT HEATING COIL	NEW FEEDER-BREAKER ENCL	EJ-HV03	HCP-030	HCP-030	
1HV-CH5	DUCT HEATING COIL	NEW FEEDER-BREAKER ENCL	EJ-HV03	HCP-030	HCP-030	

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1HV-FN40	EXHAUST FAN	EXIST FDR-BRKR ENCL	EJ-HV02	HCP-030	HCP-030	
1HV-MODS1A	MOD DAMPER	FDR-BRKR ENCLOSURE	EJ-HV02	HCP-030	HCP-030	
1HV-MODS1B	MOD DAMPER	FDR-BRKR ENCLOSURE	EJ-HV02	HCP-030	HCP-030	
1HV-MODS2A	MOD DAMPER	FDR-BRKR ENCLOSURE	EJ-HV02	HCP-030	HCP-030	
1HV-MODS2B	MOD DAMPER	FDR-BRKR ENCLOSURE	EJ-HV02	HCP-030	HCP-030	
1HV-UH66	UNIT HEATER	NEW FEEDER-BREAKER ENCL	EJ-HV03	HCP-030	HCP-030	
2HV-ACC1	AIR COOLED CONDENSER	ADMIN AREA	EJ-HV01	HCP-030	HCP-030	
2HV-ACC2	AIR COOLED CONDENSER	FGD CONTROL AREA	EJ-HV02	HCP-030	HCP-030	
2HV-AHU1	AIR HANDLING UNIT	ADMIN AREA	EJ-HV01	HCP-030	HCP-030	
2HV-AHU2	AIR HANDLING UNIT(STM)	FGD CONTROL AREA	EJ-HV02	HCP-030	HCP-030	
2HV-C1	REFRIGERANT COMPRESSOR	ADMIN AREA	EJ-HV01	HCP-030	HCP-030	
2HV-C2	REFRIGERANT COMPRESSOR	FGD CONTROL AREA	EJ-HV02	HCP-030	HCP-030	
2HV-CH1	STM HEATING COIL	ENGINEERING/OPERATIONS	EJ-HV01	HCP-030	HCP-030	
2HV-CH2	STM HEATING COIL	ADMIN AREAS	EJ-HV01	HCP-030	HCP-030	
2HV-CH3	STM HEATING COIL	LOCKER ROOM AREAS	EJ-HV01	HCP-030	HCP-030	
2HV-CH4	STM HEATING COIL	INSTRUMENT SHOP	EJ-HV01	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2HV-CH5	STM HEATING COIL	EXIST FEEDER BREAKER ENCL	EJ-HV02	HCP-030	HCP-030	
2HV-CH6	STM HEATING COIL	INTAKE STRUCT	EJ-HV02	HCP-030	HCP-030	
2HV-CH7	STM HEATING COIL	INTAKE STRUCT	EJ-HV02	HCP-030	HCP-030	
2HV-CH8	STM HEATING COIL	INTAKE STRUCT	EJ-HV02	HCP-030	HCP-030	
2HV-FN1	RETURN FAN	HVAC EXHAUST	EJ-HV01	HCP-030	HCP-030	
2HV-FN2	EXHAUST FAN	HVAC - BATTERY ROOM	EJ-HV01	HCP-030	HCP-030	
2HV-FN3	EXHAUST FAN	HVAC - LOCKER AREA	EJ-HV01	HCP-030	HCP-030	
2HV-FN4	EXHAUST FAN	HVAC - MAIN CONTROL ROOM	EJ-HV01	HCP-030	HCP-030	
2HV-FN5	EXHAUST FAN	HVAC - ADMIN. AREA	EJ-HV01	HCP-030	HCP-030	
2HV-FN6	EXHAUST FAN	FGD CONTROL AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN7	EXHAUST FAN	LOCKER/REST ROOM	EJ-HV02	HCP-030	HCP-030	
2HV-FN8	EXHAUST FAN	CHEMICAL TRMT AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN9	PRESSURIZATION FAN	ASH SIL AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN10	INTAKE FAN	TURBINE GENERATOR AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN11	INTAKE FAN	TURBINE GENERATOR AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN12	INTAKE FAN	TURBINE GENRTR AREA	EJ-HV02	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2HV-FN13	INTAKE FAN	BOILER AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN14	INTAKE FAN	BOILER AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN15	INTAKE FAN	BOILER AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN16	INTAKE FAN	BOILER AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN17	INTAKE FAN	BOILER AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN18	INTAKE FAN	T/G AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN19	INTAKE FAN	T/G AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN20	EXHAUST FAN	BOILER AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN21	EXHAUST FAN	BOILER AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN22	EXHAUST FAN	BOILER AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN23	EXHAUST FAN	BOILER AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN24	EXHAUST FAN	BOILER AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN25	EXHAUST FAN	BOILER AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN26	EXHAUST FAN	BOILER AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN27	INTAKE FAN	BOILER AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN28	EXHAUST FAN	ASH SILO AREA	EJ-HV02	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2HV-FN29	INTAKE FAN	FGD AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN30	EXHAUST FAN	FGD AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN31	EXHAUST FAN	FGD AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN32	EXHAUST FAN	FGD AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN33	EXHAUST FAN	FGD AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN34A	INTAKE FAN	INTAKE STRUCT ENCLOSURE	EJ-HV02	HCP-030	HCP-030	
2HV-FN34B	INTAKE FAN	INTAKE STRUCT ENCLOSURE	EJ-HV02	HCP-030	HCP-030	
2HV-FN34C	INTAKE FAN	INTAKE STRUCT ENCLOSURE	EJ-HV02	HCP-030	HCP-030	
2HV-FN35	EXHAUST FAN	STACK SAMPLING ENCL	EJ-HV02	HCP-030	HCP-030	
2HV-FN36	INTAKE FAN	EXIST BREAKER/FEEDER ENCL	EJ-HV02	HCP-030	HCP-030	
2HV-FN37	INTAKE FAN	ASH SILO AREA	EJ-HV02	HCP-030	HCP-030	
2HV-FN38	EXHAUST FAN	MAINTENANCE SHOP	EJ-HV02	HCP-030	HCP-030	
2HV-FN39	PRESSURIZATION FAN	EXTERIOR STAIRWAY	EJ-HV02	HCP-030	HCP-030	
2HV-FN40	INTAKE FAN	EXIST BREAKER/FEEDER ENCL	EJ-HV02	HCP-030	HCP-030	
2HV-FN41	EMERGENCY EXHAUST FAN	HVAC ROOM	EJ-HV01	HCP-030	HCP-030	H
2HV-MOD1	MOD DAMPER		EJ-HV01	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2HV-MOD2	MOD DAMPER		EJ-HV01	HCP-030	HCP-030	
2HV-MOD3	MOD DAMPER		EJ-HV01	HCP-030	HCP-030	
2HV-MOD4	MOD DAMPER		EJ-HV01	HCP-030	HCP-030	
2HV-MOD5	MOD DAMPER		EJ-HV01	HCP-030	HCP-030	
2HV-MOD6	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD7	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD8	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD9	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD10	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD11	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD12	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD13	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD14	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD15	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD16	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD17	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2HV-MOD18	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD19	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD20	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD21	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD22	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD23	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD24	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD25	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD26	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD27	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD28A	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD28B	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD28C	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD29	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD30A	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD30B	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2HV-MOD30C	MOD DAMPER	-	EJ-HV02	HCP-030	HCP-030	
2HV-MOD31A	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD31B	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD31C	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD32A	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD32B	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD32C	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD33A	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD33B	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD33C	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD34A	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD34B	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD34C	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD34D	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD34E	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD34F	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2HV-MOD35A	MOD DAMPER	-	EJ-HV02	HCP-030	HCP-030	
2HV-MOD35B	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD36	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD37	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD38	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD39	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD40	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD41	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD42	MOD DAMPER		EJ-HV01	HCP-030	HCP-030	
2HV-MOD43	MOD DAMPER		EJ-HV01	HCP-030	HCP-030	
2HV-MOD45A	MOD DAMPER		EJ-HV01	HCP-030	HCP-030	
2HV-MOD45B	MOD DAMPER		EJ-HV01	HCP-030	HCP-030	
2HV-MOD47	MOD DAMPER		EJ-HV01	HCP-030	HCP-030	
2HV-MOD48	MOD DAMPER		EJ-HV01	HCP-030	HCP-030	
2HV-MOD49	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	
2HV-MOD50	MOD DAMPER		EJ-HV02	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2HV-UH1	UNIT HEATER	TURBINE-GENERATOR AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH2	UNIT HEATER	TURBINE-GENERATOR AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH3	UNIT HEATER	TURBINE-GENERATOR AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH4	UNIT HEATER	TURBINE-GENERATOR AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH5	UNIT HEATER	TURBINE-GENERATOR AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH6	UNIT HEATER	TURBINE-GENERATOR AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH7	UNIT HEATER	BOILER AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH8	UNIT HEATER	BOILER AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH9	UNIT HEATER	BOILER AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH10	UNIT HEATER	BOILER AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH11	UNIT HEATER	ASH SILO AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH12	UNIT HEATER	ASH SILO AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH13	UNIT HEATER	ASH SILO AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH14	UNIT HEATER	ASH SILO AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH15	UNIT HEATER	FGD AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH16	UNIT HEATER	FGD AREA	EJ-HV03	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2HV-UH17	UNIT HEATER	FGD AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH18	UNIT HEATER	FGD AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH19	UNIT HEATER	FGD AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH20	UNIT HEATER	FGD AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH21	UNIT HEATER	FGD AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH22	UNIT HEATER	FGD AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH23	UNIT HEATER	FGD AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH24	UNIT HEATER	FGD AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH25	UNIT HEATER	FGD AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH26	UNIT HEATER	FGD AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH27	UNIT HEATER	FGD AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH28	UNIT HEATER	CHEMICAL TREATMENT AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH29	UNIT HEATER	CHEMICAL TREATMENT AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH30	UNIT HEATER	CHEMICAL TREATMENT AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH31	UNIT HEATER	CHEMICAL TREATMENT AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH32	UNIT HEATER	CHEMICAL TREATMENT AREA	EJ-HV03	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2HV-UH33	UNIT HEATER	CHEMICAL TREATMENT AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH34	UNIT HEATER	CHEMICAL TREATMENT AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH35	UNIT HEATER	BOILER AREA, EAST SIDE	EJ-HV03	HCP-030	HCP-030	
2HV-UH36	UNIT HEATER	BOILER AREA, EAST SIDE	EJ-HV03	HCP-030	HCP-030	
2HV-UH37	UNIT HEATER	BOILER AREA,EAST SIDE	EJ-HV03	HCP-030	HCP-030	
2HV-UH38	UNIT HEATER	BOILER AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH39	UNIT HEATER	TURBINE-GENERATOR AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH40	UNIT HEATER	TURBINE-GENERATOR AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH41	UNIT HEATER	TURBINE-GENERATOR AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH42	UNIT HEATER	BOILER AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH43	UNIT HEATER	BOILER AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH44	UNIT HEATER	TURBINE-GENERATOR AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH45	UNIT HEATER	TURBINE-GENERATOR AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH46	UNIT HEATER	TURBINE-GENERATOR AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH47	UNIT HEATER	TURBINE-GENERATOR AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH48	UNIT HEATER	BOILER AREA	EJ-HV03	HCP-030	HCP-030	

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2HV-UH49	UNIT HEATER	BOILER AREA	EJ-HV03	HCP-030	HCP-030	
2HV-UH50	UNIT HEATER	BUCKET ELEVATOR ROOM	EJ-HV03	HCP-030	HCP-030	
2HV-UH51	UNIT HEATER	BUCKET ELEVATOR ROOM	EJ-HV03	HCP-030	HCP-030	
2HV-UH52	UNIT HEATER	COAL SILO CONV GALLERY	EJ-HV03	HCP-030	HCP-030	
2HV-UH53	UNIT HEATER	COAL SILO CONV GALLERY	EJ-HV03	HCP-030	HCP-030	
2HV-UH54	UNIT HEATER	COAL SILO CONV GALLERY	EJ-HV03	HCP-030	HCP-030	
2HV-UH55	ELEC UNIT HEATER	INTAKE STRUCTURE ENCL	EJ-HV03	HCP-030	HCP-030	
2HV-UH56	ELEC UNIT HEATER	INTAKE STRUCTURE ENCL	EJ-HV03	HCP-030	HCP-030	
2HV-UH57	ELEC UNIT HEATER	INTAKE STRUCTURE ENCL	EJ-HV03	HCP-030	HCP-030	
2HV-UH58	ELEC UNIT HEATER	INTAKE STRUCTURE ENCL	EJ-HV03	HCP-030	HCP-030	
2HV-UH59	ELEC UNIT HEATER	INTAKE STRUCTURE ENCL	EJ-HV03	HCP-030	HCP-030	
2HV-UH60	ELEC UNIT HEATER	INTAKE STRUCTURE ENCL	EJ-HV03	HCP-030	HCP-030	
2HV-UH61	ELEC UNIT HEATER	INTAKE STRUCTURE ENCL	EJ-HV03	HCP-030	HCP-030	
2HV-UH62	ELEC UNIT HEATER	INTAKE STRUCTURE ENCL	EJ-HV03	HCP-030	HCP-030	
2HV-UH64	ELEC UNIT HEATER	STACK SAMPLING ENCL	EJ-HV03	HCP-030	HCP-030	
2HV-UH65	ELEC UNIT HEATER	STACK SAMPLING ENCL	EJ-HV03	HCP-030	HCP-030	

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2HV-UH67	ELEC UNIT HEATER	CIRC WTR YARD VLV-	EJ-HV03	HCP-030	HCP-030	
2IA-DRY1	AIR DRYER	INSTRUMENT AIR (SKD MTD)	P261D-007	P261D	HCP-030	
2IA-FLT1	COALESCING FILTER		EJ-IA01	P261D	HCP-030	
2IA-STR1	STRAINER	FLT 1 DRN	EJ-IA01	HCP-030	HCP-030	
2IA-TK1	INSTR AIR ACCUMULATOR	FLY ASH FILTER CLEANING	P241D-002	P241D	HCP-030	
2IA-TRP1	TRAP	FLT 1 DRN	EJ-IA01	HCP-030	HCP-030	
2JA-BE1	BUCKET ELEVATOR	SDA RECYCLE PRODUCT	P214W-012	P214W	HCP-030	
2JA-CNV1	PULSEFLO CONVEYOR	SDA RECYCLE PRODUCT	P214W-012	P214W	HCP-030	
2JA-CNV2	PULSEFLO CONVEYOR	SDA RECYCLE PRODUCT	P214W-012	P214W	HCP-030	
2JA-CNV3	SDA CONVEYOR	SDA RECYCLE PRODUCT	P214W-012	P214W	HCP-030	
2JA-CNV4	TRANSFER CONVEYOR	SDA RECYCLE PRODUCT	P214W-012	P214W	HCP-030	
2JA-CRH1	SDA DELUMPER	SDA CHAMBER	P214W-012	P214W	HCP-030	
2JA-EJ1	EXP. JT.	PULSEFLO HOPPER 501	P214W-012	P214W	HCP-030	
2JA-EJ2	EXP. JT.	PULSEFLO HOPPER 502	P214W-012	P214W	HCP-030	
2JA-EJ3	EXP. JT.	PULSEFLO HOPPER 503	P214W-012	P214W	HCP-030	
2JA-EJ4	EXP. JT.	PULSEFLO HOPPER 504	P214W-012	P214W	HCP-030	

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HCP-030, APPENDIX 5A, ADDENDUM H

TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2JA-EJ5	EXP. JT.	PULSEFLO HOPPER 505	P214W-012	P214W	HCP-030	
2JA-EJ6	EXP. JT.	PULSEFLO HOPPER 506	P214W-012	P214W	HCP-030	
2JA-EJ7	EXP. JT.	PULSEFLO HOPPER 507	P214W-012	P214W	HCP-030	
2JA-EJ8	EXP. JT.	PULSEFLO HOPPER 508	P214W-012	P214W	HCP-030	
2JA-EJ9	EXP. JT.	PULSEFLO HOPPER 509	P214W-012	P214W	HCP-030	
2JA-EJ10	EXP. JT.	PULSEFLO HOPPER 510	P214W-012	P214W	HCP-030	
2JA-EJ11	EXP. JT.	SDA CHAMBER	P214W-012	P214W	HCP-030	
2JA-FDR1	PULSEFLO ROT FEEDER	PULSEFLO HOPPER 501	P214W-012	P214W	HCP-030	
2JA-FDR2	PULSEFLO ROT FEEDER	PULSEFLO HOPPER 502	P214W-012	P214W	HCP-030	
2JA-FDR3	PULSEFLO ROT FEEDER	PULSEFLO HOPPER 503	P214W-012	P214W	HCP-030	
2JA-FDR4	PULSEFLO ROT FEEDER	PULSEFLO HOPPER 504	P214W-012	P214W	HCP-030	
2JA-FDR5	PULSEFLO ROT FEEDER	PULSEFLO HOPPER 505	P214W-012	P214W	HCP-030	
2JA-FDR6	PULSEFLO ROT FEEDER	PULSEFLO HOPPER 506	P214W-012	P214W	HCP-030	
2JA-FDR7	PULSEFLO ROT FEEDER	PULSEFLO HOPPER 507	P214W-012	P214W	HCP-030	
2JA-FDR8	PULSEFLO ROT FEEDER	PULSEFLO HOPPER 508	P214W-012	P214W	HCP-030	
2JA-FDR9	PULSEFLO ROT FEEDER	PULSEFLO HOPPER 509	P214W-012	P214W	HCP-030	

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HCP-030, APPENDIX 5A, ADDENDUM H

TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2JA-FDR10	PULSEFLO ROT FEEDER	PULSEFLO HOPPER 510	P214W-012	P214W	HCP-030	
2JA-FDR11	SDA ROTARY FEEDER	SDA CHAMBER DISCH	P214W-012	P214W	HCP-030	
2JB-ACM1	PULSE AIR ACCUMULATOR	BAGHOUSE	P214W-011	P214W	HCP-030	
2JB-BH1	BAGHOUSE MODULE		P214W-012	P214W	HCP-030	
2JB-BH2	BAGHOUSE MODULE		P214W-012	P214W	HCP-030	
2JB-BH3	BAGHOUSE MODULE		P214W-012	P214W	HCP-030	
2JB-BH4	BAGHOUSE MODULE		P214W-012	P214W	HCP-030	
2JB-BH5	BAGHOUSE MODULE		P214W-012	P214W	HCP-030	
2JB-BH6	BAGHOUSE MODULE		P214W-012	P214W	HCP-030	
2JB-BH7	BAGHOUSE MODULE		P214W-012	P214W	HCP-030	
2JB-BH8	BAGHOUSE MODULE		P214W-012	P214W	HCP-030	
2JB-BH9	BAGHOUSE MODULE		P214W-012	P214W	HCP-030	
2JB-BH10	BAGHOUSE MODULE		P214W-012	P214W	HCP-030	
2JB-DP3A	BYPASS DAMPER	BAGHOUSE	P214W-011	P214W	HCP-030	
2JB-DP3B	BYPASS DAMPER	BAGHOUSE	P214W-011	P214W	HCP-030	
2JF-HOS1	FLEXIBLE HOSE	FEED SLURRY GRIT SCREEN	P214W-008	P214W	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2JF-HOS2	FLEXIBLE HOSE	FEED SLURRY GRIT SCREEN	P214W-008	P214W	HCP-030	
2JF-HOS5	FLEXIBLE HOSE	FEED SLURRY GRIT SCREEN	P214W-008	P214W	HCP-030	
2JF-HOS6	MATERICAL HANDLING HOSE	FEED SLURRY GRIT SCREEN	P214W-008	HCP-030	HCP-030	
2JF-HOS7	SLURRY PUMP DISCH FLX HOS	FEED SLURRY	P214W-008	P214W	HCP-030	
2JF-HOS8	TOWER MILL	FEED SLURRY	P214W-008	P214W	HCP-030	
2JF-MIX1	AGITATOR	FEED SLURRY TANK	P214W-008	P214W	HCP-030	
2JF-MIX2	TANK MIXER	TOWER MILL	P214W-008	P214W	HCP-030	
2JF-P3	FEED SLURRY PUMP	FEED SLURRY	P214W-008	P214W	HCP-030	
2JF-P4	FEED SLURRY PUMP	FEED SLURRY	P214W-008	P214W	HCP-030	
2JF-SCN1	FEED SLURRY GRIT SCREEN		P214W-008	P214W	HCP-030	
2JF-TK1	TOWER MILL		P214W-008	P214W	HCP-030	
2JF-TK2	FEED SLURRY TANK		P214W-008	P214W	HCP-030	
2JR-EDU1	DRY REINJECTION INDUCTOR	FCM RECYCLE	P214W-007	P214W	HCP-030	
2JR-FDR1	VAR SPEED FEEDER	FCM RECYCLE	P214W-007	P214W	HCP-030	
2JR-FDR2	VAR SPEED FEEDER	FCM RECYCLE	P214W-007	P214W	HCP-030	
2JR-FDR3	VARIABLE SPEED FEEDER	FCM RECYCLE	P214W-007	P214W	HCP-030	

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HCP-030, APPENDIX 5A, ADDENDUM H

TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2JR-FLT1	BIN VENT FILTER	FCM RECYCLE SURGE BIN	P214W-007	P214W	HCP-030	
2JR-FLT2	INLET FILTER	AERATION BLOWER	P214W-007	P214W	HCP-030	
2JR-FN1	AERATION BLOWER	FCM RECYCLE	P214W-007	P214W	HCP-030	
2JR-FN2	BIN VENT FAN	FCM RECYCLE SURGE BIN	P214W-007	P214W	HCP-030	
2JR-FN3	DRY REINJECTION BLOWER	FCM RECYCLE	P214W-007	P214W	HCP-030	
2JR-FN4	SCRUBBER VENT FAN	RECYCLE SLURRY MIXING TK	P214W-007	P214W	HCP-030	
2JR-H1	DISCH AIR HEATER	AERATION BLOWER	P214W-007	P214W	HCP-030	
2JR-HOS4	FLEXIBLE HOSE	RECYCLE SLURRY PMP DISCH	P214W-007	P214W	HCP-030	
2JR-MIX1	TANK AGITATOR	RECYCLE SLURRY MIXING TK	P214W-007	P214W	HCP-030	
2JR-P1	RECYCLE SLURRY PUMP	RECYCLE SLURRY MIXING TK	P214W-007	P214W	HCP-030	
2JR-P2	RECYCLE SLURRY PUMP	RECYCLE SLURRY MIXING TK	P214W-007	P214W	HCP-030	
2JR-SCR1	DUST SCRUBBER	RECYCLE SLURRY MIXING TK	P214W-007	P214W	HCP-030	
2JR-SIL1	DISCH SILENCER	AERATION BLOWER	P214W-007	P214W	HCP-030	
2JR-SLO1	SURGE BIN	FCM RECYCLE	P214W-007	P214W	HCP-030	
2JR-TK1	RECYCLE SLURRY MIXING TK		P214W-007	P214W	HCP-030	
2JR-VSD1	VAR SPEED DRIVE	FCM RECYCLE	P214W-007	P214W	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2JR-VSD2	VAR SPEED DRIVE	FCM RECYCLE	P214W-007	P214W	HCP-030	
2JR-VSD3	VARIABLE SPEED DRIVE	FCM RECYCLE	P214W-007	P214W	HCP-030	
2JS-EJ1	EXPANSION JOINT	SDA/BAGHOUSE	P214W-009	P214W	HCP-030	
2JS-HOS1	FLEXIBLE HOSE	SLURRY PIPE FLUSH	P214W-009	P214W	HCP-030	
2JS-HOS2	FLEXIBLE HOSE	HEAD TK TO SDA	P214W-009	P214W	HCP-030	
2JS-HOS3	FLEXIBLE HOSE	DRY REINJ DIV VLVE	P214W-009	P214W	HCP-030	
2JS-SEW1	PORTABLE EYE WASH STATION	HEAD TANK AREA	P214W-009	P214W	HCP-030	
2JS-TK1	ATOMIZER HEAD TANK		P214W-009	P214W	HCP-030	
2JS-TK2	SDA CHAMBER		P214W-009	P214W	HCP-030	
2JT-ATZ1A	FGD ATOMIZER		P214W-010	P214W	HCP-030	
2JT-ATZ1B	FGD ATOMIZER	SPARE	P214W-010	P214W	HCP-030	
2JT-FLT1	FILTER	COMP COOLING WTR	P214W-010	P214W	HCP-030	
2JT-FLT3	FILTER	ATMZER SEAL WTR	P214W-010	P214W	HCP-030	
2JT-FLT5	FILTER	ATMZER COOL AIR	P214W-010	P214W	HCP-030	
2JT-FN1	COOLING FAN	ATOMIZER INLET	P214W-010	P214W	HCP-030	
2JT-HOS2	FLEXIBLE HOSE	ATOMIZER INLET-SLURRY	P214W-010	P214W	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2JT-HOS3	FLEXIBLE HOSE	ATOMIZER INL-CW INL	P214W-010	P214W	HCP-030	
2JT-HOS4	FLEXIBLE HOSE	ATOMIZER INL SEAL WTR	P214W-010	P214W	HCP-030	
2JT-HOS5	FLEXIBLE HOSE	ATOMIZER INLET-AIR	P214W-010	P214W	HCP-030	
2JT-HOS6	FLEXIBLE HOSE	ATOMIZER INLET CW OUT	P214W-010	P214W	HCP-030	
2JT-P1	OIL PUMP	ATOMIZER	P214W-010	P214W	HCP-030	
2LH-BWR1A	LIMESTONE SILO FEED BLWR		P201B-017	HCP-030	HCP-030	
2LH-BWR1B	LIMESTONE SILO FEED BLWR		P201B-017	HCP-030	HCP-030	
2LH-BWR2A	CARRIER AIR BLOWER	COMBUSTOR INJECTION	P201B-017	P201X	HCP-009	
2LH-BWR2B	CARRIER AIR BLOWER	COMBUSTOR INJECTION	P201B-017	P201X	HCP-009	
2LH-BWR3	LIMESTONE AUXILIARY BLWR	TRUCK UNLOADING	P201B-017	HCP-030	HCP-030	
2LH-DC1	DUST COLLECTOR	LIMESTONE STORAGE SILO	P201B-017	P201X	HCP-009	
2LH-DC2	DUST COLLECTOR	LIMESTONE SURGE BIN	P201B-017	HCP-030	HCP-030	
2LH-EDU1A	LIMESTONE EDUCTOR	LIMESTONE FEED	P201B-017	P201X	HCP-009	
2LH-EDU1B	LIMESTONE EDUCTOR	LIMESTONE FEED	P201B-017	P201X	HCP-009	
2LH-EJ1A	INLET EXP JOINT	LIMESTONE SILO FEED BLWR	P201B-017	HCP-030	HCP-030	
2LH-EJ1B	INLET EXP JOINT	LIMESTONE SILO FEED BLWR	P201B-017	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2LH-EJ2A	DISCH EXP JOINT	LIMESTONE SILO FEED BLWR	P201B-017	HCP-030	HCP-030	
2LH-EJ2B	DISCH EXP JOINT	LIMESTONE SILO FEED BLWR	P201B-017	HCP-030	HCP-030	
2LH-EJ3A	INLET EXP JOINT	CARRIER AIR BLOWER	P201B-017	P201X	HCP-009	
2LH-EJ3B	INLET EXP JOINT	CARRIER AIR BLOWER	P201B-017	P201X	HCP-009	
2LH-EJ4A	DISCH EXP JOINT	CARRIER AIR BLOWER	P201B-017	P201X	HCP-009	
2LH-EJ4B	DISCH EXP JOINT	CARRIER AIR BLOWER	P201B-017	P201X	HCP-009	
2LH-EJ5	INLET EXP JOINT	LIMESTONE AUX BLOWER	P201B-017	HCP-030	HCP-030	
2LH-EJ6	DISCH EXP JOINT	LIMESTONE AUX BLOWER	P201B-017	HCP-030	HCP-030	
2LH-FDR1	MASS WEIGH FEEDER	LIMESTONE FEED	P201B-017	P201X	HCP-009	
2LH-FLT1A	INLET FILTER	LIMESTONE SILO FEED BLWR	P201B-017	HCP-030	HCP-030	
2LH-FLT1B	INLET FILTER	LIMESTONE SILO FEED BLWR	P201B-017	HCP-030	HCP-030	
2LH-FLT2A	INLET FILTER	CARRIER AIR BLOWER	P201B-017	P201X	HCP-009	
2LH-FLT2B	INLET FILTER	CARRIER AIR BLOWER	P201B-017	P201X	HCP-009	
2LH-FLT3	INLET FILTER	LIMESTONE AUX BLOWER	P201B-017	HCP-030	HCP-030	
2LH-FN1	DUST COLLECTOR FAN	LIMESTONE SURGE BIN	P201B-017	HCP-030	HCP-030	
2LH-RA1	ROTARY AIRLOCK VALVE	LIMESTONE FEED	P201B-017	P201X	HCP-009	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2LH-RA2	ROTARY AIRLOCK VALVE	LIMESTONE SURGE TANK FEED	P201B-017	HCP-030	HCP-030	
2LH-SIL1A	INLET SILENCER	LIMESTONE SILO FEED BLWR	P201B-017	HCP-030	HCP-030	
2LH-SIL1B	INLET SILENCER	LIMESTONE SILO FEED BLWR	P201B-017	HCP-030	HCP-030	
2LH-SIL2A	DISCH SILENCER	LIMESTONE SILO FEED BLWR	P201B-017	HCP-030	HCP-030	
2LH-SIL2B	DISCH SILENCER	LIMESTONE SILO FEED BLWR	P201B-017	HCP-030	HCP-030	
2LH-SIL3A	INLET SILENCER	CARRIER AIR BLOWER	P201B-017	P201X	HCP-009	
2LH-SIL3B	INLET SILENCER	CARRIER AIR BLOWER	P201B-017	P201X	HCP-009	
2LH-SIL4A	DISCH SILENCER	CARRIER AIR BLOWER	P201B-017	P201X	HCP-009	
2LH-SIL4B	DISCH SILENCER	CARRIER AIR BLOWER	P201B-017	P201X	HCP-009	
2LH-SIL5	INLET SILENCER	LIMESTONE AUX BLOWER	P201B-017	HCP-030	HCP-030	
2LH-SIL6	DISCH SILENCER	LIMESTONE AUX BLOWER	P201B-017	HCP-030	HCP-030	
2LH-SLO1	LIMESTONE STORAGE SILO		P201B-017	P201X	HCP-009	
2LH-SLO2	LIMESTONE SURGE BIN		P201B-017	HCP-030	HCP-030	
2LH-SPT1	FLOW DIVERTER	LIMESTONE FEED TO EDUCTOR	P201B-017	P201B	HCP-009	
2LH-VBM1	BIN VIBRATOR	LIMESTONE STORAGE SILO	P201B-017	P201B	HCP-009	
2LH-VBM2	BIN ACTIVATOR	LIMESTONE SURGE BIN	P201B-017	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2LO-CDT1	LUBE OIL CONDITIONER SKID		EJ-LO01	P101J	HCP-030	
2LO-DMS1	DEMISTER	LO VAPOR EXTR (ON LO SKD)	EJ-LO01	P101J	HCP-030	
2LO-FLT1	POLISHING FILTER	LUBE OIL CONDITIONER SKID	EJ-LO01	P101J	HCP-030	
2LO-FN1	VAPOR EXTRACTOR	LUBE OIL CONDITIONER SKID	EJ-LO01	P101J	HCP-030	
2LO-P1	CIRCULATING PUMP	LUBE OIL CONDITIONER SKID	EJ-LO01	P101J	HCP-030	
2LO-P2	DIRTY OIL TRANSFER PUMP		EJ-LO01	HCP-030	HCP-030	
2LO-STR1	BASKET STRAINER	LUBE OIL CONDITIONER SKID	EJ-LO01	P101J	HCP-030	
2LO-STR2	Y-STRAINER	LUBE OIL TRANSFER PUMP	EJ-LO01	HCP-030	HCP-030	
2LO-STR3	Y-STRAINER	LUBE OIL COIL PIPING FLSH	EJ-LO01	HCP-030	HCP-030	
2ME-CRN1	BRIDGE CRANE	TURBINE/GEN	N/A	P251B	HCP-030	
2ME-C[illegible]	[illegible] CRANE	MAINTENANCE SHOP	N/A	HCP-030	HCP-030	
2ME-CRN3	BRIDGE CRANE	INTAKE STRUCTURE	N/A	HCP-030	HCP-030	
2ME-CRN4	BRIDGE CRANE	PULVERIZER	N/A	HCP-030	HCP-030	
2ME-MR1	MONORAIL W/TROLLEY-HOIST	BLR FEED PUMPS	N/A	HCP-030	HCP-030	
2ME-MR2	MONORAIL W/TROLLEY-HOIST	MAT'L HANL EQPT	N/A	HCP-030	HCP-030	
2ME-MR3	MONORAIL W/TROLLEY-HOIST	FLYASH SILO	N/A	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2ME-MR5	MONORAIL W/TROLLEY-HOIST	COAL BUCKET ELEV		HCP-030	HCP-030	
2ME-MR6	MONORAIL W/TROLLEY-HOIST	WTR TRMT EQPT		HCP-030	HCP-030	
2ME-MR7	MONORAIL W/TROLLEY-HOIST	RECYCLE PROD BUCK ELEV		HCP-030	HCP-030	
2ME-MR8	MONORAIL W/TROLLEY-HOIST	ATOMIZER		HCP-030	HCP-030	
2ME-MR9	MONORAIL W/TROLLEY-HOIST	COAL CONVEYOR GALLERY		HCP-030	HCP-030	
2ME-MR10	TROLLEY-HOIST	BTM ASH BUCK ELEV		HCP-030	HCP-030	
2ME-MR11	JIB CRANE	INTAKE STRUCTURE	N/A	HCP-030	HCP-030	
2MS-TUR1	MAIN STEAM TURBINE		EJ-MS01	HCP-013	HCP-013	
1SA-TRP1	LIQUID DRAINER	UNIT 1/1DP-P2	EJ-DP01	HCP-030	HCP-030	
2SA-FLX1A	FLEX HOSE	IGNITOR ATOM AIR	P201B-088	P201X	HCP-009	
2SA-FLX1B	FLEX HOSE	IGNITOR ATOM AIR	P201B-089	P201X	HCP-009	
2SA-FLX2A	FLEX HOSE	IGNITOR PURGE AIR	P201B-088	P201X	HCP-009	
2SA-FLX2B	FLEX HOSE	IGNITOR PURGE AIR	P201B-089	P201X	HCP-009	
2SA-FLX3A	FLEX HOSE	IGNITOR ATOM AIR	P201B-088	P201X	HCP-009	
2SA-FLX3B	FLEX HOSE	IGNITOR ATOM AIR	P201B-089	P201X	HCP-009	
2SA-FLX4A	FLEX HOSE	IGNITOR ATOM AIR	P201B-088	P201X	HCP-009	

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2SA-FLX4B	FLEX HOSE	IGNITOR ATOM AIR	P201B-089	P201X	HCP-009	
2SA-FLX5A	FLEX HOSE	IGNITOR PURGE AIR	P201B-088	P201X	HCP-009	
2SA-FLX5B	FLEX HOSE	IGNITOR PURGE AIR	P201B-089	P201X	HCP-009	
2SA-FLX6A	FLEX HOSE	IGNITOR ATOM AIR	P201B-088	P201X	HCP-009	
2SA-FLX6B	FLEX HOSE	IGNITOR ATOM AIR	P201B-089	P201X	HCP-009	
2SA-STR1A	Y-STRAINER	IGNITOR ATOM AIR	P201B-088	P201X	HCP-009	
2SA-STR1B	Y-STRAINER	IGNITOR ATOM AIR	P201B-089	P201X	HCP-009	
2SA-STR2	Y-STRAINER	IGNITOR ATOM AIR	P201B-088	HCP-030	HCP-030	
2SA-STR2A	Y-STRAINER	IGNITOR ATOM AIR	P201B-088	P201X	HCP-009	
2SA-STR2B	Y-STRAINER	IGNITOR ATOM AIR	P201B-089	P201X	HCP-009	
2SA-TRP1	LIQUID DRAINER	2DP-P8A/B	EJ-DP01	HCP-030	HCP-030	
2SA-TRP2	LIQUID DRAINER	IGNITOR ATOM AIR	P201B-088	HCP-030	HCP-030	
2SD-STR1	STRAINER	GLAND STEAM CONDENSER	P101A-154	HCP-030	HCP-030	
2SD-TRP1	LIQUID DRAINER	GLAND STEAM CONDENSER	P101A-154	HCP-030	HCP-030	
2SS-CHL1	WATER COOLED CHILLER	SAMPLE SYSTEM	W013D-008	W013D	HCP-030	
2SS-P1	SAMPLE RECOVERY PUMP	SAMPLE SYSTEM (IN SS PNL)	W013D-008	W013D	W013D	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2SS-P2A	CHLD WTR RTN PMP A	SAMPLE SYSTEM (IN-SS PNL)	W013D-008	W013D	W013D	
2SS-P2B	CHLD WTR RTN PMP B	SAMPLE SYSTEM (IN SS PNL)	W013D-008	W013D	W013D	
2SS-P3	SAMPLE PMP	LP FW HTR NO. 1	W013D-006	W013D	HCP-030	
2SS-P4	SAMPLE PMP	LP FW HTR NO. 2	W013D-006	W013D	HCP-030	
2SS-P5	SAMPLE PUMP	AUX COND SYS	W013D-006	HCP-030	HCP-030	
2SS-PNL1	WATER & STEAM SMPL	PANEL	W013D-005	W013D	HCP-030	
2SS-TK1	SURGE TANK(SS PNL)	CHILLED WTR	W013D-008	W013D	W013D	
2SS-TK2	RECOVERY TANK(SS PNL)	CONDENSATE	W013D-008	W013D	W013D	
2SW-P1A	SERVICE WATER PUMP		EJ-SW01	HCP-030	HCP-030	
2SW-P1B	SERVICE WATER PUMP		EJ-SW01	HCP-030	HCP-030	
2SW-STR1	STRAINER	2FP-P2 INLET	EJ-SW01	HCP-030	HCP-030	
2TE-NRV2	NON RET VLVE	5TH PT EXTRACTION	EJ-TE01	P302N	HCP-030	
2TE-NRV4	NON RET VLVE	4TH PT EXTRACTION	EJ-TE01	P302N	HCP-030	
2TE-NRV6A	NON RET VLVE	3RD PT EXTRACTION	EJ-TE01	P302N	HCP-030	
2TE-NRV6B	NON RET VLVE	3RD PT EXTRACTION	EJ-TE01	P302N	HCP-030	
2TE-NRV8	NON RET VLVE	2ND PT EXTRACTION	EJ-TE01	P302N	HCP-030	

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MECHANICAL EQUIPMENT LIST
HCP-030, APPENDIX 5A, ADDENDUM H

TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2TE-NRV10	NON RET VLVE	1ST PT EXTRACTION -	EJ-TE01	P302N	HCP-030	
2TG-TGR1	TURNING GEAR	MAIN TURBINE	P101A-027	HCP-013	HCP-013	
2TH-ACM1	ACCUMULATOR	ACCUMULATOR STAND	P101A-027	HCP-013	HCP-013	
2TH-DRY1	AIR BREATHER W/DRYER	EHC PUMPING UNIT	P101A-027	HCP-013	HCP-103	
2TH-E1A	FLUID COOLER	EHC PUMPING UNIT	P101A-027	HCP-013	HCP-013	
2TH-E1B	FLUID COOLER	EHC PUMPING UNIT	P101A-027	HCP-013	HCP-013	
2TH-FLT1A	CONTROL FLUID SUCT FILTER	EHC PUMPING UNIT	P101A-027	HCP-013	HCP-013	
2TH-FLT1B	CONTROL FLUID SUCT FILTER	EHC PUMPING UNIT	P101A-027	HCP-013	HCP-013	
2TH-FLT2A	CONTROL FLUID DISCH FLTR	EHC PUMPING UNIT	P101A-027	HCP-013	HCP-013	
2TH-FLT2B	CONTROL FLUID DISCH FLTR	EHC PUMPING UNIT	P101A-027	HCP-013	HCP-013	
2TH-FLT3	POLISHING FILTER	EHC PUMPING UNIT	P101A-027	HCP-013	HCP-013	
2TH-FLT4	EARTH FILTER	EHC PUMPING UNIT	P101A-027	HCP-013	HCP-013	
2TH-FLT5	BACKUP FILTER	EHC PUMPING UNIT	P101A-027	HCP-013	HCP-013	
2TH-FLT6	LAST CHANCE FILTER	ACCUMULATOR STAND	P101A-027	HCP-013	HCP-013	
2TH-FLT7	SUCTION FILTER	EHC PUMPING UNIT	P101A-027	HCP-013	HCP-013	
2TH-FN1A	RADIATOR FAN	FLUID COOLER AIR/FAN RAD	P101A-027	HCP-013	HCP-013	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2TH-FN1B	RADIATOR FAN	FLUID COOLER AIR/FAN RAD	P101A-027	HCP-013	HCP-013	
2TH-P1A	CONTROL FLUID PUMP	EHC PUMPING UNIT	P101A-027	HCP-013	HCP-013	
2TH-P1B	CONTROL FLUID PUMP	EHC PUMPING UNIT	P101A-027	HCP-013	HCP-013	
2TH-P2	HEATING PUMP	EHC PUMPING UNIT	P101A-027	HCP-013	HCP-013	
2TH-TK1	CONTROL FLUID TANK	EHC PUMPING UNIT	P101A-027	HCP-013	HCP-013	
2TH-TK2	BUFFER TANK	ACCUMULATOR STAND	P101A-027	HCP-013	HCP-013	
2TO-E1A	LUBE OIL COOLER	TURB LUBE OIL	P101A-027	HCP-013	HCP-013	
2TO-E1B	LUBE OIL COOLER	TURB LUBE OIL	P101A-027	HCP-013	HCP-013	
2TO-FLT1	LUBE OIL FILTER	TURB LUBE OIL	P101A-027	HCP-013	HCP-013	
2TO-FLT2	TURB TRIP OIL INLET FLTR	TURBINE	P101A-027	HCP-013	HCP-013	
2TO-FN1	OIL TANK VAPOR EXTRACTOR	TURB LUBE OIL	P101A-027	HCP-013	HCP-013	
2TO-H1	OIL TANK IMMERSION HEATER	TURB LUBE OIL	P101A-027	HCP-013	HCP-013	
2TO-OV1	OVER FLOW SIGHT GLASS	TURB LUBE OIL RES.	P101A-027	HCP-013	HCP-013	
2TO-P1A	MAIN OIL PUMP	TURB LUBE OIL	P101A-027	HCP-013	HCP-013	
2TO-P1B	MAIN OIL PUMP	TURB LUBE OIL	P101A-027	HCP-013	HCP-013	
2TO-P2	DC EMERGENCY OIL PUMP	TURB LUBE OIL	P101A-027	HCP-013	HCP-013	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2TO-P3	JACKING OIL PUMP	TURB LUBE OIL	P101A-027	HCP-013	HCP-013	
2TO-STR1	STRAINER	TURB LUBE OIL	P101A-027	HCP-013	HCP-013	
2TO-TK1	MAIN LUBE OIL TANK	TURB LUBE OIL	P101A-027	HCP-013	HCP-013	
2TS-CND1	GLND STM CONDENSER	GLAND STEAM	P101A-154	HCP-013	HCP-013	
2TS-FN1A	GLND STM EXHAUSTER	TURBINE GLAND STEAM COND	P101A-154	HCP-013	HCP-013	
2TS-FN1B	GLND STM EXHAUSTER	TURBINE GLAND STEAM COND	P101A-154	HCP-013	HCP-013	
2VC-BWR1	EXHAUSTER	VACUUM CLEANING SYSTEM	N/A	HCP-030	HCP-030	
2VC-BWR2	EXHAUSTER	VACUUM CLEANING SYSTEM	N/A	HCP-030	HCP-030	
2VC-SEP1	PRIMARY SEPARATOR	VACUUM CLEANING SYSTEM	N/A	HCP-030	HCP-030	
2VC-SEP2	PRIMARY SEPARATOR	VACUUM CLEANING SYSTEM	N/A	HCP-030	HCP-030	
2VC-SEP3	SECONDARY SEPARATOR	VACUUM CLEANING SYSTEM	N/A	HCP-030	HCP-030	
2VC-SEP4	SECONDARY SEPARATOR	VACUUM CLEANING SYSTEM	N/A	HCP-030	HCP-030	
2VP-P1A	VACUUM PUMP	VACUUM PRIMING	EJ-VP01	HCP-030	HCP-030	
2VP-P1B	VACUUM PUMP	VACUUM PRIMING	EJ-VP01	HCP-030	HCP-030	
2VP-SIL1A	DISCH SEPARATOR/SILENCER	VACUUM PRIMING PUMP	EJ-VP01	HCP-030	HCP-030	
2VP-SIL1B	DISCH SEPARATOR/SILENCER	VACUUM PRIMING PUMP	EJ-VP01	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2VP-TK1	AIR/WATER SEPARATOR TANK	VACUUM PRIMING	EJ-VP01	HCP-030	HCP-030	
2VP-TK2	AIR/WATER SEPARATOR TANK	VACUUM PRIMING	EJ-VP01	HCP-030	HCP-030	
2VP-TK3	AIR/WATER SEPARATOR TANK	VACUUM PRIMING	EJ-VP01	HCP-030	HCP-030	
2VP-TK4	AIR/WATER SEPARATOR TANK	VACUUM PRIMING	EJ-VP01	HCP-030	HCP-030	
2VP-TK5	AIR/WATER SEPARATOR TANK	VACUUM PRIMING	EJ-VP01	HCP-030	HCP-030	
2VP-TK6	AIR/WATER SEPARATOR TANK	VACUUM PRIMING	EJ-VP01	HCP-030	HCP-030	
2VP-TK7	VACUUM TANK	VACUUM PRIMING	EJ-VP01	HCP-030	HCP-030	
2VP-TK8	DRAIN TANK	VACUUM PRIMING	EJ-VP01	HCP-030	HCP-030	
2WD-P1A	SEWAGE LIFT PUMP		EJ-DP02	HCP-030	HCP-030	
2WD-P1B	SEWAGE LIFT PUMP		EJ-DP02	HCP-030	HCP-030	
2WP-BFP1	BACK FLOW PREVENTER		EJ-WP01	HCP-030	HCP-030	
2WP-EJ2A	EXPANSION JOINT	PLANT WATER PUMP INLET	EJ-WP01	HCP-030	HCP-030	
2WP-EJ2B	EXPANSION JOINT	PLANT WATER PUMP INLET	EJ-WP01	HCP-030	HCP-030	
2WP-FLT1A	PLANT WATER MM FILTER		EJ-WP01	W014Z	W014Z	
2WP-FLT1B	PLANT WATER MM FILTER		EJ-WP01	W014Z	W014Z	
2WP-P1	WELL PUMP		EJ-WP01	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2WP-P2A	PLANT WATER SUPPLY PUMP	-	EJ-WP01	HCP-030	HCP-030	
2WP-P2B	PLANT WATER SUPPLY PUMP		EJ-WP01	HCP-030	HCP-030	
2WP-SKD1	PLANT WATER MMF SKID	WATER TREATMENT SYS	EJ-WP01	W014Z	HCP-030	
2WP-SKD2	PLANT WATER MMF SKID	WATER TREATMENT SYS	EJ-WP01	W014Z	HCP-030	
2WP-STR1A	FILTER OUTLET STRAINER	FILTER 1A	EJ-WP01	W014Z	W014Z	
2WP-STR1B	FILTER OUTLET STRAINER	FILTER 1B	EJ-WP01	W014Z	W014Z	
2WP-TK1	FILTERED WATER STG TANK	FILTERED WELL WATER	EJ-WP01	HCP-030	HCP-030	
2WT-EJ1A	EXPANSION JOINT	DEMINERALIZED WATER PMP	W014Z-013	HCP-030	HCP-030	
2WT-EJ1B	EXPANSION JOINT	DEMINERALIZED WATER PMP	W014Z-013	HCP-030	HCP-030	
2WT-FLT1A	RO CARTRIDGE FILTER	R.O. BOOSTER PUMP	W014Z-009	W014Z	W014Z	
2WT-FLT1B	RO CARTRIDGE FILTER	R.O. BOOSTER PUMP	W014Z-009	W014Z	W014Z	
2WT-FLT2	CARTRIDGE FILTER	RO CLEAN IN PLACE	W014Z-009	W014Z	W014Z	
2WT-FLT4A	HEPA FILTER	DEGASIFIER BLOWER	W014Z-010	W014Z	W014Z	
2WT-FLT4B	HEPA FILTER	DEGASIFIER BLOWER	W014Z-010	W014Z	W014Z	
2WT-FLT5	TANK VENT FILTER	DEMIN TANK VENT	W014Z-013	HCP-030	HCP-030	
2WT-FN1A	DEGASIFIER AIR BLOWER	WTR TRNT SYS	W014Z-010	W014Z	W014Z	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2WT-FN1B	DEGASIFIER AIR BLOWER	WTR TRMT SYS	W014Z-010	W014Z	W014Z	
2WT-H1	RO CIP 2 kW TANK HEATER	WTR TRMT SYS	W014Z-009	W014Z	W014Z	
2WT-IOE1A	MIXED BED ION EXCHANGER	WTR TRMT SYS	W014Z-011	W014Z	W014Z	
2WT-IOE1B	MIXED BED ION EXCHANGER	WTR TRMT SYS	W014Z-011	W014Z	W014Z	
2WT-MIX1	RO CIP TANK MIXER	SOLUTION TANK	W014Z-009	W014Z	W014Z	
2WT-P1A	RO BOOSTER PUMP	REV OSMOS UNIT SUPPLY	W014Z-009	W014Z	W014Z	
2WT-P1B	RO BOOSTER PUMP	REV OSMOS UNIT SUPPLY	W014Z-009	W014Z	W014Z	
2WT-P2	RECIRCULATION PUMP	CARTRIDGE FLT SUPPLY	W014Z-009	W014Z	W014Z	
2WT-P3A	MIXED BED FEED PUMP	DEGAS PROD WTR STR TK	W014Z-010	W014Z	W014Z	
2WT-P3B	MIXED BED FEED PUMP	DEGAS PROD WTR STR TK	W014Z-010	W014Z	W014Z	
2WT-P4A	DEMINERALIZED WATER PUMP	DEMIN WTR TK	W014Z-013	HCP-030	HCP-030	
2WT-P4B	DEMINERALIZED WATER PUMP	DEMIN WTR TK	W014Z-013	HCP-030	HCP-030	
2WT-ROM1A	REVERSE OSMOSIS UNIT	WTR TRMT SYS	W014Z-009	W014Z	W014Z	
2WT-ROM1B	REVERSE OSMOSIS UNIT	WTR TRMT SYS	W014Z-009	W014Z	W014Z	
2WT-ROM2A	REVERSE OSMOSIS UNIT	WTR TRMT SYS	W014Z-009	W014Z	W014Z	
2WT-ROM2B	REVERSE OSMOSIS UNIT	WTR TRMT SYS	W014Z-009	W014Z	W014Z	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2WT-SKD1	RO MEMBRANES SKID	WATER TREATMENT SYS	W014Z-009	W014Z	HCP-030	
2WT-SKD2	MIXED BED ION EXCH UNIT	WATER TREATMENT SYS	W014Z-011	W014Z	HCP-030	
2WT-SKD3	MIXED BED ION EXCH UNIT	WATER TREATMENT SYS	W014Z-011	W014Z	HCP-030	
2WT-SKD4	MIXED BED FEED PUMPS	WATER TREATMENT SYS	W014Z-010	W014Z	HCP-030	
2WT-SKD5	R.O. CARTRIDGE FILTERS	WATER TREATMENT SYS	W014Z-009	W014Z	HCP-030	
2WT-SKD6	R.O. BOOSTER PUMPS SKID	WATER TREATMENT SYS	W014Z-009	W014Z	HCP-030	
2WT-SKD7	FORCED DRAFT DEGASIFIER	WATER TREATMENT SYS	W014Z-010	W014Z	HCP-030	
2WT-SKD8	DEGASIFIER AIR BLOWERS	WATER TREATMENT SYS	W014Z-010	W014Z	HCP-030	
2WT-SKD9	RO CLEAN IN PLACE SKID	WATER TREATMENT SYS	W014Z-009	W014Z	HCP-030	
2WT-STR1A	MIXED BED RESIN TRAP	(SKID MOUNTED)	W014Z-011	W014Z	W014Z	
2WT-STR1B	MIXED BED RESIN TRAP	(SKID MOUNTED)	W014Z-011	W014Z	W014Z	
2WT-TK1	RO CLEANING SOLUTION TANK	WTR TRMT SYS	W014Z-009	W014Z	W014Z	
2WT-TK2	DEGASFR PROD WTR STG TK	FORCED DRAFT DEGASIFIER	W014Z-010	W014Z	W014Z	
2WT-TK3	DEMINERALIZED WATER TANK		W014Z-013	HCP-030	HCP-030	
2WW-EDU1A	MIXING EDUCTOR	NEUTRALIZATION TANK	W014Z-014	HCP-030	HCP-030	
2WW-EDU1B	MIXING EDUCTOR	NEUTRALIZATION TANK	W014Z-014	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDENDUM
2WW-EJ2A	PMP EXPANSION JOINT	NEUT WW PMP	W0142-014	HCP-030	HCP-030	
2WW-EJ2B	PMP EXPANSION JOINT	NEUT WW PMP	W0142-014	HCP-030	HCP-030	
2WW-EJ3A	PMP EXPANSION JOINT	DIRTY WW PMP	W0142-003	HCP-030	HCP-030	
2WW-EJ3B	PMP EXPANSION JOINT	DIRTY WW PMP	W0142-003	HCP-030	HCP-030	
2WW-EJ4A	PMP EXPANSION JOINT	FILT WW PMP	W0142-003	HCP-030	HCP-030	
2WW-EJ4B	PMP EXPANSION JOINT	FILT WW PMP	W0142-003	HCP-030	HCP-030	
2WW-EJ5A	EXPANSION JOINT	SEPARATOR EFFLUENT PMP	EJ-DP01	HCP-030	HCP-030	
2WW-EJ5B	EXPANSION JOINT	SEPARATOR EFFLUENT PMP	EJ-DP01	HCP-030	HCP-030	
2WW-FLT1A	WSTWATER MEDIA FILTER	WASTEWATER TREATMENT	W0142-012	W0142	W0142	
2WW-FLT1B	WSTWATER MEDIA FILTER	WASTEWATER TREATMENT	W0142-012	W0142	W0142	
2WW-P1A	CHEMICAL SUMP PUMP	DEMIN AREA CHEM SUMP	W0142-014	HCP-030	HCP-030	
2WW-P1B	CHEMICAL SUMP PUMP	DEMIN AREA CHEM SUMP	W0142-014	HCP-030	HCP-030	
2WW-P2A	NEUTRALIZED WATER PUMP	WASTEWATER TREATMENT	W0142-014	HCP-030	HCP-030	
2WW-P2B	NEUTRALIZED WATER PUMP	WASTEWATER TREATMENT	W0142-014	HCP-030	HCP-030	
2WW-P3A	DIRTY WASTEWATER PUMP	DIRTY WSTWTR TK	W0142-003	HCP-030	HCP-030	
2WW-P3B	DIRTY WASTEWATER PUMP	DIRTY WSTWTR TK	W0142-003	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2WW-P4A	FILTERED WASTEWATER PUMP	FLT WASTE WTR TK	W014Z-003	HCP-030	HCP-030	
2WW-P4B	FILTERED WASTEWATER PUMP	FLT WASTE WTR TK	W014Z-003	HCP-030	HCP-030	
2WW-P5A	SEPARATOR EFFLUENT PUMP		EJ-DP01	HCP-030	HCP-030	
2WW-P5B	SEPARATOR EFFLUENT PUMP		EJ-DP01	HCP-030	HCP-030	
2WW-P6A	FGD DRAINAGE SUMP PUMP	FGD SUMP	EJ-DP02	HCP-030	HCP-030	
2WW-P6B	FGD DRAINAGE SUMP PUMP	FGD SUMP	EJ-DP02	HCP-030	HCP-030	
2WW-SKD1	WASTE WATER MMF SKID	WATER TREATMENT SYS	W014Z-012	W014Z	HCP-030	
2WW-SKD2	WASTE WATER MMF SKID	WATER TREATMENT SYS	W014Z-012	W014Z	HCP-030	
2WW-STR1A	STRAINER	WW MM FILTER DISCH	W014Z-012	W014Z	W014Z	
2WW-STR1B	STRAINER	WW MM FILTER DISCH	W014Z-012	W014Z	W014Z	
2WW-STR2A	PUMP INLET STRAINER	NEUTRALIZED WW PUMP	W014Z-014	HCP-030	HCP-030	
2WW-STR2B	PUMP INLET STRAINER	NEUTRALIZED WW PUMP	W014Z-014	HCP-030	HCP-030	
2WW-STR3A	STRAINER	DIRTY WW PMP INLET	W014Z-003	HCP-030	HCP-030	
2WW-STR3B	STRAINER	DIRTY WW PMP INLET	W014Z-003	HCP-030	HCP-030	
2WW-STR5A	INLET STRAINER	SEPARATOR EFFLUENT PMP	EJ-DP01	HCP-030	HCP-030	
2WW-STR5B	INLET STRAINER	SEPARATOR EFFLUENT PMP	EJ-DP01	HCP-030	HCP-030	

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TAG NO.	DESCRIPTION	SERVICE	P&ID	PURCHASE SPEC	INSTL SPEC	ADDEN-DUM
2WW-TK1	NEUTRALIZATION TANK	WASTEWATER TREATMENT	W014Z-014	HCP-030	HCP-030	
2WW-TK2	DIRTY WASTEWATER TANK	WASTE WTR TREATMENT	W014Z-003	HCP-030	HCP-030	
2WW-TK3	FILTERED WASTEWATER TANK	FLTR WASTE WTR PUMPS	W014Z-003	HCP-030	HCP-030	