System Descriptions

Common System Descriptions

Unit 1 System Descriptions

Unit 2 System Descriptions

Unit 3 System Descriptions

Unit 4 System Descriptions

System Description

1.1 System Identification

Unit Designation	Common
System Name	AQCS Reserve Power Supply
System Codes	APF
File Number	41.0804.3.MC01

1.2 Function

The function of the AQCS Reserve Power Supply System shall be to distribute backup electrical power to various pieces of equipment, devices, and cabinets, and to provide overcurrent and fault protection.

1.3 Process Description

The 13.8 kV and 4160V system shall consist of the following major components:

Two (2) two-winding delta primary, resistance grounded wye AQC Reserve Auxiliary Transformers. The high voltage rating shall be 13.8 kV. The low voltage side shall be 4160V. The 13.8 kV primary feed will be supplied from the existing 14.0 kV Outdoor Substation's existing 13.8 kV switchgear. The 4160V secondary winding shall serve their respective switchgear bus.

One neutral grounding resistor on each secondary winding of each AQC Reserve Auxiliary Transformer.

The 4160V system shall also consist of the following major components:

Four (4), single vertical section, arc resistant 4160V metal-clad, switchgear with a main/feeder breaker on each bus. The 4160V switchgear shall be of single-high construction.

The 4160V switchgear shall be located within the Common AQC Reserve Power Distribution Center.

Each 4160V switchgear shall feed reserve power to the 4160V AQC switchgear in Units 1, 2, 3, and 4.

4160V cable bus connection from its respective Common AQC Reserve Auxiliary Transformer.

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The 13.8 kV system shall also consist of the following major components:

13.8 kV cable in ductbank, from the existing 13.8kV outdoor switchgear to the Common AQC Reserve Auxiliary Transformer.

13.8 kV extension of the existing outdoor 13.8kV switchgear to support the cable connection to the Common AQC Reserve Auxiliary Transformer.

1.4 Reference Drawing

- B&V Conceptual Overall One Line – AQCS Reserve 168908-MCDE-E1005
- Existing Station Auxiliary One Line – LG&E 317255-E502, Rev R

System Description

1.1 System Identification

- Unit Designation — Common
- System Name — Grounding
- System Code — EEB
- File Number — 41.0804.3.MC02

1.2 Function

The station electrical system is susceptible to ground faults, lightning, and switching surges that could result in high potentials and constitute a hazard to station personnel and electrical equipment. The function of the Grounding System shall be to provide an adequate path to permit the dissipation of ground fault currents from system faults and lightning preventing the buildup of voltages that may result in hazard to personnel. Proper grounding also provides protection from ground potential rise and noise on control and instrument circuits.

1.3 Process Description

The existing ground grid at Mill Creek shall be expanded for the additions associated with the new air quality control system (AQCS). Structures and equipment that shall be grounded shall include buildings, new Unit 4 WFGD and chimney, PJFFs, raceways, structural support steel transformers, and electrical equipment. Each grounded equipment and structure shall be connected to the grounding grid. Ground rods shall be installed for each perimeter grounding system. Perimeter grounding systems shall be connected to adjacent existing grounding systems by at least two parallel conductors.

1.3.1 Buildings and Structures

The ground grid system addition shall consist of bare copper stranded cable buried in the soil below structures and ground floor concrete slabs in a suitable grid pattern. Each junction of the grid shall be securely bonded together by exothermic connection, with the exception for equipment ground that can be compression connectors or copper strap. Copper-clad ground rods shall be installed and attached to the ground grid system at various locations.

The pattern for the ground grid addition, and the length and number of ground rods, shall be determined during detailed design using soil resistivities obtained by measurements taken at the station site along with generation ground grid calculations for safe touch and step voltage potentials performed by a grounding software program.

Ground stingers shall be run from the ground grid to at least every other building column and to every utility bridge support. These stingers shall be bare copper cable connected to the columns or supports with compression lugs.

To ensure a station low-impedance ground-fault return path and to interconnect new remote ground grids to the main station grid, two bare copper conductors shall be buried with all new duct banks. These conductors shall be connected to the station ground grid system, outlying building ground grids, existing switchyard ground grid, and all manhole grounding systems along the duct banks.

1.3.2 Chimney

A loop grounding conductor shall be installed around the new Unit 4 chimney foundation. The loop conductor shall be connected to ground rods and to the station ground grid by two parallel conductors. Ground stingers shall extend from the loop conductor to the lightning protection system, stack ladder, and electrical pull box near the stack foundation.

1.3.3 Raceway

All new metallic raceway, including, but not limited to, cable trays, conduits, wireway, and racks, shall be bonded to the ground grid by ground conductors. This raceway ground shall also form a bonding path from electrical equipment to the supply source while at the same time bonding both to the ground grid.

1.3.4 Electrical Equipment

All electrical equipment shall be grounded.

1.3.5 Cathodic Protection

All underground metallic piping, underground steel tanks, and pad-mounted steel tanks shall be dielectrically separated from the station ground grid to prevent corrosion caused by electrolytic reaction of the structures with copper grounding material. Pad-mounted steel storage tanks shall be grounded with copper ground rods and insulated ground conductors. The tank ground rods shall be completely isolated from the station ground grid and cathodically protected along with the associated tank bottom. In cases where the station ground grid must pass close to tank copper ground rods, insulated ground conductors shall be used to maintain adequate isolation.

Buried or submerged equipment, and their foundation bolts or piping to which cathodic protection may be applied, shall not be in contact with reinforcing rods, metallic conduit, grounding cable, or other piping. Insulating flanges, unions, or couplings may be required in the pipe risers just above ground elevation.

1.3.6 Cranes and Hoists

Cranes and hoists shall be grounded through their rails. Rails shall be electrically bonded together and connected to the grounding system at each end. However, grounding of equipment shall be primarily through the ground conductor on the cable reel.

1.3.7 Switchyard

The plant ground grid addition shall be interconnected with the existing switchyard ground grid with at least two separate conductors.

1.3.8 Lightning Protection

The design of the lightning protection system for the AQCS additions shall include determination of the overall lightning hazard for the geographic location of the project and for the structures, the selection of Class I and/or Class II materials, the need of corrosion protection for the copper and/or aluminum components used, and consideration of other pertinent factors. The design shall produce a zone of protection from lightning to prevent personal injury, structural damage, and equipment downtime. For purposes of the estimate, the estimated cost of the new Unit 4 chimney includes the cost of and integral lightning protection system.

Lightning protection systems shall be bonded to grounding electrode systems in accordance with the National Electrical Code.

1.3.9 Control System

The Distributed Control System (DCS) shall be grounded with dedicated insulated ground conductors attached to the main ground grid in accordance with manufacturer's recommendations. All control panels and cabinets shall be connected to the ground grid by ground stingers.

System Description

1.1 System Identification

- Unit Designation — Common
- System Name — Site Fire Protection
- System Code — STG
- File Number — 41.0804.3.MC03

1.2 Function

The Site Fire Protection System provides fixed water suppression systems, carbon dioxide suppression systems, fire extinguishers, and independent fire detection systems. The Site Fire Protection System also provides manual firefighting capability with hose streams at the site facilities as required by code. These systems provide for the protection of the new plant enclosures and equipment in an event of fire.

1.3 Process Description

The Site Fire Protection System includes various fixed detection and suppression systems. The Mill Creek systems are listed in Table 1. The basic operation of each type of system is as follows:

- Dry-Pipe Sprinkler System. Dry-pipe sprinkler systems use closed sprinkler heads attached to a piping system supplied by the fire protection water loop. The dry-pipe valve is a differential pressure latch valve which depends on air pressure in the system to keep it closed against the water supply pressure. When a sprinkler head is opened, system air pressure is relieved through the open sprinkler. The water supply pressure then forces the dry-pipe valve open, and water flows into the piping system and discharges through the open sprinkler head. A supervisory air pressure switch is provided on the air side of the dry-pipe valve to provide an alarm in the event that pressure decays from 40 psig to approximately 26 psig within the system.

- Automatic Water Spray (Preaction) System. The automatic preaction sprinkler system utilizes spot type heat detectors installed throughout the protected area. When high temperature is detected, an alarm is activated, which opens the preaction valve to admit water to the system piping. The sprinklers/spray nozzles are closed and will discharge water only when individual heads open due to excessive heat. The systems are used where it is particularly important to prevent the accidental discharge of water and where an alarm in advance of sprinkler/spray nozzle operation is desired.

- Hose station (dry). Manual dry hose stations utilize a dry pipe valve to supply water to the hose connection. When the hose valve is opened, system air pressure is relieved through the open valve. The water supply pressure then forces the dry-pipe valve open, and water flows into the piping system and discharges through the open hose valve. A supervisory air pressure switch is provided on the air side of the dry-pipe valve to provide an alarm. The number of hose stations will be per NFPA 14 such that all portions of the building are within 30 feet of a nozzle when attached to not more than 100 feet of hose.

- Automatic / Manual Carbon Dioxide (CO_2) system. Automatic CO_2 systems utilize heat detection or carbon monoxide detectors to detect a fire condition and activate the system. Manual system use manual pulls to active the system. The piping from the releasing valve to the protection area is empty until a detector or pull station is activated. Upon activation of system, the area is inerted or flooded with CO2 via the open nozzles. The system is monitored by the local fire panel and will annunciate an alarm locally and back in the control room when activated.

The fixed water suppression systems and hose stations are supplied water via the existing underground yard distribution piping.

The Powder Activated Carbon (PAC)'s silos include a low-pressure CO_2 system to address fires that can occur in the silo. The PAC is a combustible material. The protection system in the PAC silo is similar to that used in power plant coal silos.

Portable, hand-held fire extinguishers are provided at key locations in accordance with the requirements of NFPA 10. The extinguishing agent will be either dry chemical or carbon dioxide. The agent used will be selected based on the fire hazards encountered in the immediate area.

Fire detection equipment consists of fixed temperature heat detectors, rate-compensated heat detectors, and ionization type smoke detectors. Smoke detectors will consist of ionization detectors which respond to both visible and invisible products of combustion.

A Fire Protection Signaling System is provided to monitor the new fixed fire protection systems, and will transmit the system status to the main control room and annunciate on the existing Main Fire Alarm Annunciator Panel. The Fire Protection Signaling System includes a local panel at each unit. Audible fire and trouble alarms will also be provided at the local supervisory panels for local annunciation. All of the new fire protection systems will communicate their alarm information to the existing main fire alarm annunicator panel located in the main control room.

An existing underground yard distribution system is provided to supply fire protection water throughout the main plant area and can be extended to the new areas and fire protection systems. The yard distribution piping does not appear to be looped around the new Unit 4 WFGD area and should be expanded to provide a loop as called out in NFPA. The fire main supplies water to the new fire hydrants and new fixed water suppression systems. The addition of the loop will allow for multiple flow paths such that if one path fails, other piping paths can supply sufficient fire protection water to the system. Valves (post indicator or curb valve box type for underground lines) will be provided at each connection to the existing piping. These valves enable isolation of any failed piping section. Isolation valves are also provided at each additional fire hydrant. Fire hydrants are typically spaced approximately 300 feet apart around the loop and additional hydrants may be needed.

Existing pumps are sufficient to provide the amount of pressure and flow needed for the additional systems.

The new water suppression systems tie into the existing plant underground fire main pipe. Tap locations are shown on the process flow diagram, 168908-MCSTG-M2547. Each tap will be provided with an isolation valve for the new system

Suppression systems for the Mill Creek Project are listed in Table 1.

1.4 Pulse Jet Fabric Filter (PJFF) Fire Protection

Fire protection for PJFFs is a growing concern in the industry, especially when PAC is used and captured for reducing emissions. Therefore, recommendations and requirements for PJFF fire protection are currently evolving. Currently NFPA states that fires have been caused in bag houses by incomplete combustion in the boiler resulting in carryover of burning particulate igniting the filter media or in this case the combustible material covering the bags or hoppers. The combustible material covering the bags has primarily been attributed to the injection of powder activated carbon (PAC) into the flue gas upstream of the PJFF, which is used to reduce the pollutants like mercury and others present in the exhaust. The PAC and unburned carbon are combustible materials collected on the bags and hoppers during normal operation. Current industry opinions and recommendations recognized by B&V fire protection experts are that there is a need for suppression systems in PJFFs due to the fire hazard introduced by the collection of PAC. As research and studies continue, it may ultimately be determined that the hazard could be reduced if the PAC concentration in the PJFF is low enough when collected with other inert materials like sorbent and or fly ash. However, at this point if PAC is injected upstream of a PJFF, it is recommended to include installation of a suppression system to minimize damage in an event of fire. The basis of the cost estimate includes suppression systems in the PJFFs.

Two types of suppression systems may be utilized for PJFFs, a preaction spray system or a CO_2 gas system. Each of these systems has its own advantages and disadvantages. The preaction spray system is less costly to install, but is typically not recommended by the manufacturers due to the damage water can cause if the system is activated. If water is sprayed into the PJFF, the affected bags and possibly cages will need to be replaced or repaired in that compartment. The CO_2 gas system is more expensive to install, takes up more real estate, and has some personnel safety concerns with discharge, but CO_2 suppression system does not damage the bags and cages when discharged.

The cost estimate includes each PJFF being provided with a preaction spray system. An optional price to use CO_2 instead of the spray system can be provided if desired.

Table 1
Mill Creek Station
Fire Protection System Design Conditions

System Designation	**Area or Equipment Protected**	**System Type**	**Detection or Actuation Device**

Common

System Designation	Area or Equipment Protected	System Type	Detection or Actuation Device
STG-1	PAC Silos (Units 1 &2)	Low Pressure Carbone Dioxide	Carbon Monoxide Detector
STG-2	PAC Silos (Units 1 &2)	Low Pressure Carbone Dioxide	Carbon Monoxide Detector

Unit 1

STG1-1	PJFF *	Automatic Water Spray (PreAction)	Spot Heat.
STG1-2	AQCS ELECT BLDG	Early Warning Detection	Smoke Detectors
STG1-3	Fan VFD ENC	Early Warning Detection	Smoke Detectors
STG1-4	Transformer**	Firewall Protection	

Unit 2

System Designation	Area or Equipment Protected	System Type	Detection or Actuation Device
STG2-1	PJFF *	Automatic Water Spray (PreAction)	Spot Heat.
STG2-2	Fly Ash Handling Equipment Area*		Fire Extinguishers
STG2-3	AQCS ELECT GEAR*	Early Warning Detection	Smoke Detectors
STG2-4	Fan VFD ENC	Early Warning Detection	Smoke Detectors
STG2-5	Transformer**	Firewall Protection	

Unit 3

System Designation	Area or Equipment Protected	System Type	Detection or Actuation Device
STG3-1	PJFF *	Automatic Water Spray (PreAction)	Spot Heat.
STG3-2	Fly Ash Handling Equipment Area	Dry Pipe Sprinkler	Quartzoid bulb sprinkler heads
STG3-3	Fan VFD ENC	Early Warning Detection	Smoke Detectors
STG3-4	PAC Silos	Low Pressure Carbone Dioxide	Carbon Monoxide Detector
STG3-5	Transformer**	Firewall Protection	

Unit 4a & Unit 4b

System Designation	Area or Equipment Protected	System Type	Detection or Actuation Device
STG4-1 (a&b)	WFGD Pump Building	Hose Station, dry	
STG4-2 (a&b)	PJFF *	Automatic Water Spray (PreAction)	Spot Heat.
STG4-3 (a)	Fly Ash Handling Equipment Area		Fire Extinguishers
STG4-4 (b)	Fly Ash Handling Equipment Building	Dry Pipe Sprinkler	Quartzoid bulb sprinkler heads
STG4-5 (a&b)	WFGD PUMP Building	Dry Pipe Sprinkler	Quartzoid bulb sprinkler heads
STG4-6 (b)	Sample Lab & Annex Buildings	Dry Pipe Sprinkler	Quartzoid bulb sprinkler heads
STG4-7 (b)	Multifunctional Warehouse Building	Dry Pipe Sprinkler	Quartzoid bulb sprinkler heads
STG4-8 (a&b)	AQCS ELECT BLDG	Early Warning Detection	Smoke Detectors
STG4-9 (a&b)	VFD Enclosure	Early Warning Detection	Smoke Detectors
STG4-10 (a&b)	Switchgear BLDG	Early Warning Detection	Smoke Detectors
STG4-11 (a&b)	PAC Silos	Low Pressure Carbone Dioxide	Carbon Monoxide Detector
STG4-12 (a&b)	Transformer**	Firewall Protection	

*Optional CO_2 system pricing can be provided if requested.
**Per NFPA 850

System Description

1.1 System Identification

- Unit Designation — Common
- System Name — Site
- System Code — STA
- File Number — 41.0804.3.MC04

1.2 Function

The Site System shall provide a stable well-drained site and vehicular access to all added structures.

1.3 Process Description

The Roads and Parking System shall include the following major components:

Excavations and backfills

Road and parking area subgrades

Plant loop road and access roads

Reagents and sorbents unloading and containment stations

Pipe bollards at corners of buildings adjacent to roads, adjacent to truck access doors, at pipe stub-ups such as at chemical unloading stations and at fire hydrants and similar facilities

Fills and embankments

Site drainage works including inlets, culverts, catch basins, detention facilities, etc.

A site-wide storm water drainage system already exists at Mill Creek. To a major extent, the additions and modifications proposed by the Phase II study will not result in significant changes to the amounts and locations of concentration of storm water runoff occurring onsite. The addition of individual structures will locally increase the impervious area, generating additional runoff, and this additional runoff will be taken into account during detailed design. To the extent practical, the existing system of ditches, trenches, and culverts, inlets, and storm sewers will be used as is to collect and convey runoff in the manner in which it is currently controlled. Erosion protection will be provided at the edges of ditches and elsewhere where concentrations of flow may occur and lead to scouring. Selective storm drains, surface swales, and storm sewers will be added or modified to handle additional flow generated by the design storm event due to the Phase II modifications. Any overall change in site-wide runoff quantities due to the Phase II modifications is expected to be minimal.

Major construction envisioned in Phase II will in general lie between the main unit buildings and the east site loop road. During construction, portions of this road will be impacted and temporary detours or alternates will be required to maintain access through the site. Upon completion of the Phase II modifications the east loop road will, for the most part, be re-established in place. The loop road at the corner northeast of Unit 2 may require some repositioning on structural fill to maintain loop travel around the additions at Unit 2. The west leg of the main loop road passes through the extended turbine hall encompassing all four units, with entrances at the Unit 2 and Unit 4 ends. During construction, any modifications impacting the west loop road will be made such that at least one entrance to the extended turbine hall remains in operation at all times.

Asphalt paved roads and parking areas shall be provided to access and maintain new equipment. Truck parking will be provided near the bulk materials unloading areas to maintain traffic flow around those areas. The truck access and unloading dock to the warehouse north of Unit 2 will require relocation to the north due to added equipment at Unit 2 unless Arrangement B at Unit 4 is ultimately selected. In that arrangement a new warehouse and loading dock will be installed (reference File 41.0804.3.M405). Suggested locations of roads are shown on the General Arrangement Drawing. Local parking areas will be provided adjacent to new structures. Impacts to overall site parking are expected to be minimal, except if a new warehouse is constructed per Arrangement B for Unit 4. In that case, displaced parking spaces will be relocated to areas near the new Sample Lab and Annex Building.

System Description

1.1 System Identification

• Unit Designation	Unit 1
• System Name	AQCS Power Supply
• System Codes	APB--AC Power Supply (120/208 Volts)
	APC--AC Power Supply (480 Volts)
	APD--AC Power Supply (4160 Volts)
	APH--DC Power Supply
	API--Uninterruptible Power Supply
• File Number	41.0804.3.M101

1.2 Function

The function of the Auxiliary Power Supply System shall be to distribute electrical power to various pieces of equipment, devices, and cabinets, and to provide overcurrent and fault protection.

1.3 Process Description

1.3.1 AC Power Supply (120/208V) (APB)

Power shall be provided to 120V single-phase and 208V three-phase loads by ac panelboards rated 120/208V, three-phase, four-wire. The panelboards shall also provide branch circuit protection and a means of disconnect for the branch circuit loads through manually operated thermal magnetic circuit breakers. Power shall be provided to the panelboards by low voltage transformers, with 480V three-phase primary (APC) and 120/208V secondary with directly grounded neutral. The system shall be designed to provide 100 percent of the required continuous loads with 20 percent spare kVA.

1.3.2 AC Power Supply (480V) (APC)

Power shall be provided to 480V three-phase loads by the following major power system components, in general:

4160V to 480V dry type secondary unit substation (SUS) transformers with high resistance grounded wye secondary grounding.

480V, 3-phase, 3-wire, metal enclosed double-ended SUS switchgear.

480V, 3-phase, 3-wire, motor control centers (MCCs).

480V, 3-phase, 3-wire, panelboards.

480V to 480Y/277V and 120/208V dry type transformers for lighting and receptacle loads.

480 Y/277V and 120/208V, 3-phase, 4-wire panelboards for lighting and receptacle loads.

The 480V secondary of the SUS transformers shall be connected high resistance grounded wye. All SUS transformers shall be indoor, dry type transformers furnished with AN or ANAF cooling rating and a 150 ^{o}C temperature rise.

The AC Power Supply (480 V) System will be designed to feed the facility's low voltage loads. Each SUS transformer and associated low voltage switchgear line-up will be sized to serve its maximum coincidental operation load. All SUS, MCCs and panelboards will be initially designed with a minimum of 20 percent spare circuit breakers.

1.3.3 AC Power Supply (4160V) (APD)

The 4160V systems shall consist of the following major components:

One two-winding delta primary, resistance grounded wye Main Auxiliary Transformer. The high voltage rating shall be 22kV and the low voltage rating 4160V to serve the Unit 1 switchgear buses A & B.

One neutral grounding resistor on each secondary winding of each auxiliary transformer.

The 4160V system shall also consist of the following major components:

Two (2) 4160V metal-clad, single-ended switchgear with a main breaker on each bus connecting it to the AQC Main Auxiliary Transformer and a secondary main breaker connecting the switchgear bus to the Common AQC Reserve Auxiliary Transformer. The 4160V switchgear shall be arc resistant and of two-high construction. The switchgear shall be located within the AQC Electrical Building

4160V cable bus.

4160V medium voltage circuit breakers and contactors.

Two (2) variable frequency drives (VFD) fed from the 4160 SWGR A & B respectively. Each drive will power and control an ID Fan motor. The VFDs will be located within the Fan VFD Enclosure.

The existing 13,800V system:

The existing 13.8 kV outdoor metal-clad, switchgear shall be modified with an extension to feed the Common AQC Reserve Transformers. The Common AQC Reserve transformers have a 4160V secondary which will provide reserve power to the Unit 1 AQC 4160V Switchgear A and B.

13.8 kV cable in underground duct bank from the existing 13.8kV switchgear to the Common Reserve Auxiliary Transformers..

Reference Common system AQCS Reserve Power Supply system description: 41.0804.3.MC01 for additional detail.

1.3.4 DC Power Supply (APH)

The DC Power Supply System will consist of 125VDC lead acid station batteries, two (2) full-capacity redundant solid-state chargers per battery and a Main distribution panel.

The DC Power Supply System will consist of a station battery system located in a dedicated battery room. The system will utilize flooded type batteries with trays under the batteries. These batteries will provide DC power to the plant DCS, critical FGD System loads, and control power for the auxiliary electrical system equipment. The battery will be connected to a main distribution panel and continuously charged by two fully redundant battery chargers.

Under normal conditions, the battery chargers supply dc power to the dc loads. The battery chargers receive 480VAC power from the motor control centers. The chargers will continuously float-charge the battery while supplying power to the dc loads. Under abnormal or emergency conditions when 480VAC power is not available, the battery supplies dc power to the dc loads. Recharging of discharged batteries occurs whenever 480VAC power becomes available. The rate of charge is dependent upon the characteristics of the battery, battery chargers, and the connected dc load during charging. Each station battery charger shall be capable of charging the fully discharged battery within 8 hours with battery load present.

The battery will be located in a dedicated battery room that is a space conditioned area so that suitable temperatures can be maintained, thus helping to ensure long battery life. Battery temperature for sizing calculations shall be 77^{o} F. The battery shall be sized in accordance with IEEE 485. An exhaust fan(s) shall be furnished for limiting the concentration of hydrogen gas in each battery room. The equalizing voltage shall be used to determine the hydrogen gas emission for fan sizing. Climate control and exhaust fans shall be provided that are suitable for the environment.

1.3.5 Uninterruptible Power Supply (API)

A UPS shall be provided in the AQC Electrical Building for Unit 1. The UPS shall provide reliable power to the control system equipment, other equipment needing a regulated power supply, and other critical equipment needing a reliable power supply. . The UPS system shall be able to handle full load capacity for four (4) hours.

One (1) 120V AC Main UPS Distribution Panel shall be mounted with the chargers and UPS inverter. The panels shall be mounted within the AQS Electrical Building.

A120-208V AC distribution panel for the instrumentation shall be located in the AQC Electrical Building. This distribution panel shall be fed from a 480V:120-208V isolation transformer. The isolation/regulating transformer will regulate the output voltage and provide isolation and noise attenuation based on normal AC input. The voltage regulation shall be + - 1% with -10% to +20% input variation.

Each transformer will be fed from an automatic transfer switch (ATS) which will be fed from each of the 480V MCCs in the building. The ATS shall consist of a double throw power transfer switch mechanism and microprocessor controller of the same manufacturer to provide automatic operation. The ATS shall be switched automatically via voltage sensing and have the capacity to be transferred manually both locally and remotely. The distribution panels shall include circuit breakers in series with fast acting fuses for branch circuit protection.

Each UPS and isolation/regulating transformer shall include 20% spare capacity and distribution panelboards shall have 20% spare branch breakers/fuses for future use by the Purchaser.

1.4 Reference Drawings

- Conceptual Overall One Line – Unit 1: 168908-M1DE-E1001
- Conceptual Overall One Line – Common: 168908-MCDE-E1005

System Description

1.1 System Identification

- Unit Designation — Unit 1
- System Name — Communication
- System Code — CMA
- File Number — 41.0804.3.M102

1.2 Function

The function of the Communication System shall be to provide station personnel with a reliable and convenient means of plant paging and party line communications, and to provide raceway and other provisions for telephone/LAN wiring and equipment and closed circuit television (CCTV).

1.3 Process Description

The Communication System shall include microprocessor-based page/party equipment, raceway, and page/party communication cable as manufactured by Gai-Tronics Corporation. The new microprocessor-based system shall be fully adaptable to the existing system installed at Mill Creek Unit 1 and shall provide self-diagnostic monitoring of the new system for system integrity. The page/party equipment shall provide two-way voice communication on each party line and shall utilize a page line for voice transmission over a plant-wide speaker system. While a conversation is taking place on a party line, other conversations may be held on other party lines or the page line. Each page/party handset station shall have five party lines and one page line. Page/party handset stations and speakers shall be strategically located throughout the plant site. The power supply for the page/party equipment shall be 120 volts ac, from the normal AC System.

The new system shall interface with the existing Mill Creek Unit 1 system.

Raceway and space provisions for telephone/LAN equipment and CCTV shall be provided. Base equipment shall be located in the common control room and peripheral equipment shall be strategically located.

System Description

1.1 System Identification

- Unit Designation Unit 1
- System Name Control and Monitoring
- System Code COA
- File Number 41.0804.3.M103

1.2 Function

The existing Honeywell Experion Distributed Control System (DCS) will be expanded to incorporate control and monitoring of the new AQCS equipment. The resulting DCS shall provide a means to control in manual and automatic the AQCS equipment individually, as well as in coordination with other plant systems. The DCS shall be central to all plant operations and control the various systems and subsystems, including those required for the new AQCS equipment. The existing DCS will be the central location in the plant for alarm management, historical data archiving, report generation, and data trending. The primary operator interface to the DCS shall be the existing Unit 1 workstations located in the Mill Creek Main Control Room. The existing unit protection system will be retained in the existing DCS to protect critical plant equipment, including critical ID fan and draft system interlocks.

No local operator stations are included in the conceptual design for the AQCS areas.

- The new AQCS DCS shall consist of the extending existing DCS universal control network (UCN) 01, and the addition of a new high performance manager (HPM) to control the new AQCS common unit equipment. The AQCS DCS equipment shall communicate by means of redundant UCN data highways.

The AQCS DCS equipment shall include the following major components:

- Redundant UCN.
- Redundant HPM.
- DCS system cabinets and input/output (I/O) cabinets.

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1.3 Process Description

The AQCS DCS control processors in the HPM shall contain the control logic for the AQCS equipment. Analog control loop logic and discrete logic shall be implemented in the redundant control processors. The Main Control Room DCS operator interface equipment shall be used as the means to control and monitor plant AQCS processes and process equipment. The DCS configuration will provide interface to all AQCS processes and equipment from either the Unit 1 designated operator workstations.

The AQCS DCS equipment shall interface with the existing DCS to allow retrieval of historic plant data, trend process parameters, and to develop specialized displays of plant information. The operator graphics shall be developed based on the AQCS systems to be controlled, and displayed in a hierarchical format.

The configuration of the AQCS DCS equipment shall take into account redundancy wherever the failure or loss of a component could cause plant upset or loss of generation capacity. Total control processor loading for all required control parameters and communication functions shall be limited to no more than 80 percent loading on each redundant pair. Each input/output cabinet shall contain 20 percent installed spare modules to allow for future expansion.

DCS HPM processor and I/O cabinets shall be located in space-conditioned rooms in the following locations to allow control and instrument cabling to be managed within buildings, minimizing the amount of cable installed between buildings:

- Unit 1 AQCS Electrical Building.
- Unit 1 & 2 SCR Power Distribution Center (PDC).
- Common reserve Power Distribution Center (PDC).

Control processors, power supplies, input/output cards, and other associated hardware shall be a common form factor to provide flexibility of mounting individual control system devices on common rack or carrier. Process controllers, input/output modules, mounting racks or carriers, communication hardware, power supplies, ventilation fans, and other required accessories shall be housed in industrial enclosures with NEMA rating appropriate for the mounting location of the cabinet.

System Description

1.1 System Identification

- Unit Designation — Unit 1
- System Name — Lighting
- System Code — LTA
- File Number — 41.0804.3.M104

1.2 Function

The function of the Lighting System is to provide station personnel with illumination for station operation under normal conditions, egress under emergency conditions, and emergency operational lighting to perform tasks during a power outage of the normal source. The permanent lighting may be used for construction lighting in areas where early installation is practical. Additional construction lighting shall be provided using temporary luminaires and construction power distribution grid. The system also provides 120 volt convenience outlets for portable lamps and tools.

1.3 Process Description

Luminaires for areas with finished acoustical ceilings, if any, shall be fluorescent static troffers. The lighting system for continuously occupied control rooms shall utilize the same type static troffer, except with a dimming ballast and 1/2 inch square louvered low iridescent parabolic diffuser for glare control. Fluorescent lamps shall be energy effiicent 3000K, T8 and not exceed four feet and shall be low mercury content. Ballasts shall be energy efficient electronic type with less than 10 percent harmonic content.

Low bay, wall and stanchion mount luminaires shall be used in outdoor areas and unfinished, hazardous and non-hazardous, enclosed areas of the station. Metal halide luminaires shall be used in the industrial and high bay areas of the plant. Metal halide luminaires shall comply with the Energy Independence and Security Act of 2007, and therefore, all metal halide ballasts and lamps 400 watts and under shall be pulse start metal halide type. Except for high bay areas, pulse start metal halide luminaires shall be enclosed and gasketed with threaded glass refractors. Luminaires located in hazardous areas shall be Underwriters Laboratories (UL), or other North American third party testing lab, listed for the National Electrical Code (NEC) classification. High bay luminaires shall be enclosed and have aluminum or glass reflectors. Luminaires in wet locations or in wash down areas shall be in National Electrical Manufacturers Association (NEMA) 4 enclosures. Approximately 25 percent of the non-hazardous industrial area metal halide luminaires shall be provided with a quartz auxiliary lamp option to provide immediate illumination upon starting and restrike conditions.

Emergency lighting shall be provided for interior building egress paths, interior stairways, selected areas around electrical equipment, and local control rooms. The emergency lighting luminaires for the plant areas shall be powered from individual battery pack units with halogen lamps. Emergency lighting shall provide 90 minutes of operation per the NFPA Life Safety Code 101. Emergency operational lighting for control room area lighting shall be powered by connecting selected fluorescent luminaires to the plant UPS system.

Exit light luminaires shall use light emitting diode (LED) lamps for most areas, with compact fluorescent lamps used in hazardous rated areas, and shall be located in the egress pathways and ground level exit doors of enclosed buildings. The exit luminaires shall be powered from normal ac power and integral batteries for emergency service.

Roadway luminaires shall be pulse start metal halide, cutoff cobra head type mounted on aluminum or galvanized steel poles with helix steel or concrete anchor foundations.

Power used to supply fluorescent and pulse start metal halide luminaires shall be 277 volt ac, except for the possible use of 120 volt ac power for some small remote buildings where 277 volt ac power is not readily available or economically feasible. Luminaires shall be powered from the panelboards, with alternate luminaires or rows of luminaires fed from alternate panelboard circuit breakers. Power used to supply convenience receptacles shall be 120 volts ac. Power used to supply roadway and area lighting shall be 480 or 277 volts ac.

Lighting is not required for roof top PRVs. However, one 120 volt ac ground fault current interrupter receptacle shall be installed on the roof and suitable for access to all the PRV's. A photoelectric controlled light fixture shall be installed near any roof top access doors.

Convenience receptacles shall be grounded duplex type and located throughout the station. The convenience receptacles shall be a minumum of 15 inches above the floor in office areas and 36 inches above the floor in industrial areas. The convenience outlets shall be spaced, at the same elevation, to provide access to any point in the industrial areas with a 100 foot extension cord. Convenience outlets for use without extension cords shall be located in finished areas such as offices, control room, and laboratory. Each outlet shall have the grounding pole located at the top of the device. Each office shall have a minimum of two receptacles on opposite walls. No more than eight receptacles shall be connected to a branch circuit breaker. Receptacles shall be circuited to alternating circuits within an area. Weatherproof snap action covers shall be installed on all receptacles located outdoors and in wet indoor areas. In general, receptacles for outdoor and plant indoor wet areas shall be standard 125 volt, 20 amp, 2-pole with ground, NEMA 5-20R type. Selected receptacles in finished and industrial areas shall have GFCI protection in accordance with the NEC. In areas with hazardous atmospheres, convenience outlets shall be suitable for the NEC class, division, and group requirements.

Operation of the Lighting System is dependent upon the visual requirements of the station operating personnel. The general lighting for interior process areas shall be manually switched on and off at panelboard circuit breakers. The lighting for smaller enclosed areas within the buildings shall be manually switched on and off at local light switches near personnel entrance doors. The OFF position of the toggle switch shall be in the downward position. The lighting for continuously occupied control rooms shall be controlled from dimmer switches. The exterior process area lighting shall be controlled through common contactors that automatically operate between sunset and sunrise via photoelectric controllers. The lighting contactors shall have a hand-off-auto (HOA) switch for daytime maintenance override. Luminaires with integral photocells shall be provided for roadway luminaires and luminaires at exterior personnel entrances only. Separate photo-electrically controlled electrically held lighting contactors with a HOA switch shall be provided for exterior lighting in different areas of the plant.

Luminaires shall be installed at a minimum height of 7 feet 0 inches above the floor to provide an unobstructed way of exit travel from any point in the buildings. Luminaires shall be designed and installed with consideration for maintenance and access. Luminaires shall be installed in locations where maintenance shall not be blocked by structural steel, piping, raceway, grating, etc.

Lighting cable powered from 277 volt ac and all branch circuits installed outdoors shall be XHHW-2 . All 120 volt ac branch circuits installed indoors in heated spaces shall be THHN cable. Pre-assembled and prewired cable assemblies shall be used only in finished environments.

Lighting and receptacle branch circuit voltage drop shall not exceed 3%. This shall include the voltage drop from the last outlet in the branch circuit to the lighting panelboard. In addition, 120 volt branch circuits longer than 75 feet shall use 10 AWG and 277 volt branch circuits longer than 200 feet shall use 10 AWG conductors.
General access interior structure lighting for permanent structures required during construction shall be provided using the permanent luminaires connected to the construction power grid, where practical. Any additional lighting required for construction operation shall be provided by the construction contractor.

The Lighting System shall comply with the regulatory requirements of Occupational Safety and Health Administration (OSHA) and applicable building codes.

Lighting shall be designed in accordance with the Illuminating Engineering Society of North America (IESNA) to provide the illumination levels recommended by the following standards and organizations:

- American National Standards Institute (ANSI)/IESNA RP-7, Industrial Lighting.
- ANSI/IESNA RP-8, Roadway Lighting.
- OSHA.

- National Fire Protection Association (NFPA), National Electric Code (NFPA 70).
- NFPA, Life Safety Code (NFPA 101).
- Local Building Code (latest adopted version).

The following criteria shall also be considered in the lighting system design:

- Illumination calculations shall be based upon the mean lumen output of the respective lamps (lamp lumen depreciation [LLD]).
- Illumination calculations shall be based upon a luminaire dirt depreciation (LDD) factor.
- Interior illumination calculations shall be based upon a room surface dirt depreciation (RSDD) factor.
- Illumination calculations shall be based upon the luminaire ballast factors of the light fixtures utilized in the design.
- The illumination calculations shall be determined at a 30 inch workplane height above the floor.

System Description

1.1 System Identification

- Unit Designation — Unit 1
- System Name — Buildings and Enclosures
- System Code — BSA
- File Number — 41.0804.3.M105

1.2 Function

The function of the Buildings and Enclosures System will be to provide support, enclosure, and access to the systems contained within each structure's boundaries.

1.3 Description

The various structures associated with the Buildings and Enclosures will generally consist of the following six components:

- Foundation--provides support and carries the loads to the subsurface.
- Structural frame--provides support for the contained systems and stability for the entire structure.
- Architectural--provides isolation of systems, enclosure, and protection from natural phenomena, where required, through walls, partitions, ceilings, and roofs.
- Access--provides means of ingress and egress and allow for access to the contained systems and equipment through doors, stairs, floors, elevators, cranes, and hoists.
- Space Conditioning -- provides the required heating, ventilating and air conditioning for the buildings.
- Drains and Plumbing--provides plumbing, floor and equipment drains and floor trenches and sumps for the enclosed equipment and facilities.

The buildings and structures will be designed to accommodate the function and arrangement of the systems they enclose. Building arrangements will take into consideration maintenance and operating access requirements as well as the equipment itself. Suitable design features will be provided to prevent or contain oil or chemical spills where appropriate. All occupied buildings will be designed to meet NFPA 100 Life

Safety egress requirements. Since no new or refurbished administrative areas are included within the scope of the Phase II Unit 1 modifications, the new structures will not require design in accordance with the Americans with Disability Act Accessibility Guidelines (ADAAG) requirements.

HVAC systems will be designed to maintain indoor conditions suitable for the equipment and operations enclosed under the design ambient conditions for the Project site in the Project Design Memorandum. Ventilation, heating, and cooling equipment will be located to ensure relatively uniform temperature distribution throughout the space. Air conditioning for control and electrical equipment will be designed to meet appropriate filtration levels and noise criteria.

Fire protection systems meeting appropriate NFPA and building code requirements will be provided for each building where required. Since none of the new buildings or structures intended for the Phase II Unit 1 modifications is expected to be manned on a continuous basis, and since existing facilities remain in the immediate area, no plumbing or toilets are intended for these structures.

1.3.1 Unit 1 PJFF Support Structure

The Unit 1 Pulse Jet Fabric Filter Support Structure will allow the Unit 1 PJFF to be installed above the existing SDRS Building. The structure will be unenclosed and will consist of a structural steel superstructure mounted on concrete footings. The concrete footings will be supported on drilled piers where practical or on micropiles in areas of severe congestion. The steel superstructure will consist of four braced towers, one per corner, with long-span steel trusses spanning over the SDRS Building. Trusses will be located so as to support the columns provided as part of the PJFF structure and will transfer loads to the towers at the corners. The structure is intended to have no impact on the construction or operation of the SDRS Building and will be of a height sufficient to clear the building. The structure will be topped with a steel deck supporting a six-inch nominal thickness concrete slab to be used as the working floor for the PJFF.

Steel stair towers at the east and west ends of the structure will allow personnel access to the working floor level. The structure will be designed to accommodate the maintenance hoists supplied with the PJFF, allowing replacement bags and maintenance material to be transported from grade. The working floor and any large penetrations will be surrounded by handrail for safety. As an unenclosed structure, no heating or ventilation will be required.

1.3.2 Unit 1 AQCS Electrical Building

The Unit 1 AQCS Electrical Building will house additional electrical and control equipment serving the new PJFF and the ID fans. The Electrical Building is intended as a single story pre-engineered metal building mounted to a small foundation with a floating interior slab. For purposes of the Unit 1 estimate, drilled piers or micropiles were assumed under the columns of the building to minimize excavations and impact to existing undergrounds, but shallow soil-supported foundations may be deemed acceptable at time of detailed design. The superstructure will consist of steel framing enclosed with insulated metal panel walls and roof. The interior will be of unfinished construction and doors will be located and sized to access equipment for maintenance as well as provide personnel access. HVAC will be as required for the equipment enclosed, but will at minimum include heating and ventilation. The building is intended as a "dry" enclosure and floor drains will be minimized.

1.3.3 ID Fan VFD Enclosure.

The VFD Enclosure houses the variable frequency drive equipment serving the two new Unit 1 ID fans. The enclosure is intended to be a pre-manufactured enclosure furnished complete with equipment installed. The prefabricated structure will be placed on a shallow foundation with necessary utilities and services provided for tie-in to the enclosed equipment. The structure will be furnished with necessary HVAC appropriate for the enclosed equipment and doors pre-installed

1.3.4 SCR Support Structure.

The Unit 1 selective catalytic reduction module will be installed in the location currently occupied by the Unit 1 electrostatic precipitator on top of the low roof above the existing ID fans. Removal of the ESP will result in significant excess capacity in the existing Unit 1 boiler structure being available for supporting the SCR. During detailed design the load removed will be evaluated versus the load to be added in this location and modifications, if required, to the existing superstructure will be determined. To the extent practical, the supports carrying the existing ESP will be incorporated into the support structure for the SCR. Additional superstructures will be added as required to distribute any new loads in excess of those removed to the foundations to avoid or at least minimize modifications to the existing foundations. For purposes of the Unit 1 estimate, modifications to the existing foundation will be assumed limited to four new foundations (one per SCR support leg) added between existing column foundations in the building. The cost of a new independent steel superstructure will be included in the estimate, with the expectation that this cost would cover any modification to the existing structural steel plus any added new supplemental steel.

Modifications to the existing structure will include re-establishing weathertight construction at the low roof when the ESP is removed, providing personnel access to the SCR components, and re-establishment of roof drains and storm water piping. Additional support steel will be provided where required to support ductwork into and out of the SCR. Primary personnel access to the SCR area will be through existing boiler building stairwells and the elevator. A means of handling catalyst and other maintenance material and equipment to the required locations in the SCR module will be provided, either mounted directly to the module structure or via established pathways existing in the boiler building. No new HVAC will be required for the SCR module. However, impacts to the existing building HVAC of any modifications on the existing structure itself will be evaluated and addressed as required.

System Description

1.1 System Identification

- Unit Designation — Unit 1
- System Name — Fly Ash
- System Code — ASB
- File Number — 41.0804.3.M106

1.2 Function

The Fly Ash System will pneumatically remove fly ash from the pulse jet fabric filter (PJFF) hoppers, SCR hoppers, and intermediate duct work hoppers. In addition, the ash handling system will handle powder activated carbon (PAC) and sorbent (trona/lime) which are injected upstream of the PJFF and collected in the PJFF hoppers. The collected fly ash byproducts will be conveyed to the existing west silo or a new fly ash silo. The process is shown on drawing 168908-M1ASB-M2022: Fly Ash, Unit 1

1.3 Process Description

The Fly Ash System includes the following major equipment and components:

- Fly ash feed valves.
- Fly ash conveying equipment (both new and existing).
- Common Fly Ash Transfer Tank originally for Units 1 and 2 (existing).
- West fly ash silo (existing) and new fly ash silo.

The Fly Ash System shall service all the PJFF material collection hoppers as well as the SCR and duct ash hoppers. Each collection point in the Fly Ash System shall be tied into a pneumatic vacuum conveying system arranged in a new branch line from a new main conveying line. The existing filter separators and mechanical exhausters may require a rate upgrade to account for the additional ash, PAC, and sorbent collected in the PJFF hoppers. The design margin in the existing system may be sufficient to meet the new requirements. This will be determined during detailed design.

Each PJFF, SCR, and ductwork hopper will be equipped with a manual hopper isolation valve and new automatic feed valves. The automatic feed valves will isolate the hopper being emptied and provide a controlled flow of fly ash to the conveyor line. The conveying system shall sequentially remove ash from the PJFF hoppers,from the SCR hoppers, or from the ductwork hoppers and transfer it to the existing Common Unit 1 and Unit 2 Fly Ash Transfer Tank. The ash will then be transported via the existing pressure conveying system to the west silo or to a new fly ash waste silo using the existing conveying lines with a new branch line to service the new silo. While the Unit 3 and 4 ESP are operating, the existing connection to the east silo will be temporarily disabled to prevent waste ash from mixing with saleable ash.

System Description

1.1 System Identification

- Unit Designation Unit 1
- System Name Induced Draft
- System Code CCE
- File Number 41.0804.3.M107

1.2 Function

The Induced Draft System, in conjunction with the steam generator forced draft fans, provides the static pressure required to induce the flow of combustion gases from the steam generator furnace through the gas path to the stack. The system includes the capability of controlling the flue gas flow rate to maintain furnace draft over the specified load range.

1.3 Process Description

The Induced Draft System will consist of the following major components.

- Two 50 percent nominal capacity, centrifugal induced draft (ID) fans using variable speed operation as the primary means of flow control accomplished through the use of variable frequency drives.
- New, direct-drive induction motors designed for the full fan capacity and operation with variable frequency drives.
- New variable frequency drives designed for the full fan capacity.
- New couplings for each fan to transmit the rotational energy from the new motors to the fan. Couplings will be an elastomeric type designed to limit the transmission of any VFD generated coupling vibration.
- New ID fan lubricating oil units.
- New ID fan inlet dampers and damper drives that will be used as a means of secondary flow control.
- New ID fan discharge dampers and damper drives.
- Associated new and existing ductwork and expansion joints upstream and downstream of the ID fans.

- Associated new and existing piping, valves, instruments, controls, and accessories.

The ID fans will induce flow of the combustion gases through the steam generator, new selective catalytic reduction (SCR) system, regenerative air heaters, and new pulse jet fabric filters (PJFF). They will also provide sufficient pressure to exhaust the combustion gases through the refurbished wet flue gas desulfurization (WFGD) scrubber and the existing stack. The ID fans will also be used during the steam generator and associated equipment and ductwork purging cycle prior to firing fuel in the furnace or after the steam generator is shut down.

These centrifugal fans will have variable speed capability, using variable frequency drives, that will be used as the primary means of exhaust gas flow control over the unit operating load range. Each of these new fans will be designed for direct connection through an elastomeric coupling to a new motor and associated variable frequency drive. The variable frequency drives will be used to control the speed of the motors and fans depending on the desired capacity from the plant control system. The system will control the fans to maintain the furnace pressure at a predetermined value. During a severe transient, such as a loss of fuel, the system will be capable of responding to the commands from the Distributed Control System (DCS) in such a manner as to avoid any damage from a negative pressure transient in the steam generator. The secondary means of flow control, the inlet dampers, may need to be used in this case.

In conjunction with the forced draft and primary air fans, combustion flue gas will flow from the new PJFF outlet to the inlet duct of each ID fan. The ID fans will be sized to achieve 60 percent of the MCR condition with one ID fan in service. The ID fans will discharge into a ductwork header which will exhaust combustion flue gas through the refurbished WFGD scrubber and existing stack to the atmosphere.

Expansion joints will be provided in the new ductwork where required to accommodate movements due to thermal expansion and contraction. This will prevent detrimental stresses in the ductwork, deformation, or failure of structures or equipment due to thermal expansion. Inlet and outlet isolation dampers and a forced lubrication oil unit are provided with each ID fan. The ID fan sound level is attenuated by the use of insulation and lagging of the ID fan casings.

The new and existing ductwork will continue to provide a flow path from the existing steam generator air heaters to the new PJFF, then to the ID fans, and exiting the ID fans to the refurbished WFGD scrubber and existing stack.

System Description

1.1 System Identification

- Unit Designation — Unit 1
- System Name — Pulse Jet Fabric Filter
- System Code — CCB
- File Number — 41.0804.3.M108

1.2 Function

The Particulate Removal System will collect particulate matter from the boiler flue gas stream on filter bags. Particulate matter will also be collected from the powder activated carbon (PAC) and sorbent injection systems in ductwork upstream of the pulse jet fabric filter. The collected particulate will be stored in hoppers until removed by the Fly Ash Handling System.

1.3 Process Description

The Particulate Removal System will include the following major equipment and components:

- Pulse Jet Fabric Filter (PJFF) casing with inlet and outlet transition ducts and expansion joints.
- Fabric filter compartment inlet, outlet dampers, and casing bypass dampers along with seal air system.
- Fabric filters bags and cages.
- Air pulse cleaning system, including headers, valves, and controls.
- Compressors, air driers, and air receivers with 100 percent spare capacity
- Hoppers, including heaters, level detectors, and ports for hopper fluidizing system.
- Permanent and mobile pre-coating system
- Insulation and lagging of fabric filter housing.
- Walk-in or Top door plenum to allow access to the tube sheet for inspection, and maintenance.
- Weather enclosed penthouse with lighting and ventilation.
- Electric hoist on the exterior penthouse level to lift boxes of bags and cages to the penthouse level for maintenance purposes.
- Access provisions required for maintenance, including hoists.
- Associated piping, valves, instruments, controls, and accessories.

The Particulate Removal System consists of compartmentalized PJFF located between the sorbent injection lances and the inlet of the induced draft (ID) fans. The number of compartments is determined by economic compartment sizing, total flue gas flow rate, air-to-cloth ratio, and cleaning system design. The PJFF will be designed with a spare compartment.

Under normal operation, flue gas enters the fabric filter inlet plenum and is distributed to the individual compartments through inlet dampers at each fabric filter compartment. Flue gas will pass upwards through the filter bags where the particulates within the gas stream will collect on the outside of the filter bags and the clean gas exits each fabric filter compartment through an outlet damper into fabric filter outlet plenum. To prevent collapse of the bag, a metal cage is installed on the inside of the filter bags. Filter bags and cages are suspended from a tube sheet at the top of the compartment. Each individual compartment will be provided with inlet and outlet isolation dampers for access or maintenance.

The collected particulate will be cleaned from the filter bags by suddenly inflating the filter bags with a pulse of compressed air over several rows of filter bags, causing the dust on the outside to separate from the bags and drop into hoppers below. The pulsing system will have optimum flow geometry and will be designed with no mechanically actuated parts or acoustic systems that are required to operate for the pulse air cleaning process. The cleaning frequency will be regulated by the control system based on overall fabric filter pressure drop. Online or isolated mode of cleaning of fabric filter will also be regulated by the control system. The fabric filter will be pulse-cleaned utilizing clean, dry, oil free, compressed air supplied by pulse jet air compressors and associated air receivers and dryers.

The dust collected in the fabric filter discharge hoppers will be fluidized and removed by the Fly Ash Handling System. The flue gas from the outlet plenum of the fabric filter will flow through the induced draft fans in the Induced Draft System and then to the Wet Flue Gas Desulfurization System.

The PJFF shall be designed to achieve particulate matter emissions of 0.01 lb/MBtu. The fabric filter shall be designed to allow for continuous, reliable operation of the boiler at the maximum flue gas flow rate and grain loading with one fabric filter compartment removed from service for maintenance with the fabric filter net cloth velocity not exceeding 4.0 ft/s.

System Description

1.1 System Identification

- Unit Designation — Unit 1
- System Name — Neural Network
- System Code — SGM
- File Number — 41.0804.3.M109

1.2 Function

Neural networks utilize a DCS based computer system that obtains plant data such as load, firing rate, burner position, air flow, CO emissions, etc. The computer system analyzes the impact of various combustion parameters on CO emissions. The system then provides feedback to the control system to improve operation for lower CO emissions.

In addition to burner performance these monitoring systems also allow continuous indication of pulverizer, classifier and fuel delivery system performance to provide early indication of impending component failures or maintenance requirements. This system is also used to improve heat rate and often provides operational cost savings along with CO control.

1.3 Process Description

The Neural Network System uses real-time operational data extracted from the plant DCS to “learn” solutions from plant operational experience to achieve reductions in the emissions produced, while possibly improving the heat rate of the plant.

Neural network computing differs from traditional computing in that engineering, statistical, and first-law principles have been replaced by complex, time-varying, nonlinear relationships. Neural networks do not presume that a relationship is known between process inputs and outputs, but rather determines the relationships by analyzing datasets of input and output.

Neural network equipment will be minimal, consisting of a few computer servers that can be located in the same room as the DCS master equipment

System Description

1.1 System Identification

- Unit Designation — Unit 1
- Category Name — Compressed Air
- System Name — AQCS Compressed Air
- System Code — CAB
- File Number — 41.0804.3.M110

1.2 Function

The Air Quality Control System (AQCS) Compressed Air Systems will provide the clean, dry, oil free compressed air at an adequate pressure and adequate capacity for the pulse jet fabric filter (PJFF), actuators, controls, instrumentation, and other air users in the AQCS addition.

1.3 Process Description

The AQCS Compressed Air System includes the following major equipment and components:

- Two full capacity air compressors.
- Two full capacity air filter/dryers.
- One air receiver.
- Distribution pipe, valve, and fittings
- Controls and instruments

Two full capacity air compressors will be provided to supply air to the air receiver. During normal operation, only one of the compressors will be in service at a time. Air from the compressors is routed to the air filter/dryers that will dry control air to a dew point of -40° F or lower before entering the air receiver. Air will be supplied from the receiver to the PJFF and other users upon demand.

Cross-ties with the existing station and instrument air systems will be installed. These will allow air from either existing system to be used to back-up the AQCS compressed air system. It will also allow AQCS compressed air to be used to back-up the existing systems. The equipment comprising the AQCS Compressed Air System is intended to be located in the Unit 1/Unit 2 Common Fly Ash Handling Building.

System Description

1.1 System Identification

- Unit Designation — Unit 1
- System Name — AQCS Service Water
- System Code — WSC
- File Number — 41.0804.3.M111

1.2 Function

The Air Quality Control System (AQCS) Service Water System will extend the existing service water systems for washdown, makeup, and seal water for equipment in the AQCS areas.

1.3 Process Description

The AQCS Service Water System shall consist of the following major equipment and components:

- Washdown stations
- Distribution piping, valves, and fittings
- Controls and instruments

The source of service water shall be from a branch connection from the existing service water distribution piping. Existing service water quality will be sufficient to protect the AQCS systems.

Service water distribution piping shall supply seal and makeup water to washdown stations servicing all AQCS additions.

System Description

1.1 System Identification

- Unit Designation — Unit 1
- Category Name — Combustion Gas Cleaning and Exhaust
- System Name — Sorbent Injection
- System Code — CCH
- File Number — 41.0804.3.M112

1.2 Function

The function of the Sorbent Injection System is to remove SO_3 from the flue gas by injecting sorbent into the flue gas ductwork between the boiler air heater outlet and the Pulse Jet Fabric Filter (PJFF) inlet.

1.3 Process Description

The Sorbent Injection System will consist of the following equipment and components:

- Two (2) sorbent storage silos with structural skirted enclosure with all necessary appurtenances.
- Three blower/feeder skid assemblies.
- Rotary valve and motors.
- Feed hoppers.
- Screw feeder and motors.
- Eductors.
- Sorbent distribution manifolds with isolation valves to each lance.
- Custom injection lances with flex hose connections.
- Associated piping, valves, instruments, and accessories.
- Controls and instrumentation.

The Sorbent Injection System will receive bulk sorbent by truck. The sorbent will be unloaded pneumatically into one of the storage silos through a stationary positive pressure dilute phase conveying system. The trucks should be equipped with their own pneumatic unloading system.

The sorbent will be fed from the silo by a rotary valve into a volumetric feeder hopper where it will be temporarily stored. The sorbent will then be conveyed by the feeder screw into the drop tube. The sorbent will be fed through the drop tube directly into the eductor inlet, located below the feeder discharge.

The passing of motive air through the eductor nozzle will produce a vacuum in the eductor inlet, which will help draw the sorbent and air into the mixing zone directly downstream of the mouth. The sorbent will be transported through the piping system and is distributed to an array of injection lances and into the boiler exhaust gas stream to maintain H_2SO_4 emissions below 5 ppmvd @ 3% O_2 based on the flue gas flow rate, temperature and upstream H_2SO_4 concentration.

The number of injection lances will vary based on the width of the receiving duct and the required rate of injection. Each lance will contain valves and instrumentation for verifying flow out of each lance. A marshalling cabinet will allow plant operators to access data collected from the injection lances, flue gas analyzers and other instruments on the injection system. A long residence time for the flue gas, moving through straight sections of ductwork from the injection ports to the downstream filtering equipment, is essential to remove H_2SO_4. A retention time less than two seconds is unfavorable for a sorbent injection system's ability to remove H_2SO_4.

System Description

1.1 System Identification

- Unit Designation — Unit 1
- System Name — Powder Activated Carbon Injection
- System Code — CCH
- File Number — 41.0804.3.M113

1.2 Function

The function of the Powder Activated Carbon (PAC) Injection system is to remove mercury from the flue gas by injecting PAC into the flue gas ductwork between the boiler air heater outlet and the Pulse Jet Fabric Filter (PJFF) inlet.

1.3 Process Description

The PAC Injection System will consist of the following equipment and components:

- Two (2) PAC storage silos with structural skirted enclosure with all necessary appurtenances.
- Three blower/feeder skid assemblies.
- Rotary valve and motors.
- Feed hoppers.
- Screw feeder and motors.
- Eductors.
- PAC distribution manifolds with isolation valves to each lance.
- Custom injection lances with flex hose connections.
- Associated piping, valves, instruments, and accessories.
- Controls and instrumentation.

The PAC Injection System will receive bulk PAC by truck. The PAC will be unloaded pneumatically into one of the storage silos through a stationary positive pressure dilute phase conveying system. The trucks will be equipped with their own pneumatic unloading system or by a secondary blower located at the silos.

The PAC will be fed from the silo by a rotary valve into a volumetric feeder hopper where it will be temporarily stored. The PAC will then be conveyed by the feeder screw into the drop tube. The variable speed motor for the screw feeder allows for adjustment of the PAC feed rate. The PAC will be fed through the drop tube directly into the eductor inlet, located below the feeder discharge.

The passing of motive air through the eductor nozzle will produce a vacuum in the eductor inlet, which will help draw the PAC and air into the mixing zone directly downstream of the mouth. The PAC will be transported through the piping system and is distributed to an array of injection lances to evenly distribute the carbon into the existing flue gas stream to maintain Hg emissions below 1 lb/TBtu based on the flue gas flow rate, temperature and upstream Hg concentration.

The injection lances are placed in the ductwork stream before the pulse jet fabric filter. The number of injection lances will vary based on the width of the receiving duct and the required rate of injection. Each lance will contain valves and instrumentation for verifying flow out of each lance. A marshalling cabinet will allow plant operators to access data collected from the injection lances, flue gas analyzers and other instruments on the injection system. A long residence time for the flue gas, moving through straight sections of ductwork from the injection ports to the downstream filtering equipment, is essential to remove Hg. A retention time less than two seconds is unfavorable for a PAC injection system's ability to remove Hg. The PJFF removes the activated carbon particles along with the adsorbed mercury.

System Description

1.1 System Identification

- Unit Designation — Unit 1
- System Name — Selective Catalytic Reduction
- System Code — CCF
- File Number — 41.0804.3.M114

1.2 Function

The function of the NO_x Reduction system is to remove NO_x from the flue gas. The NO_x Reduction System uses the injection of ammonia (NH_3) into the flue gas and a Selective Catalytic Reduction (SCR) system to produce molecular nitrogen (N_2) and water vapor. These reactions take place in the SCR reactor in the presence of a catalyst with known cycle life under appropriate temperature conditions, pressure conditions and fuel characteristics.

1.3 Process Description

The Selective Catalytic Reduction System will include the following major equipment and components:

- SCR reactor.
- Catalyst.
- NO_x analyzers.
- Diluent (O_2 or CO_2) analyzers.
- Sonic horns and/or soot blowers
- Large Particle Ash (LPA) Screen
- Ammonia injection control valves
- Delta Wing Static Mixers and Guide Vanes
- Ductwork, dampers, and expansion joints.

The hot flue gas leaving the economizer section of the boiler will pass through a large particle ash (LPA) screen before proceeding to the ammonia injection site and to the SCR reactor. The LPA screen will be used to remove any ash particles that are larger than the pitch of the catalyst. The objective of the LPA screen is to avoid potential operating problems due to catalyst plugging. The primary ammonia mixers are located in the vertical section of the inlet duct to mix the incoming anhydrous ammonia into the flue gas. There are two 100% anhydrous ammonia injection control valves per reactor that flash the sub-cooled anhydrous ammonia and inject vaporized ammonia directly into a dilution air stream. There is currently an anhydrous ammonia storage area on site that will supply ammonia to the injection skid via two 100% anhydrous ammonia feed pumps. This ammonia-air vapor is introduced behind the Delta Wing static mixers where it is mixed with the flue gas to ensure uniform distribution of the NO_x and NH_3. The ammonia reacts with the NO_x in the presence of the catalyst to remove NO_x from the flue gas. The quantity of ammonia can be adjusted as it reacts with the NO_x in the presence of the catalyst to remove NO_x from the flue gas. The inlet duct continues onward to the reactor inlet. The elbow at the reactor inlet is fitted with small mixing plates, called homogenizers, which provide increased uniformity of ash distribution across the entire catalyst surface. The final turn downward into the catalyst utilizes a large array of turning vanes to guide the gas downward to the topmost layer of catalyst and minimize dust collection in the reactor cap

The guide vanes in the reactor inlet elbow are used to align the flue gas and ash particles to within the specified flow requirements of design standards required for high removal efficiency SCR systems. The mixing devices including Delta Wings static mixers, and guide vanes are necessary to ensure an optimal flow to the catalyst. The removable door sections on each catalyst layer are used to load and unload catalyst from the reactor. These door sections are seal welded in place to prevent leakage of flue gas or infiltration of air into the reactor. The temperature measurement connections at each catalyst layer and at the SCR inlet and outlet are used to monitor the temperature of the catalyst and reactor steel structure during start-up and operation. The sonic horn catalyst cleaning system on the reactor provides the required cleaning of the catalyst during normal operation. Inlet and outlet flue gas pressure transmitters are provided across the SCR reactor to continually measure and record SCR pressure loss. NOx measurement systems installed in each of the SCR inlet and outlet ducts are used to control ammonia injection to each reactor.

The flue gas leaves the reactor inlet turning vanes and enters the first layer of catalyst in a uniform manner. The flue gas is homogeneously distributed over the reactor cross-sectional area and passes through the catalyst face. This insures minimal erosion by ash impact on the catalyst. The flow continues through the second layer in the same manner. The flue gas exits the reactor and enters the air heater inlet duct. Turning vanes and plates are used, as required, ensuring acceptable distributions of ash, temperature and flow to the air heater.

The potential NO_x reduction is sensitive to the temperature of reaction and time available for the NO_x reducing reaction to occur. The catalyst is of vanadium/titanium dioxide based material. Sealing material is installed between catalyst blocks to prevent untreated flue gas leakage.

System Description

1.1 System Identification

- Unit Designation — Unit 1
- System Name — Ammonia Supply
- System Code — CGE
- File Number — 41.0804.3.M115

1.2 Function

The Ammonia Supply System shall include the following major components:

- Two existing 60,000-gallon anhydrous ammonia storage tanks, with adequate storage capacity to require refilling no more than one time per 9 days based on estimated ammonia consumption of all four units.
- Two existing full-capacity ammonia pumps.
- One ammonia injection skid, the skid consists of two full capacity mass flow meters and ammonia flow control valve trains.
- Two full capacity ammonia dilution air blowers common for Unit 1 and Unit 2 SCRs.
- Two full capacity air pre-heaters common for Unit 1 and Unit 2 SCRs.

1.3 Process Description

The Ammonia Supply System provides a means of transferring anhydrous ammonia to the selective catalytic reduction (SCR) system

Liquid anhydrous ammonia from the existing anhydrous ammonia storage tanks is directed to the Units 1, 2, 3, and 4 ammonia injection skids by the existing ammonia pumps.

Unit 1 ammonia injection system will consist of one ammonia injection skid and a common ammonia dilution air system. Unit 1 ammonia injection skid will consist of two 100% mass flow meters and ammonia flow control valve trains, pipe, valves, and instrumentations. The ammonia dilution air system will be common for both Unit 1 and Unit 2 SCRs and will consist of two 100% ammonia dilution air blowers and two 100% air pre-heaters to provide hot dilution air. Air pre-heaters will be steam heater type. Steam will be provided from the existing plant steam supply header.

Upon demand, ammonia flow rate will be controlled by the flow controllers and mixed with the hot dilution air stream to dilute the ammonia to a concentration of 5% by volume before introduced into Unit 1 SCR flue gas stream. Air flow rate will be measured by air flow meters located upstream of the air/ammonia mixing devices.

System Description

1.1 System Identification

- Unit Designation — Unit 2
- System Name — AQCS Power Supply
- System Codes — APB--AC Power Supply (120/208 Volts)

  APC--AC Power Supply (480 Volts)

  APD--AC Power Supply (4160 Volts)

  APH--DC Power Supply

  API--Uninterruptible Power Supply
- File Number — 41.0804.03.M201

1.2 Function

The function of the Auxiliary Power Supply System shall be to distribute electrical power to various pieces of equipment, devices, and cabinets, and to provide overcurrent and fault protection.

1.3 Process Description

1.3.1 AC Power Supply (120/208V) (APB)

Power shall be provided to 120V single-phase and 208V three-phase loads by ac panelboards rated 120/208V, three-phase, four-wire. The panelboards shall also provide branch circuit protection and a means of disconnect for the branch circuit loads through manually operated thermal magnetic circuit breakers. Power shall be provided to the panelboards by low voltage transformers, with 480V three-phase primary (APC) and 120/208V secondary with directly grounded neutral. The system shall be designed to provide 100 percent of the required continuous loads with 20 percent spare kVA.

1.3.2 AC Power Supply (480V) (APC)

Power shall be provided to 480V three-phase loads by the following major power system components, in general:

- 4160V to 480V dry type secondary unit substation (SUS) transformers with high resistance grounded wye secondary grounding.
- 480V, 3-phase, 3-wire, metal enclosed double-ended SUS switchgear.
- 480V, 3-phase, 3-wire, motor control centers (MCCs).
- 480V, 3-phase, 3-wire, panelboards.
- 480V to 480Y/277V and 120/208V dry type transformers for lighting and receptacle loads.
- 480 Y/277V and 120/208V, 3-phase, 4-wire panelboards for lighting and receptacle loads.

The 480V secondary of the SUS transformers shall be connected high resistance grounded wye. All SUS transformers shall be indoor, dry type transformers furnished with AN or ANAF cooling rating and a 150 ^{o}C temperature rise.

The AC Power Supply (480 V) System will be designed to feed the facility's low voltage loads. Each SUS transformer and associated low voltage switchgear line-up will be sized to serve its maximum coincidental operation load. All SUS, MCCs and panelboards will be initially designed with a minimum of 20 percent spare circuit breakers.

1.3.3 AC Power Supply (4160V) (APD)

The 4160V systems shall consist of the following major components:

- One two-winding delta primary, resistance grounded wye Main Auxiliary Transformer. The high voltage rating shall be 22kV and the low voltage rating 4160V to serve the Unit 2 switchgear buses A & B.
- One neutral grounding resistor on each secondary winding of each auxiliary transformer.

The 4160V system shall also consist of the following major components:

- Two (2) 4160V metal-clad, single-ended switchgear with a main breaker on each bus connecting it to the AQC Main Auxiliary Transformer and a secondary main breaker connecting the switchgear bus to the Common AQC Reserve Auxiliary Transformer. The 4160V switchgear shall be arc resistant and of two-high construction. The switchgear shall be located within the AQC Electrical Building
- 4160V cable bus.

- 4160V medium voltage circuit breakers and contactors.

- Two (2) variable frequency drives (VFD) fed from the 4160 SWGR A & B respectively. Each drive will power and control an ID Fan motor. The VFDs will be located within the Fan VFD Enclosure.

The existing 13,800V system:

- The existing 13.8 kV outdoor metal-clad, switchgear shall be modified with an extension to feed the Common AQC Reserve Transformers. The Common AQC Reserve transformers have a 4160V secondary which will provide reserve power to the Unit 2 AQC 4160V Switchgear A and B.

- 13.8 kV cable in underground duct bank from the existing 13.8kV switchgear to the Common Reserve Auxiliary Transformers.

- Reference Common system AQCS Reserve Power Supply system description: 41.0804.3.MC01 for additional detail.

1.3.4 DC Power Supply (APH)

The DC Power Supply System will consist of 125VDC lead acid station batteries, two (2) full-capacity redundant solid-state chargers per battery and a main distribution panel.

The DC Power Supply System will consist of a station battery system located in a dedicated battery room. The system will utilize flooded type batteries with trays under the batteries. These batteries will provide DC power to the plant DCS, critical FGD System loads, and control power for the auxiliary electrical system equipment. The battery will be connected to a main distribution panel and continuously charged by two fully redundant battery chargers.

Under normal conditions, the battery chargers supply dc power to the dc loads. The battery chargers receive 480VAC power from the motor control centers. The chargers will continuously float-charge the battery while supplying power to the dc loads. Under abnormal or emergency conditions when 480VAC power is not available, the battery supplies dc power to the dc loads. Recharging of discharged batteries occurs whenever 480VAC power becomes available. The rate of charge is dependent upon the characteristics of the battery, battery chargers, and the connected dc load during charging. Each station battery charger shall be capable of charging the fully discharged battery within 8 hours with battery load present.

The battery will be located in a dedicated battery room that is a space conditioned area so that suitable temperatures can be maintained, thus helping to ensure long battery life. Battery temperature for sizing calculations shall be 77^{o}F. The battery shall be sized in accordance with IEEE 485. An exhaust fan(s) shall be furnished for limiting the concentration of hydrogen gas in each battery room. The equalizing voltage shall be used to determine the hydrogen gas emission for fan sizing. Climate control and exhaust fans shall be provided that are suitable for the environment.

1.3.5 Uninterruptible Power Supply (API)

A UPS shall be provided in the AQC Electrical Building for Unit 2. The UPS shall provide reliable power to the control system equipment, other equipment needing a regulated power supply, and other critical equipment needing a reliable power supply. . The UPS system shall be able to handle full load capacity for four (4) hours.

One (1) 120V AC Main UPS Distribution Panel shall be mounted with the chargers and UPS inverter. The panels shall be mounted within the AQS Electrical Building.

A120-208V AC distribution panel for the instrumentation shall be located in the AQC Electrical Building. This distribution panel shall be fed from a 480V:120-208V isolation transformer. The isolation/regulating transformer will regulate the output voltage and provide isolation and noise attenuation based on normal AC input. The voltage regulation shall be +/- 1% with -10% to +20% input variation.

Each transformer will be fed from an automatic transfer switch (ATS) which will be fed from each of the 480V MCCs in the building. The ATS shall consist of a double throw power transfer switch mechanism and microprocessor controller of the same manufacturer to provide automatic operation. The ATS shall be switched automatically via voltage sensing and have the capacity to be transferred manually both locally and remotely. The distribution panels shall include circuit breakers in series with fast acting fuses for branch circuit protection.

Each UPS and isolation/regulating transformer shall include 20% spare capacity and distribution panelboards shall have 20% spare branch breakers/fuses for future use by the Purchaser.

1.4 Reference Drawings

- Conceptual Overall One Line – Unit 1: 168908-M2DE-E1002
- Conceptual Overall One Line – Common: 168908-MCDE-E1005

System Description

1.1 System Identification

- Unit Designation Unit 2
- System Name Communication
- System Code CMA
- File Number 41.0804.3.M202

1.2 Function

The function of the Communication System shall be to provide station personnel with a reliable and convenient means of plant paging and party line communications, and to provide raceway and other provisions for telephone/LAN wiring and equipment and closed circuit television (CCTV).

1.3 Process Description

The Communication System shall include microprocessor-based page/party equipment, raceway, and page/party communication cable as manufactured by Gai-Tronics Corporation. The new microprocessor-based system shall be fully adaptable to the existing system installed at Mill Creek Unit 2 and shall provide self-diagnostic monitoring of the new system for system integrity. The page/party equipment shall provide two-way voice communication on each party line and shall utilize a page line for voice transmission over a plant-wide speaker system. While a conversation is taking place on a party line, other conversations may be held on other party lines or the page line. Each page/party handset station shall have five party lines and one page line. Page/party handset stations and speakers shall be strategically located throughout the plant site. The power supply for the page/party equipment shall be 120 volts ac, from the normal AC System.

The new system shall interface with the existing Mill Creek Unit 2 system.

Raceway and space provisions for telephone/LAN equipment and CCTV shall be provided. Base equipment shall be located in the common control room and peripheral equipment shall be strategically located.

System Description

1.1 System Identification

- Unit Designation Unit 2
- System Name Control and Monitoring
- System Code COA
- File Number 41.0804.3.M203

1.2 Function

The existing Honeywell Experion Distributed Control System (DCS) will be expanded to incorporate control and monitoring of the new AQCS equipment. The resulting DCS shall provide a means to control in manual and automatic the AQCS equipment individually, as well as in coordination with other plant systems. The DCS shall be central to all plant operations and control the various systems and subsystems, including those required for the new AQCS equipment. The existing DCS will be the central location in the plant for alarm management, historical data archiving, report generation, and data trending. The primary operator interface to the DCS shall be the existing Unit 2 workstations located in the Mill Creek Main Control Room. The existing unit protection system will be retained in the existing DCS to protect critical plant equipment, including critical ID fan and draft system interlocks.

No local operator stations are included in the conceptual design for the AQCS areas.

- The new AQCS DCS shall consist of the extending existing DCS universal control network (UCN) 01, and the addition of one new high performance manager (HPM) to control the new AQCS common unit equipment. The AQCS DCS equipment shall communicate by means of redundant UCN data highways.

The AQCS DCS equipment shall include the following major components:

- Redundant UCN.
- Redundant HPM.
- DCS system cabinets and input/output (I/O) cabinets.

1.3 Process Description

The AQCS DCS control processors in the HPM shall contain the control logic for the AQCS equipment. Analog control loop logic and discrete logic shall be implemented in the redundant control processors. The Main Control Room DCS operator interface equipment shall be used as the means to control and monitor plant AQCS processes and process equipment. The DCS configuration will provide interface to all AQCS processes and equipment from either the Unit 1 designated operator workstations.

The AQCS DCS equipment shall interface with the existing DCS to allow retrieval of historic plant data, trend process parameters, and to develop specialized displays of plant information. The operator graphics shall be developed based on the AQCS systems to be controlled, and displayed in a hierarchical format.

The configuration of the AQCS DCS equipment shall take into account redundancy wherever the failure or loss of a component could cause plant upset or loss of generation capacity. Total control processor loading for all required control parameters and communication functions shall be limited to no more than 80 percent loading on each redundant pair. Each input/output cabinet shall contain 20 percent installed spare modules to allow for future expansion.

DCS HPM processor and I/O cabinets shall be located in space-conditioned rooms in the following locations to allow control and instrument cabling to be managed within buildings, minimizing the amount of cable installed between buildings:

- Unit 2 AQCS Electrical Building.
- Unit 1& 2 SCR Power Distribution Center (PDC).
- Common Reserve Power Distribution Center (PDC).

Control processors, power supplies, input/output cards, and other associated hardware shall be a common form factor to provide flexibility of mounting individual control system devices on common rack or carrier. Process controllers, input/output modules, mounting racks or carriers, communication hardware, power supplies, ventilation fans, and other required accessories shall be housed in industrial enclosures with NEMA rating appropriate for the mounting location of the cabinet.

System Description

1.1 System Identification

- Unit Designation — Unit 2
- System Name — Lighting
- System Code — LTA
- File Number — 41.0804.3.M204

1.2 Function

The function of the Lighting System is to provide station personnel with illumination for station operation under normal conditions, egress under emergency conditions, and emergency operational lighting to perform tasks during a power outage of the normal source. The permanent lighting may be used for construction lighting in areas where early installation is practical. Additional construction lighting shall be provided using temporary luminaires and construction power distribution grid. The system also provides 120 volt convenience outlets for portable lamps and tools.

1.3 Process Description

Luminaires for areas with finished acoustical ceilings, if any, shall be fluorescent static troffers. The lighting system for continuously occupied control rooms shall utilize the same type static troffer, except with a dimming ballast and 1/2 inch square louvered low iridescent parabolic diffuser for glare control. Fluorescent lamps shall be energy effiicent 3000K, T8 and not exceed four feet and shall be low mercury content. Ballasts shall be energy efficient electronic type with less than 10 percent harmonic content.

Low bay, wall and stanchion mount luminaires shall be used in outdoor areas and unfinished, hazardous and non-hazardous, enclosed areas of the station. Metal halide luminaires shall be used in the industrial and high bay areas of the plant. Metal halide luminaires shall comply with the Energy Independence and Security Act of 2007, and therefore, all metal halide ballasts and lamps 400 watts and under shall be pulse start metal halide type. Except for high bay areas, pulse start metal halide luminaires shall be enclosed and gasketed with threaded glass refractors. Luminaires located in hazardous areas shall be Underwriters Laboratories (UL), or other North American third party testing lab, listed for the National Electrical Code (NEC) classification. High bay luminaires shall be enclosed and have aluminum or glass reflectors. Luminaires in wet locations or in wash down areas shall be in National Electrical Manufacturers Association (NEMA) 4 enclosures. Approximately 25 percent of the non-hazardous industrial area metal halide luminaires shall be provided with a quartz auxiliary lamp option to provide immediate illumination upon starting and restrike conditions.

Emergency lighting shall be provided for interior building egress paths, interior stairways, selected areas around electrical equipment, and local control rooms. The emergency lighting luminaires for the plant areas shall be powered from individual battery pack units with halogen lamps. Emergency lighting shall provide 90 minutes of operation per the NFPA Life Safety Code 101. Emergency operational lighting for control room area lighting shall be powered by connecting selected fluorescent luminaires to the plant UPS system.

Exit light luminaires shall use light emitting diode (LED) lamps for most areas, with compact fluorescent lamps used in hazardous rated areas, and shall be located in the egress pathways and ground level exit doors of enclosed buildings. The exit luminaires shall be powered from normal ac power and integral batteries for emergency service.

Roadway luminaires shall be pulse start metal halide, cutoff cobra head type mounted on aluminum or galvanized steel poles with helix steel or concrete anchor foundations.

Power used to supply fluorescent and pulse start metal halide luminaires shall be 277 volt ac, except for the possible use of 120 volt ac power for some small remote buildings where 277 volt ac power is not readily available or economically feasible. Luminaires shall be powered from the panelboards, with alternate luminaires or rows of luminaires fed from alternate panelboard circuit breakers. Power used to supply convenience receptacles shall be 120 volts ac. Power used to supply roadway and area lighting shall be 480 or 277 volts ac.

Lighting is not required for roof top PRVs. However, one 120 volt ac ground fault current interrupter receptacle shall be installed on the roof and suitable for access to all the PRV's. A photoelectric controlled light fixture shall be installed near any roof top access doors.

Convenience receptacles shall be grounded duplex type and located throughout the station. The convenience receptacles shall be a minumum of 15 inches above the floor in office areas and 36 inches above the floor in industrial areas. The convenience outlets shall be spaced, at the same elevation, to provide access to any point in the industrial areas with a 100 foot extension cord. Convenience outlets for use without extension cords shall be located in finished areas such as offices, control room, and laboratory. Each outlet shall have the grounding pole located at the top of the device. Each office shall have a minimum of two receptacles on opposite walls. No more than eight receptacles shall be connected to a branch circuit breaker. Receptacles shall be circuited to alternating circuits within an area. Weatherproof snap action covers shall be installed on all receptacles located outdoors and in wet indoor areas. In general, receptacles for outdoor and plant indoor wet areas shall be standard 125 volt, 20 amp, 2-pole with ground, NEMA 5-20R type. Selected receptacles in finished and industrial areas shall have GFCI protection in accordance with the NEC. In areas with hazardous atmospheres, convenience outlets shall be suitable for the NEC class, division, and group requirements.

Operation of the Lighting System is dependent upon the visual requirements of the station operating personnel. The general lighting for interior process areas shall be manually switched on and off at panelboard circuit breakers. The lighting for smaller enclosed areas within the buildings shall be manually switched on and off at local light switches near personnel entrance doors. The OFF position of the toggle switch shall be in the downward position. The lighting for continuously occupied control rooms shall be controlled from dimmer switches. The exterior process area lighting shall be controlled through common contactors that automatically operate between sunset and sunrise via photoelectric controllers. The lighting contactors shall have a hand-off-auto (HOA) switch for daytime maintenance override. Luminaires with integral photocells shall be provided for roadway luminaires and luminaires at exterior personnel entrances only. Separate photo-electrically controlled electrically held lighting contactors with a HOA switch shall be provided for exterior lighting in different areas of the plant.

Luminaires shall be installed at a minimum height of 7 feet 0 inches above the floor to provide an unobstructed way of exit travel from any point in the buildings. Luminaires shall be designed and installed with consideration for maintenance and access. Luminaires shall be installed in locations where maintenance shall not be blocked by structural steel, piping, raceway, grating, etc.

Lighting cable powered from 277 volt ac and all branch circuits installed outdoors shall be XHHW-2 . All 120 volt ac branch circuits installed indoors in heated spaces shall be THHN cable. Pre-assembled and prewired cable assemblies shall be used only in finished environments.

Lighting and receptacle branch circuit voltage drop shall not exceed 3%. This shall include the voltage drop from the last outlet in the branch circuit to the lighting panelboard. In addition, 120 volt branch circuits longer than 75 feet shall use 10 AWG and 277 volt branch circuits longer than 200 feet shall use 10 AWG conductors.
General access interior structure lighting for permanent structures required during construction shall be provided using the permanent luminaires connected to the construction power grid, where practical. Any additional lighting required for construction operation shall be provided by the construction contractor.

The Lighting System shall comply with the regulatory requirements of Occupational Safety and Health Administration (OSHA) and applicable building codes.

Lighting shall be designed in accordance with the Illuminating Engineering Society of North America (IESNA) to provide the illumination levels recommended by the following standards and organizations:

- American National Standards Institute (ANSI)/IESNA RP-7, Industrial Lighting.
- ANSI/IESNA RP-8, Roadway Lighting.
- OSHA.

- National Fire Protection Association (NFPA), National Electric Code (NFPA 70).
- NFPA, Life Safety Code (NFPA 101).
- Local Building Code (latest adopted version).

The following criteria shall also be considered in the lighting system design:

- Illumination calculations shall be based upon the mean lumen output of the respective lamps (lamp lumen depreciation [LLD]).
- Illumination calculations shall be based upon a luminaire dirt depreciation (LDD) factor.
- Interior illumination calculations shall be based upon a room surface dirt depreciation (RSDD) factor.
- Illumination calculations shall be based upon the luminaire ballast factors of the light fixtures utilized in the design.
- The illumination calculations shall be determined at a 30 inch workplane height above the floor.

System Description

1.1 System Identification

- Unit Designation — Unit 2
- System Name — Buildings and Enclosures
- System Code — BSA
- File Number — 41.0804.3.M205

1.2 Function

The function of the Buildings and Enclosures System will be to provide support, enclosure, and access to the systems contained within each structure's boundaries.

1.3 Description

The various structures associated with the Buildings and Enclosures will generally consist of the following six components:

- Foundation--provides support and carries the loads to the subsurface.
- Structural frame--provides support for the contained systems and stability for the entire structure.
- Architectural--provides isolation of systems, enclosure, and protection from natural phenomena, where required, through walls, partitions, ceilings, and roofs.
- Access--provides means of ingress and egress and allow for access to the contained systems and equipment through doors, stairs, floors, elevators, cranes, and hoists.
- Space Conditioning -- provides the required heating, ventilating and air conditioning for the buildings.
- Drains and Plumbing--provides plumbing, floor and equipment drains and floor trenches and sumps for the enclosed equipment and facilities.

The buildings and structures will be designed to accommodate the function and arrangement of the systems they enclose. Building arrangements will take into consideration maintenance and operating access requirements as well as the equipment itself. Suitable design features will be provided to prevent or contain oil or chemical spills where appropriate. All occupied buildings will be designed to meet NFPA 100 Life

Safety egress requirements. Since no new or refurbished administrative areas are included within the scope of the Phase II Unit 2 modifications, the new structures will not require design in accordance with the Americans with Disability Act Accessibility Guidelines (ADAAG) requirements.

HVAC systems will be designed to maintain indoor conditions suitable for the equipment and operations enclosed under the design ambient conditions in the Project Design Memorandum. Ventilation, heating, and cooling equipment will be located to ensure relatively uniform temperature distribution throughout the space. The air conditioning for control and electrical equipment will be designed to meet appropriate filtration levels and noise criteria.

Fire protection systems meeting appropriate NFPA and building code requirements will be provided for each building where required. Since none of the new buildings or structures intended for the Phase II Unit 2 modifications is expected to be manned on a continuous basis, and since existing facilities remain in the immediate area, no plumbing or toilets are intended for these structures.

1.3.1 Unit 1 & 2 Common Fly Ash Handling Building

The Unit 1 & 2 Common Fly Ash Handling Building will house the new exhausters, blowers, transfer tanks, and other fly ash handling equipment required for Units 1 and 2, as well as the AQCS Compressed Air System serving both units. The Ash Handling Building is intended as a single story pre-engineered metal building on a concrete foundation. The concrete foundation will be supported or drilled piers or micropiles and will contain equipment pads for mounting of equipment. The superstructure will consist of steel framing enclosed with insulated metal panel walls and roof. The interior will be of unfinished construction. Personnel and overhead doors will be located and sized to access equipment for maintenance as well as provide personnel access. HVAC will include heating and ventilation, except as otherwise required by specific equipment.

1.3.2 Unit 2 and Common AQCS Electrical Building

The Unit 2 and Common AQCS Electrical Building will house additional electrical and control equipment serving the Unit 2 PJFF and the ID fans. The building will also house electrical and control equipment serving the common fly ash handling equipment in that building. The Electrical Building is intended as a single story pre-engineered metal building on a concrete foundation. For purposes of the Unit 2 estimate, drilled piers or micropiles were assumed under the columns of the building to minimize excavations and impact to existing undergrounds, but shallow soil-supported foundations may be deemed acceptable at time of detailed design. The superstructure will consist of steel framing enclosed with insulated metal panel walls and roof. The interior will be of unfinished construction and doors will be located and sized to access equipment for maintenance as well as provide personnel access. HVAC will be as required for the equipment enclosed, but will at minimum include heating and ventilation. The building is intended as a “dry” enclosure and floor drains will be minimized.

Consideration should be given to combining the Unit 1 and 2 Common Fly Ash Handling Building and the Unit 2 and Common AQCS Electrical Building into one structure with separate rooms. A single structure would likely be less of a capital expense than two adjacent but separate buildings. The combined structure would consist of a single story pre-engineered metal building on a concrete foundation appropriate for the equipment enclosed. A masonry wall would divide the mechanical and electrical rooms to provide the fire-rated separation required. However, for purposes of the Unit 2 estimate, separate structures were assumed for both the Common Fly Ash Handling Building and the AQCS Electrical Building.

1.3.3 ID Fan VFD Enclosure.

The VFD Enclosure houses the variable frequency drive equipment serving the two new Unit 2 ID fans. The enclosure is intended to be a pre-manufactured enclosure furnished complete with equipment installed. The prefabricated structure will be placed on a shallow foundation with necessary utilities and services provided for tie-in to the enclosed equipment. The structure will be furnished with necessary HVAC appropriate for the enclosed equipment and doors pre-installed

1.3.4 SCR Support Structure.

The Unit 2 selective catalytic reduction module will be installed in the location currently occupied by the Unit 2 electrostatic precipitator on top of the low roof above the existing ID fans. Removal of the ESP will result in significant excess capacity in the existing Unit 2 boiler structure being available for supporting the SCR. During detailed design the load removed will be evaluated versus the load to be added in this location and modifications, if required, to the existing superstructure will be determined. To the extent practical, the supports carrying the existing ESP will be incorporated into the support structure for the SCR. Additional superstructures will be added as required to distribute any new loads in excess of those removed to the foundations to avoid or at least minimize modifications to the existing foundations. For purposes of the Unit 2 estimate, modifications to the existing foundation will be assumed limited to four new foundations (one per SCR support leg) added between existing column foundations in the building. The cost of a new independent steel superstructure will be included in the estimate, with the expectation that this cost would cover any modification to the existing structural steel plus any added new supplemental steel.

Modifications to the existing structure will include re-establishing weathertight construction at the low roof when the ESP is removed, providing personnel access to the SCR components, and re-establishment of roof drains and storm water piping. Additional support steel will be provided where required to support ductwork into and out of the SCR. Primary personnel access to the SCR area will be through existing boiler building stairwells and the elevator. A means of handling catalyst and other maintenance material and equipment to the required locations in the SCR module will be provided, either mounted directly to the module structure or via established pathways existing in the boiler building. No new HVAC will be required for the SCR module. However, impacts to the existing building HVAC of any modifications on the existing structure itself will be evaluated and addressed as required.

System Description

1.1 System Identification

- Unit Designation Unit 2
- System Name Fly Ash
- System Code ASB
- File Number 41.0804.3.M206

1.2 Function

The Fly Ash System will pneumatically remove fly ash from the pulse jet fabric filter (PJFF) hoppers, SCR hoppers, and intermediate duct work hoppers. In addition, the ash handling system will convey powder activated carbon (PAC) and sorbent (trona/lime) which are injected upstream of the PJFF and collected in the PJFF hoppers. The collected fly ash byproducts will be conveyed to the existing west silo or a new fly ash silo. The process is shown on drawing 168908-M2ASB-M2022: Fly Ash, Unit 2

1.3 Process Description

The Fly Ash System includes the following major equipment and components:

- Fly ash feed valves.
- Fly ash conveying equipment (both new and existing).
- New Fly Ash Transfer Tank.
- West fly ash silo (existing) and new fly ash silo

The Fly Ash System shall service all the PJFF material collection hoppers as well as the SCR and duct ash hoppers. Each collection point in the Fly Ash System shall be tied into a new vacuum conveying system via new branch lines from a main vacuum conveying line.

Each PJFF, SCR, and ductwork hopper will be equipped with a manual hopper isolation valve and a new automatic feed valve. The automatic feed valves will isolate the hopper being emptied and provide a controlled flow of fly ash to the conveying line. The conveying system shall sequentially remove ash from the PJFF hoppers, or from the SCR hoppers, or from the ductwork hoppers and transfer it to a new Unit 2 Fly Ash Transfer

Tank. The ash will then be transported from the tank to the west silo or to a new fly ash waste silo via a new pressure conveying system utilizing a single 1 x 100% pressure conveying line similar to the existing system. The single pressure line will be supplied with two (2 x 100%) pressure blower assemblies. A branch from the main pressure line may be added to connect the pressure conveying line to the east silo when the Unit 3 & 4 ESP hoppers are decommissioned. A new ash silo for all units will provide additional site capacity for non-saleable ash and will include a new fluidizing system, bin vent, new ash conditioners, and a dry ash telescoping spout.

System Description

1.1 System Identification

- Unit Designation — Unit 2
- System Name — Induced Draft
- System Code — CCE
- File Number — 41.0804.3.M207

1.2 Function

The Induced Draft System, in conjunction with the steam generator forced draft fans, provides the static pressure required to induce the flow of combustion gases from the steam generator furnace through the gas path to the stack. The system includes the capability of controlling the flue gas flow rate to maintain furnace draft over the specified load range.

1.3 Process Description

The Induced Draft System will consist of the following major components.

- Two new 50 percent nominal capacity, centrifugal induced draft (ID) fans using variable speed operation as the primary means of flow control accomplished through the use of variable frequency drives.
- New, direct-drive induction motors designed for the full fan capacity and operation with variable frequency drives.
- New variable frequency drives designed for the full fan capacity.
- New couplings for each fan to transmit the rotational energy from the new motors to the fan. Couplings will be an elastomeric type designed to limit the transmission of any VFD generated coupling vibration.
- New ID fan lubricating oil units.
- New ID fan inlet dampers and damper drives that will be used as a means of secondary flow control.
- New ID fan discharge dampers and damper drives.
- Associated new and existing ductwork and expansion joints upstream and downstream of the ID fans.

- Associated new and existing piping, valves, instruments, controls, and accessories.

The ID fans will induce flow of the combustion gases through the steam generator, new selective catalytic reduction (SCR) system, regenerative air heaters, and new pulse jet fabric filters (PJFF). They will also provide sufficient pressure to exhaust the combustion gases through the refurbished wet flue gas desulfurization (WFGD) scrubber and the existing stack. The ID fans will also be used during the steam generator and associated equipment and ductwork purging cycle prior to firing fuel in the furnace or after the steam generator is shut down.

These centrifugal fans will have variable speed capability, using variable frequency drives, that will be used as the primary means of exhaust gas flow control over the unit operating load range. Each of these new fans will be designed for direct connection through an elastomeric coupling to a new motor and associated variable frequency drive. The variable frequency drives will be used to control the speed of the motors and fans depending on the desired capacity from the plant control system. The system will control the fans to maintain the furnace pressure at a predetermined value. During a severe transient, such as a loss of fuel, the system will be capable of responding to the commands from the Distributed Control System (DCS) in such a manner as to avoid any damage from a negative pressure transient in the steam generator. The secondary means of flow control, the inlet dampers, may need to be used in this case.

In conjunction with the forced draft and primary air fans, combustion flue gas will flow from the new PJFF outlet to the inlet duct of each ID fan. The ID fans will be sized to achieve 60 percent of the MCR condition with one ID fan in service. The ID fans will discharge into a ductwork header which will exhaust combustion flue gas through the refurbished WFGD scrubber and existing stack to the atmosphere.

Expansion joints will be provided in the new ductwork where required to accommodate movements due to thermal expansion and contraction. This will prevent detrimental stresses in the ductwork, deformation, or failure of structures or equipment due to thermal expansion. Inlet and outlet isolation dampers and a forced lubrication oil unit are provided with each ID fan. The ID fan sound level is attenuated by the use of insulation and lagging of the ID fan casings.

The new and existing ductwork will continue to provide a flow path from the existing steam generator air heaters to the new PJFF, then to the ID fans, and exiting the ID fans to the refurbished WFGD scrubber and existing stack.

System Description

1.1 System Identification

- Unit Designation Unit 2
- System Name Pulse Jet Fabric Filter
- System Code CCB
- File Number 41.0804.3.M208

1.2 Function

The Particulate Removal System will collect particulate matter from the boiler flue gas stream on filter bags. Particulate matter will also be collected from the powder activated carbon (PAC) and sorbent injection systems in ductwork upstream of the pulse jet fabric filter. The collected particulate will be stored in hoppers until removed by the Fly Ash Handling System.

1.3 Process Description

The Particulate Removal System will include the following major equipment and components:

- Pulse Jet Fabric Filter (PJFF) casing with inlet and outlet transition ducts and expansion joints.
- Fabric filter compartment inlet, outlet dampers, and casing bypass dampers along with seal air system.
- Fabric filters bags and cages.
- Air pulse cleaning system, including headers, valves, and controls.
- Compressors, air driers, and air receivers with 100 percent spare capacity
- Hoppers, including heaters, level detectors, and ports for hopper fluidizing system.
- Permanent and mobile pre-coating system
- Insulation and lagging of fabric filter housing.
- Walk-in or Top door plenum to allow access to the tube sheet for inspection, and maintenance.
- Weather enclosed penthouse with lighting and ventilation.
- Electric hoist on the exterior penthouse level to lift boxes of bags and cages to the penthouse level for maintenance purposes.
- Access provisions required for maintenance, including hoists.
- Associated piping, valves, instruments, controls, and accessories.

The Particulate Removal System consists of compartmentalized PJFF located between the sorbent injection lances and the inlet of the induced draft (ID) fans. The number of compartments is determined by economic compartment sizing, total flue gas flow rate, air-to-cloth ratio, and cleaning system design. The PJFF will be designed with a spare compartment.

Under normal operation, flue gas enters the fabric filter inlet plenum and is distributed to the individual compartments through inlet dampers at each fabric filter compartment. Flue gas will pass upwards through the filter bags where the particulates within the gas stream will collect on the outside of the filter bags and the clean gas exits each fabric filter compartment through an outlet damper into fabric filter outlet plenum. To prevent collapse of the bag, a metal cage is installed on the inside of the filter bags. Filter bags and cages are suspended from a tube sheet at the top of the compartment. Each individual compartment will be provided with inlet and outlet isolation dampers for access or maintenance.

The collected particulate will be cleaned from the filter bags by suddenly inflating the filter bags with a pulse of compressed air over several rows of filter bags, causing the dust on the outside to separate from the bags and drop into hoppers below. The pulsing system will have optimum flow geometry and will be designed with no mechanically actuated parts or acoustic systems that are required to operate for the pulse air cleaning process. The cleaning frequency will be regulated by the control system based on overall fabric filter pressure drop. Online or isolated mode of cleaning of fabric filter will also be regulated by the control system. The fabric filter will be pulse-cleaned utilizing clean, dry, oil free, compressed air supplied by pulse jet air compressors and associated air receivers and dryers.

The dust collected in the fabric filter discharge hoppers will be fluidized and removed by the Fly Ash Handling System. The flue gas from the outlet plenum of the fabric filter will flow through the induced draft fans in the Induced Draft System and then to the Wet Flue Gas Desulfurization System.

The PJFF shall be designed to achieve particulate matter emissions of 0.01 lb/MBtu. The fabric filter shall be designed to allow for continuous, reliable operation of the boiler at the maximum flue gas flow rate and grain loading with one fabric filter compartment removed from service for maintenance with the fabric filter net cloth velocity not exceeding 4.0 ft/s.

System Description

1.1 System Identification

• Unit Designation	Unit 2
• System Name	Neural Network
• System Code	SGM
• File Number	41.0804.3.M209

1.2 Function

Neural networks utilize a DCS based computer system that obtains plant data such as load, firing rate, burner position, air flow, CO emissions, etc. The computer system analyzes the impact of various combustion parameters on CO emissions. The system then provides feedback to the control system to improve operation for lower CO emissions.

In addition to burner performance these monitoring systems also allow continuous indication of pulverizer, classifier and fuel delivery system performance to provide early indication of impending component failures or maintenance requirements. This system is also used to improve heat rate and often provides operational cost savings along with CO control.

1.3 Process Description

The Neural Network System uses real-time operational data extracted from the plant DCS to “learn” solutions from plant operational experience to achieve reductions in the emissions produced, while possibly improving the heat rate of the plant.

Neural network computing differs from traditional computing in that engineering, statistical, and first-law principles have been replaced by complex, time-varying, nonlinear relationships. Neural networks do not presume that a relationship is known between process inputs and outputs, but rather determines the relationships by analyzing datasets of input and output.

Neural network equipment will be minimal, consisting of a few computer servers that can be located in the same room as the DCS master equipment

System Description

1.1 System Identification

- Unit Designation — Unit 2
- System Name — AQCS Compressed Air
- System Code — CAB
- File Number — 41.0804.3.M210

1.2 Function

The Air Quality Control System (AQCS) Compressed Air Systems will provide the clean, dry, oil free compressed air at an adequate pressure and adequate capacity for the pulse jet fabric filter (PJFF), actuators, controls, instrumentation, and other air users in the AQCS addition.

1.3 Process Description

The AQCS Compressed Air System includes the following major equipment and components:

- Two full capacity air compressors.
- Two full capacity air filter/dryers.
- One air receiver.
- Distribution pipe, valve, and fittings
- Controls and instruments

Two full capacity air compressors will be provided to supply air to the air receiver. During normal operation, only one of the compressors will be in service at a time. Air from the compressors is routed to the air filter/dryers that will dry control air to a dew point of -40° F or lower before entering the air receiver. Air will be supplied from the receiver to the PJFF and other users upon demand.

Cross-ties with the existing station and instrument air systems will be installed. These will allow air from either existing system to be used to back-up the AQCS compressed air system. It will also allow AQCS compressed air to be used to back-up the existing systems. The equipment comprising the AQCS Compressed Air System is intended to be located in the Unit 1/Unit 2 Common Fly Ash Handling Building.

System Description

1.1 System Identification

- Unit Designation — Unit 2
- System Name — AQCS Service Water
- System Code — WSC
- File Number — 41.0804.3.M211

1.2 Function

The Air Quality Control System (AQCS) Service Water System will extend the existing service water systems for washdown, makeup, and seal water for equipment in the AQCS areas.

1.3 Process Description

The AQCS Service Water System shall consist of the following major equipment and components:

- Washdown stations
- Distribution piping, valves, and fittings
- Controls and instruments

The source of service water shall be from a branch connection from the existing service water distribution piping. Existing service water quality will be sufficient to protect the AQCS systems.

Service water distribution piping shall supply seal and makeup water to washdown stations servicing all AQCS additions.

System Description

1.1 System Identification

- Unit Designation — Unit 2
- System Name — Sorbent Injection
- System Code — CCH
- File Number — 41.0804.3.M212

1.2 Function

The function of the Sorbent Injection System is to remove SO_3 from the flue gas by injecting sorbent into the flue gas ductwork between the boiler air heater outlet and the pulse jet fabric filter (PJFF) inlet.

1.3 Process Description

The Sorbent Injection System will consist of the following equipment and components:

- Two (2) sorbent storage silos with structural skirted enclosure with all necessary appurtenances.
- Three blower/feeder skid assemblies.
- Rotary valve and motors.
- Feed hoppers.
- Screw feeder and motors.
- Eductors.
- Sorbent distribution manifolds with isolation valves to each lance.
- Custom injection lances with flex hose connections.
- Associated piping, valves, instruments, and accessories.
- Controls and instrumentation.

The Sorbent Injection System will receive bulk sorbent by truck. The sorbent will be unloaded pneumatically into one of the storage silos through a stationary positive pressure dilute phase conveying system. The trucks should be equipped with their own pneumatic unloading system.

The sorbent will be fed from the silo by a rotary valve into a volumetric feeder hopper where it will be temporarily stored. The sorbent will then be conveyed by the feeder screw into the drop tube. The sorbent will be fed through the drop tube directly into the eductor inlet, located below the feeder discharge.

The passing of motive air through the eductor nozzle will produce a vacuum in the eductor inlet, which will help draw the sorbent and air into the mixing zone directly downstream of the mouth. The sorbent will be transported through the piping system and is distributed to an array of injection lances and into the boiler exhaust gas stream to maintain H_2SO_4 emissions below 5 ppmvd @ 3% O_2 based on the flue gas flow rate, temperature and upstream H_2SO_4 concentration.

The number of injection lances will vary based on the width of the receiving duct and the required rate of injection. Each lance will contain valves and instrumentation for verifying flow out of each lance. A marshalling cabinet will allow plant operators to access data collected from the injection lances, flue gas analyzers and other instruments on the injection system. A long residence time for the flue gas, moving through straight sections of ductwork from the injection ports to the downstream filtering equipment, is essential to remove H_2SO_4. A retention time less than two seconds is unfavorable for a sorbent injection system's ability to remove H_2SO_4.

System Description

1.1 System Identification

- Unit Designation — Unit 2
- System Name — Powder Activated Carbon Injection
- System Code — CCH
- File Number — 41.0804.3.M213

1.2 Function

The function of the Powder Activated Carbon (PAC) Injection system is to remove mercury from the flue gas by injecting PAC into the flue gas ductwork between the boiler air heater outlet and the pulse jet fabric filter inlet.

1.3 Process Description

The PAC Injection System will consist of the following equipment and components:

- Two (2) PAC storage silos with structural skirted enclosure with all necessary appurtenances.
- Three blower/feeder skid assemblies.
- Rotary valve and motors.
- Feed hoppers.
- Screw feeder and motors.
- Eductors.
- PAC distribution manifolds with isolation valves to each lance.
- Custom injection lances with flex hose connections.
- Associated piping, valves, instruments, and accessories.
- Controls and instrumentation.

The PAC Injection System will receive bulk PAC by truck. The PAC will be unloaded pneumatically into one of the storage silos through a stationary positive pressure dilute phase conveying system. The trucks will be equipped with their own pneumatic unloading system or by a secondary blower located at the silos.

The PAC will be fed from the silo by a rotary valve into a volumetric feeder hopper where it will be temporarily stored. The PAC will then be conveyed by the feeder screw into the drop tube. The variable speed motor for the screw feeder allows for adjustment of the PAC feed rate. The PAC will be fed through the drop tube directly into the eductor inlet, located below the feeder discharge.

The passing of motive air through the eductor nozzle will produce a vacuum in the eductor inlet, which will help draw the PAC and air into the mixing zone directly downstream of the mouth. The PAC will be transported through the piping system and is distributed to an array of injection lances to evenly distribute the carbon into the existing flue gas stream to maintain Hg emissions below 1 lb/TBtu based on the flue gas flow rate, temperature and upstream Hg concentration.

The injection lances are placed in the ductwork stream before the pulse jet fabric filter (PJFF). The number of injection lances will vary based on the width of the receiving duct and the required rate of injection. Each lance will contain valves and instrumentation for verifying flow out of each lance. A marshalling cabinet will allow plant operators to access data collected from the injection lances, flue gas analyzers and other instruments on the injection system. A long residence time for the flue gas, moving through straight sections of ductwork from the injection ports to the downstream filtering equipment, is essential to remove Hg. A retention time less than two seconds is unfavorable for a PAC injection system's ability to remove Hg. The PJFF removes the activated carbon particles along with the adsorbed mercury.

System Description

1.1 System Identification

- Unit Designation — Unit 2
- System Name — Selective Catalytic Reduction
- System Code — CCF
- File Number — 41.0804.3.M214

1.2 Function

The function of the NO_x Reduction system is to remove NO_x from the flue gas. The NO_x Reduction System uses the injection of ammonia (NH_3) into the flue gas and a Selective Catalytic Reduction (SCR) system to produce molecular nitrogen (N_2) and water vapor. These reactions take place in the SCR reactor in the presence of a catalyst with known cycle life under appropriate temperature conditions, pressure conditions and fuel characteristics.

1.3 Process Description

The Selective Catalytic Reduction System will include the following major equipment and components:

- SCR reactor.
- Catalyst.
- NO_x analyzers.
- Diluent (O_2 or CO_2) analyzers.
- Sonic horns and/or soot blowers
- Large Particle Ash (LPA) Screen
- Ammonia injection control valves
- Delta Wing Static Mixers and Guide Vanes
- Ductwork, dampers, and expansion joints.

The hot flue gas leaving the economizer section of the boiler will pass through a large particle ash (LPA) screen before proceeding to the ammonia injection site and to the SCR reactor. The LPA screen will be used to remove any ash particles that are larger than the pitch of the catalyst. The objective of the LPA screen is to avoid potential operating problems due to catalyst plugging. The primary ammonia mixers are located in the vertical section of the inlet duct to mix the incoming anhydrous ammonia into the flue gas. There are two 100% anhydrous ammonia injection control valves per reactor that flash the sub-cooled anhydrous ammonia and inject vaporized ammonia directly into a dilution air stream. There is currently an anhydrous ammonia storage area on site that will supply ammonia to the injection skid via two 100% anhydrous ammonia feed pumps. This ammonia-air vapor is introduced behind the Delta Wing static mixers where it is mixed with the flue gas to ensure uniform distribution of the NO_x and NH_3. The ammonia reacts with the NO_x in the presence of the catalyst to remove NO_x from the flue gas. The quantity of ammonia can be adjusted as it reacts with the NO_x in the presence of the catalyst to remove NO_x from the flue gas. The inlet duct continues onward to the reactor inlet. The elbow at the reactor inlet is fitted with small mixing plates, called homogenizers, which provide increased uniformity of ash distribution across the entire catalyst surface. The final turn downward into the catalyst utilizes a large array of turning vanes to guide the gas downward to the topmost layer of catalyst and minimize dust collection in the reactor cap

The guide vanes in the reactor inlet elbow are used to align the flue gas and ash particles to within the specified flow requirements of design standards required for high removal efficiency SCR systems. The mixing devices including Delta Wings static mixers, and guide vanes are necessary to ensure an optimal flow to the catalyst. The removable door sections on each catalyst layer are used to load and unload catalyst from the reactor. These door sections are seal welded in place to prevent leakage of flue gas or infiltration of air into the reactor. The temperature measurement connections at each catalyst layer and at the SCR inlet and outlet are used to monitor the temperature of the catalyst and reactor steel structure during start-up and operation. The sonic horn catalyst cleaning system on the reactor provides the required cleaning of the catalyst during normal operation. Inlet and outlet flue gas pressure transmitters are provided across the SCR reactor to continually measure and record SCR pressure loss. NOx measurement systems installed in each of the SCR inlet and outlet ducts are used to control ammonia injection to each reactor.

The flue gas leaves the reactor inlet turning vanes and enters the first layer of catalyst in a uniform manner. The flue gas is homogeneously distributed over the reactor cross-sectional area and passes through the catalyst face. This insures minimal erosion by ash impact on the catalyst. The flow continues through the second layer in the same manner. The flue gas exits the reactor and enters the air heater inlet duct. Turning vanes and plates are used, as required, ensuring acceptable distributions of ash, temperature and flow to the air heater.

The potential NO_x reduction is sensitive to the temperature of reaction and time available for the NO_x reducing reaction to occur. The catalyst is of vanadium/titanium dioxide based material. Sealing material is installed between catalyst blocks to prevent untreated flue gas leakage.

System Description

1.1 System Identification

- Unit Designation — Unit 2
- System Name — Ammonia Supply
- System Code — CGE
- File Number — 41.0804.3.M215

1.2 Function

The Ammonia Supply System shall include the following major components:

- Two existing 60,000-gallonanhydrous ammonia storage tanks, with adequate storage capacity to require refilling no more than one time per 9 days based on estimated ammonia consumption of all four units.
- Two existing full-capacity ammonia pumps.
- One ammonia injection skid, the skid consists of two full capacity mass flow meters and ammonia flow control valve trains.
- Two full capacity ammonia dilution air blowers common for Unit 1 and Unit 2 SCRs.
- Two full capacity air pre-heaters common for Unit 1 and Unit 2 SCRs.

1.3 Process Description

The Ammonia Supply System provides a means of transferring anhydrous ammonia to the selective catalytic reduction (SCR) system

Liquid anhydrous ammonia from the existing anhydrous ammonia storage tanks is directed to the Units 1, 2, 3, and 4 ammonia injection skids by the existing ammonia pumps.

Unit 2 ammonia injection system will consist of one ammonia injection skid and a common ammonia dilution air system. Unit 2 ammonia injection skid will consist of two 100% mass flow meters and ammonia flow control valve trains, pipe, valves, and instrumentations. The ammonia dilution air system will be common for both Unit 1 and Unit 2 SCRs and will consist of two 100% ammonia dilution air blowers and two 100% air pre-heaters to provide hot dilution air. Air pre-heaters will be steam heater type. Steam will be provided from the existing plant steam supply header.

Upon demand, ammonia flow rate will be controlled by the flow controllers and mixed with the hot dilution air stream to dilute the ammonia to a concentration of 5% by volume before introduced into Unit 2 SCR flue gas stream. Air flow rate will be measured by air flow meters located upstream of the air/ammonia mixing devices.

System Description

1.1 System Identification

- Unit Designation — Unit 3
- System Name — AQCS Power Supply
- System Codes — APB--AC Power Supply (120/208 Volts)

  APC--AC Power Supply (480 Volts)

  APD--AC Power Supply (4160 Volts)

  APH--DC Power Supply

  API--Uninterruptible Power Supply
- File Number — 41.0804.03.M301

1.2 Function

The function of the Auxiliary Power Supply System shall be to distribute electrical power to various pieces of equipment, devices, and cabinets, and to provide overcurrent and fault protection.

1.3 Process Description

1.3.1 AC Power Supply (120/208V) (APB)

Power shall be provided to 120V single-phase and 208V three-phase loads by ac panelboards rated 120/208V, three-phase, four-wire. The panelboards shall also provide branch circuit protection and a means of disconnect for the branch circuit loads through manually operated thermal magnetic circuit breakers. Power shall be provided to the panelboards by low voltage transformers, with 480V three-phase primary (APC) and 120/208V secondary with directly grounded neutral. The system shall be designed to provide 100 percent of the required continuous loads with 20 percent spare kVA.

1.3.2 AC Power Supply (480V) (APC)

Power shall be provided to 480V three-phase loads by the following major power system components, in general:

- 4160V to 480V dry type secondary unit substation (SUS) transformers with high resistance grounded wye secondary grounding.
- 480V, 3-phase, 3-wire, metal enclosed double-ended SUS switchgear.
- 480V, 3-phase, 3-wire, motor control centers (MCCs).
- 480V, 3-phase, 3-wire, panelboards.
- 480V to 480Y/277V and 120/208V dry type transformers for lighting and receptacle loads.
- 480 Y/277V and 120/208V, 3-phase, 4-wire panelboards for lighting and receptacle loads.

The 480V secondary of the SUS transformers shall be connected high resistance grounded wye. All SUS transformers shall be indoor, dry type transformers furnished with AN or ANAF cooling rating and a 150 ^{o}C temperature rise.

The AC Power Supply (480 V) System will be designed to feed the facility's low voltage loads. Each SUS transformer and associated low voltage switchgear line-up will be sized to serve its maximum coincidental operation load. All SUS, MCCs and panelboards will be initially designed with a minimum of 20 percent spare circuit breakers.

1.3.3 AC Power Supply (4160V) (APD)

The 4160V systems shall consist of the following major components:

- One two-winding delta primary, resistance grounded wye Main Auxiliary Transformer. The high voltage rating shall be 22kV and the low voltage rating 4160V to serve the Unit 3 switchgear buses A & B.
- One neutral grounding resistor on each secondary winding of each auxiliary transformer.

The 4160V system shall also consist of the following major components:

- Two (2) 4160V metal-clad, single-ended switchgear with a main breaker on each bus connecting it to the AQC Main Auxiliary Transformer and a secondary main breaker connecting the switchgear bus to the Common AQC Reserve Auxiliary Transformer. The 4160V switchgear shall be arc resistant and of two-high construction. The switchgear shall be located within the AQC Electrical Building
- 4160V cable bus.
- 4160V medium voltage circuit breakers and contactors.

- Two (2) variable frequency drives (VFD) fed from the 4160 SWGR A & B respectively. Each drive will power and control a booster fan motor. The VFDs will be located within the Fan VFD Enclosure.

- Unit 3 will use the existing Unit 4 scrubber and auxiliary systems. These Unit 4 electrical loads will be powered from the existing Unit 3 auxiliary bus. This will require the abandonment of the existing feed to the Unit 3 scrubber electrical loads, and the abandonment of the existing Unit 4 feeds to the existing Unit 4 scrubber loads. These Unit 4 scrubber loads will then be powered from the existing Unit 3 auxiliary bus now feeding Unit 3 scrubber loads. A new cable will connect the existing Unit 3 auxiliary bus scrubber feeder breakers to the existing Unit 4 scrubber auxiliary loads.

The existing 13,800V system:

- The existing 13.8 kV outdoor metal-clad, switchgear shall be modified with an extension to feed the Common AQC Reserve Transformers. The Common AQC Reserve transformers have a 4160V secondary which will provide reserve power to the Unit 3 AQC 4160V Switchgear A and B.

- 13.8 kV cable in underground duct bank from the existing 13.8kV switchgear to the Common Reserve Auxiliary Transformers..

- Reference Common system AQCS Reserve Power Supply system description: 41.0804.3.MC01 for additional detail.

1.3.4 DC Power Supply (APH)

The DC Power Supply System will consist of 125VDC lead acid station batteries, two (2) full-capacity redundant solid-state chargers per battery and a Main distribution panel.

The DC Power Supply System will consist of a station battery system located in a dedicated battery room. The system will utilize flooded type batteries with trays under the batteries. These batteries will provide DC power to the plant DCS, critical FGD System loads, and control power for the auxiliary electrical system equipment. The battery will be connected to a main distribution panel and continuously charged by two fully redundant battery chargers.

Under normal conditions, the battery chargers supply dc power to the dc loads. The battery chargers receive 480VAC power from the motor control centers. The chargers will continuously float-charge the battery while supplying power to the dc loads. Under abnormal or emergency conditions when 480VAC power is not available, the battery supplies dc power to the dc loads. Recharging of discharged batteries occurs whenever 480VAC power becomes available. The rate of charge is dependent upon the characteristics of the battery, battery chargers, and the connected dc load during charging. Each station battery charger shall be capable of charging the fully discharged battery within 8 hours with battery load present.

The battery will be located in a dedicated battery room that is a space conditioned area so that suitable temperatures can be maintained, thus helping to ensure long battery life. Battery temperature for sizing calculations shall be 77^{o} F. The battery shall be sized in accordance with IEEE 485. An exhaust fan(s) shall be furnished for limiting the concentration of hydrogen gas in each battery room. The equalizing voltage shall be used to determine the hydrogen gas emission for fan sizing. Climate control and exhaust fans shall be provided that are suitable for the environment.

1.3.5 Uninterruptible Power Supply (API)

A UPS shall be provided in the AQC Electrical Building for Unit 1. The UPS shall provide reliable power to the control system equipment, other equipment needing a regulated power supply, and other critical equipment needing a reliable power supply. . The UPS system shall be able to handle full load capacity for four (4) hours.

One (1) 120V AC Main UPS Distribution Panel shall be mounted with the chargers and UPS inverter. The panels shall be mounted within the AQS Electrical Building.

A120-208V AC distribution panel for the instrumentation shall be located in the AQC Electrical Building. This distribution panel shall be fed from a 480V:120-208V isolation transformer. The isolation/regulating transformer will regulate the output voltage and provide isolation and noise attenuation based on normal AC input. The voltage regulation shall be + - 1% with -10% to +20% input variation.

Each transformer will be fed from an automatic transfer switch (ATS) which will be fed from each of the 480V MCCs in the building. The ATS shall consist of a double throw power transfer switch mechanism and microprocessor controller of the same manufacturer to provide automatic operation. The ATS shall be switched automatically via voltage sensing and have the capacity to be transferred manually both locally and remotely. The distribution panels shall include circuit breakers in series with fast acting fuses for branch circuit protection.

Each UPS and isolation/regulating transformer shall include 20% spare capacity and distribution panelboards shall have 20% spare branch breakers/fuses for future use by the Purchaser.

1.4 Reference Drawings

- Conceptual Overall One Line – Unit 1: 168908-M3DE-E1003
- Conceptual Overall One Line – Common: 168908-MCDE-E1005

System Description

1.1 System Identification

- Unit Designation — Unit 3
- System Name — Communication
- System Code — CMA
- File Number — 41.0804.3.M302

1.2 Function

The function of the Communication System shall be to provide station personnel with a reliable and convenient means of plant paging and party line communications, and to provide raceway and other provisions for telephone/LAN wiring and equipment and closed circuit television (CCTV).

1.3 Process Description

The Communication System shall include microprocessor-based page/party equipment, raceway, and page/party communication cable as manufactured by Gai-Tronics Corporation. The new microprocessor-based system shall be fully adaptable to the existing system installed at Mill Creek Unit 3 and shall provide self-diagnostic monitoring of the new system for system integrity. The page/party equipment shall provide two-way voice communication on each party line and shall utilize a page line for voice transmission over a plant-wide speaker system. While a conversation is taking place on a party line, other conversations may be held on other party lines or the page line. Each page/party handset station shall have five party lines and one page line. Page/party handset stations and speakers shall be strategically located throughout the plant site. The power supply for the page/party equipment shall be 120 volts ac, from the normal AC System.

The new system shall interface with the existing Mill Creek Unit 3 system.

Raceway and space provisions for telephone/LAN equipment and CCTV shall be provided. Base equipment shall be located in the common control room and peripheral equipment shall be strategically located.

System Description

1.1 System Identification

- Unit Designation — Unit 3
- System Name — Control and Monitoring
- System Code — COA
- File Number — 41.0804.3.M303

1.2 Function

The existing Honeywell Experion Distributed Control System (DCS) will be expanded to incorporate control and monitoring of the new AQCS equipment. Also, the existing Unit 4 Scrubber DCS will be switched over to Unit 3 DCS. The resulting DCS shall provide a means to control in manual and automatic the AQCS equipment individually, as well as in coordination with other plant systems. The DCS shall be central to all plant operations and control the various systems and subsystems, including those required for the new AQCS equipment. The existing DCS will be the central location in the plant for alarm management, historical data archiving, report generation, and data trending. The primary operator interface to the DCS shall be the existing Unit 3 workstations located in the Mill Creek Main Control Room. The existing unit protection system will be retained in the existing DCS to protect critical plant equipment, including critical Booster fan and draft system interlocks.

No local operator stations are included in the conceptual design for the AQCS areas.

- The new AQCS DCS shall consist of the extending existing DCS universal control networks (UCNs) 03 and 13, and the addition of one new high performance manager (HPM) to control the new AQCS common unit equipment. The AQCS DCS equipment shall communicate by means of redundant UCN data highways.

The AQCS DCS equipment shall include the following major components:

- Redundant UCNs.
- Redundant HPM.
- DCS system cabinets and input/output (I/O) cabinets.

The existing Unit 4 Scrubber DCS equipment to switch over to Unit 3 DCS shall include the following major components:

- HPM 25 to UCN 03
- HPM27/28 to UCN 13

1.3 Process Description

The AQCS DCS control processors in the HPM shall contain the control logic for the AQCS equipment. Analog control loop logic and discrete logic shall be implemented in the redundant control processors. The Main Control Room DCS operator interface equipment shall be used as the means to control and monitor plant AQCS processes and process equipment. The DCS configuration will provide interface to all AQCS processes and equipment from either the Unit 3 designated operator workstations.

The AQCS DCS equipment shall interface with the existing DCS to allow retrieval of historic plant data, trend process parameters, and to develop specialized displays of plant information. The operator graphics shall be developed based on the AQCS systems to be controlled, and displayed in a hierarchical format.

The configuration of the AQCS DCS equipment shall take into account redundancy wherever the failure or loss of a component could cause plant upset or loss of generation capacity. Total control processor loading for all required control parameters and communication functions shall be limited to no more than 80 percent loading on each redundant pair. Each input/output cabinet shall contain 20 percent installed spare modules to allow for future expansion.

DCS HPM processor and I/O cabinets shall be located in space-conditioned rooms in the following locations to allow control and instrument cabling to be managed within buildings, minimizing the amount of cable installed between buildings:

- Unit 3 AQCS Electrical Building.
- Common Reserve Power Distribution Center (PDC).

Control processors, power supplies, input/output cards, and other associated hardware shall be a common form factor to provide flexibility of mounting individual control system devices on common rack or carrier. Process controllers, input/output modules, mounting racks or carriers, communication hardware, power supplies, ventilation fans, and other required accessories shall be housed in industrial enclosures with NEMA rating appropriate for the mounting location of the cabinet.

System Description

1.1 System Identification

- Unit Designation — Unit 3
- System Name — Lighting
- System Code — LTA
- File Number — 41.0804.3.M304

1.2 Function

The function of the Lighting System is to provide station personnel with illumination for station operation under normal conditions, egress under emergency conditions, and emergency operational lighting to perform tasks during a power outage of the normal source. The permanent lighting may be used for construction lighting in areas where early installation is practical. Additional construction lighting shall be provided using temporary luminaires and construction power distribution grid. The system also provides 120 volt convenience outlets for portable lamps and tools.

1.3 Process Description

Luminaires for areas with finished acoustical ceilings, if any, shall be fluorescent static troffers. The lighting system for continuously occupied control rooms shall utilize the same type static troffer, except with a dimming ballast and 1/2 inch square louvered low iridescent parabolic diffuser for glare control. Fluorescent lamps shall be energy effiicent 3000K, T8 and not exceed four feet and shall be low mercury content. Ballasts shall be energy efficient electronic type with less than 10 percent harmonic content.

Low bay, wall and stanchion mount luminaires shall be used in outdoor areas and unfinished, hazardous and non-hazardous, enclosed areas of the station. Metal halide luminaires shall be used in the industrial and high bay areas of the plant. Metal halide luminaires shall comply with the Energy Independence and Security Act of 2007, and therefore, all metal halide ballasts and lamps 400 watts and under shall be pulse start metal halide type. Except for high bay areas, pulse start metal halide luminaires shall be enclosed and gasketed with threaded glass refractors. Luminaires located in hazardous areas shall be Underwriters Laboratories (UL), or other North American third party testing lab, listed for the National Electrical Code (NEC) classification. High bay luminaires shall be enclosed and have aluminum or glass reflectors. Luminaires in wet locations or in wash down areas shall be in National Electrical Manufacturers Association (NEMA) 4 enclosures. Approximately 25 percent of the non-hazardous industrial area metal halide luminaires shall be provided with a quartz auxiliary lamp option to provide immediate illumination upon starting and restrike conditions.

Emergency lighting shall be provided for interior building egress paths, interior stairways, selected areas around electrical equipment, and local control rooms. The emergency lighting luminaires for the plant areas shall be powered from individual battery pack units with halogen lamps. Emergency lighting shall provide 90 minutes of operation per the NFPA Life Safety Code 101. Emergency operational lighting for control room area lighting shall be powered by connecting selected fluorescent luminaires to the plant UPS system.

Exit light luminaires shall use light emitting diode (LED) lamps for most areas, with compact fluorescent lamps used in hazardous rated areas, and shall be located in the egress pathways and ground level exit doors of enclosed buildings. The exit luminaires shall be powered from normal ac power and integral batteries for emergency service.

Roadway luminaires shall be pulse start metal halide, cutoff cobra head type mounted on aluminum or galvanized steel poles with helix steel or concrete anchor foundations.

Power used to supply fluorescent and pulse start metal halide luminaires shall be 277 volt ac, except for the possible use of 120 volt ac power for some small remote buildings where 277 volt ac power is not readily available or economically feasible. Luminaires shall be powered from the panelboards, with alternate luminaires or rows of luminaires fed from alternate panelboard circuit breakers. Power used to supply convenience receptacles shall be 120 volts ac. Power used to supply roadway and area lighting shall be 480 or 277 volts ac.

Lighting is not required for roof top PRVs. However, one 120 volt ac ground fault current interrupter receptacle shall be installed on the roof and suitable for access to all the PRV's. A photoelectric controlled light fixture shall be installed near any roof top access doors.

Convenience receptacles shall be grounded duplex type and located throughout the station. The convenience receptacles shall be a minumum of 15 inches above the floor in office areas and 36 inches above the floor in industrial areas. The convenience outlets shall be spaced, at the same elevation, to provide access to any point in the industrial areas with a 100 foot extension cord. Convenience outlets for use without extension cords shall be located in finished areas such as offices, control room, and laboratory. Each outlet shall have the grounding pole located at the top of the device. Each office shall have a minimum of two receptacles on opposite walls. No more than eight receptacles shall be connected to a branch circuit breaker. Receptacles shall be circuited to alternating circuits within an area. Weatherproof snap action covers shall be installed on all receptacles located outdoors and in wet indoor areas. In general, receptacles for outdoor and plant indoor wet areas shall be standard 125 volt, 20 amp, 2-pole with ground, NEMA 5-20R type. Selected receptacles in finished and industrial areas shall have GFCI protection in accordance with the NEC. In areas with hazardous atmospheres, convenience outlets shall be suitable for the NEC class, division, and group requirements.

Operation of the Lighting System is dependent upon the visual requirements of the station operating personnel. The general lighting for interior process areas shall be manually switched on and off at panelboard circuit breakers. The lighting for smaller enclosed areas within the buildings shall be manually switched on and off at local light switches near personnel entrance doors. The OFF position of the toggle switch shall be in the downward position. The lighting for continuously occupied control rooms shall be controlled from dimmer switches. The exterior process area lighting shall be controlled through common contactors that automatically operate between sunset and sunrise via photoelectric controllers. The lighting contactors shall have a hand-off-auto (HOA) switch for daytime maintenance override. Luminaires with integral photocells shall be provided for roadway luminaires and luminaires at exterior personnel entrances only. Separate photo-electrically controlled electrically held lighting contactors with a HOA switch shall be provided for exterior lighting in different areas of the plant.

Luminaires shall be installed at a minimum height of 7 feet 0 inches above the floor to provide an unobstructed way of exit travel from any point in the buildings. Luminaires shall be designed and installed with consideration for maintenance and access. Luminaires shall be installed in locations where maintenance shall not be blocked by structural steel, piping, raceway, grating, etc.

Lighting cable powered from 277 volt ac and all branch circuits installed outdoors shall be XHHW-2 . All 120 volt ac branch circuits installed indoors in heated spaces shall be THHN cable. Pre-assembled and prewired cable assemblies shall be used only in finished environments.

Lighting and receptacle branch circuit voltage drop shall not exceed 3%. This shall include the voltage drop from the last outlet in the branch circuit to the lighting panelboard. In addition, 120 volt branch circuits longer than 75 feet shall use 10 AWG and 277 volt branch circuits longer than 200 feet shall use 10 AWG conductors.
General access interior structure lighting for permanent structures required during construction shall be provided using the permanent luminaires connected to the construction power grid, where practical. Any additional lighting required for construction operation shall be provided by the construction contractor.

The Lighting System shall comply with the regulatory requirements of Occupational Safety and Health Administration (OSHA) and applicable building codes.

Lighting shall be designed in accordance with the Illuminating Engineering Society of North America (IESNA) to provide the illumination levels recommended by the following standards and organizations:

- American National Standards Institute (ANSI)/IESNA RP-7, Industrial Lighting.
- ANSI/IESNA RP-8, Roadway Lighting.
- OSHA.

- National Fire Protection Association (NFPA), National Electric Code (NFPA 70).
- NFPA, Life Safety Code (NFPA 101).
- Local Building Code (latest adopted version).

The following criteria shall also be considered in the lighting system design:

- Illumination calculations shall be based upon the mean lumen output of the respective lamps (lamp lumen depreciation [LLD]).
- Illumination calculations shall be based upon a luminaire dirt depreciation (LDD) factor.
- Interior illumination calculations shall be based upon a room surface dirt depreciation (RSDD) factor.
- Illumination calculations shall be based upon the luminaire ballast factors of the light fixtures utilized in the design.
- The illumination calculations shall be determined at a 30 inch workplane height above the floor.

System Description

1.1 System Identification

- Unit Designation — Unit 3
- System Name — Buildings and Enclosures
- System Code — BSA
- File Number — 41.0804.3.M305

1.2 Function

The function of the Buildings and Enclosures System will be to provide support, enclosure, and access to the systems contained within each structure's boundaries.

1.3 Description

The various structures associated with the Buildings and Enclosures will generally consist of the following six components:

- Foundation--provides support and carries the loads to the subsurface.
- Structural frame--provides support for the contained systems and stability for the entire structure.
- Architectural--provides isolation of systems, enclosure, and protection from natural phenomena, where required, through walls, partitions, ceilings, and roofs.
- Access--provides means of ingress and egress and allow for access to the contained systems and equipment through doors, stairs, floors, elevators, cranes, and hoists.
- Space Conditioning -- provides the required heating, ventilating and air conditioning for the buildings.
- Drains and Plumbing--provides plumbing, floor and equipment drains and floor trenches and sumps for the enclosed equipment and facilities.

The buildings and structures will be designed to accommodate the function and arrangement of the systems they enclose. Building arrangements will take into consideration maintenance and operating access requirements as well as the equipment itself. Suitable design features will be provided to prevent or contain oil or chemical spills where appropriate. All occupied buildings will be designed to meet NFPA 100 Life

Safety egress requirements. Since no new or refurbished administrative areas are included within the scope of the Phase II Unit 1 modifications, the new structures will not require design in accordance with the Americans with Disability Act Accessibility Guidelines (ADAAG) requirements.

HVAC systems will be designed to maintain suitable for the equipment and operations enclosed under the design ambient conditions in the Project Design Memorandum. Ventilation, heating, and cooling equipment will be located to ensure relatively uniform temperature distribution throughout the space. Air conditioning for control and electrical equipment will be designed to meet appropriate filtration levels and noise criteria.

Fire protection systems meeting appropriate NFPA and building code requirements will be provided for each building where required. Since none of the new buildings or structures intended for the Phase II Unit 1 modifications is expected to be manned on a continuous basis, and since existing facilities remain in the immediate area, no plumbing or toilets are intended for these structures

1.3.1 Unit 3 PJFF Support Structure

The Unit 3 Pulse Jet Fabric Filter Support Structure will be constructed in the area currently occupied by the Unit 3 wet scrubber. The structure will also span across the existing plant loop road east of the AQC area to allow sufficient length for installation of the Unit 3 PJFF above. The structure will be unenclosed and will consist of a structural steel superstructure mounted on a concrete foundation. The concrete foundation will be constructed in the area of the existing wet scrubber substructure. During detailed design the existing substructure will be evaluated to determine if or how best the existing structure may be incorporated into the foundation of the support structure. If practical, the existing substructure will simply be filled with structurally compact fill to allow loads from the new support structure to be transferred to the existing foundation via shallow footings. If necessary, new concrete columns will be extended from the existing foundations to grade to support the new steel superstructure. Only if it is determined in detailed design that the existing foundation cannot be practically modified to support the new loads to be imposed will demolition of the existing substructure be carried out. The cost estimate for Unit 3 is based on the addition of cast-in-place columns being installed on the existing substructure foundation with the remainder of the substructure being filled with structural fill.

The steel superstructure to be mounted on the foundation will consist of braced-frame construction supported on a series of steel columns. The width and length of the support structure will be dependent on the final size of the PJFF to be mounted on it. Columns will be stopped short of the existing coal delivery loop track in any case, although portions of the unused rail spur west of the rail loop may be demolished if required. For purposes of the Unit 3 estimate, the size of the PJFF is assumed to require partial demolition of the outside spur to allow installation of the easternmost columns. The steel framework will be topped with a steel deck supporting a six-inch nominal thickness concrete slab to be used as the working floor for the PJFF. The elevation of the superstructure will provide a minimum of 16’-6” clear distance between the road surface elevation of the east loop road and the bottom of steel superstructure above. The remaining area under the support structure west of the road will be reserved for the Unit 3 Fly Ash Handling Building and associated equipment.

Steel stair towers at the north and south ends of the structure will allow personnel access to the working floor level. The structure will be designed to accommodate the maintenance hoists supplied with the PJFF, allowing replacement bags and maintenance material to be transported from grade. The working floor and any large penetrations will be surrounded by handrail for safety. As an unenclosed structure, no heating or ventilation will be required. A series of steel bollards or guardrails will be installed on either side of the road under the structure to ensure vehicle impact to the supporting columns is avoided.

1.3.2 Unit 3 Fly Ash Handling Building

The Unit 3 Fly Ash Handling Building will house the new fly ash handling equipment required for Unit 3 and will be located under the Unit 3 PJFF Support Structure. The Ash Handling Building is intended as a low (less than 16’-6” high) single story pre-engineered metal building on a concrete foundation. The concrete foundation will be supported or drilled piers or micropiles and will contain equipment pads for mounting of equipment. The superstructure will consist of steel framing enclosed with insulated metal panel walls and roof. The interior will be of unfinished construction. Personnel and overhead doors will be located and sized to access equipment for maintenance as well as provide personnel access. HVAC will include heating and ventilation, except as otherwise required by specific equipment.

1.3.3 Unit 3 AQCS Electrical Building

The Unit 3 AQCS Electrical Building will house additional electrical and control equipment serving the new PJFF and the booster fans. The Electrical Building is intended as a single story pre-engineered metal building mounted to a small foundation with a floating interior slab. For purposes of the Unit 3 estimate, drilled piers or micropiles were assumed under the columns of the building to minimize excavations and impact to existing undergrounds, but shallow soil-supported foundations may be deemed acceptable at time of detailed design. The superstructure will consist of steel framing enclosed with insulated metal panel walls and roof. The interior will be of unfinished construction and doors will be located and sized to access equipment for maintenance as well as provide personnel access. HVAC will be as required for the equipment enclosed, but will at minimum include heating and ventilation. The building is intended as a “dry” enclosure and floor drains will be minimized.

1.3.3 Booster Fan VFD Enclosure.

The VFD Enclosure houses the variable frequency drive equipment serving the two new Unit 3 booster fans. The enclosure is intended to be a pre-manufactured enclosure furnished complete with equipment installed. The prefabricated structure will be placed on a shallow foundation with necessary utilities and services provided for tie-in to the enclosed equipment. The structure will be furnished with necessary HVAC appropriate for the enclosed equipment and doors pre-installed

System Description

1.1 System Identification

- Unit Designation Unit 3
- System Name Fly Ash
- System Code ASB
- File Number 41.0804.3.M306

1.2 Function

The Fly Ash System will pneumatically remove fly ash from the pulse jet fabric filter (PJFF) hoppers. In addition, the ash handling system will handle powder activated carbon (PAC) and sorbent (trona/lime) which are injected upstream of the PJFF and collected in the PJFF hoppers. The collected fly ash byproducts will be conveyed to the existing west silo or a new fly ash silo. The process is shown on drawing 168908-M3ASB-M2022: Fly Ash, Unit 3.

1.3 Process Description

The Fly Ash System includes the following major equipment and components:

- Fly ash feed valves.
- Fly ash conveying equipment.
- New Fly Ash Transfer Tank.
- West fly ash silo (existing) and new fly ash silo

A new Fly Ash System shall service all the PJFF material collection hoppers. Each PJFF hopper in the Fly Ash System shall be tied to a new pneumatic vacuum conveying system via branch lines under each hopper row. Each hopper will be equipped with a manual hopper isolation valve and new automatic feed valve. The automatic feed valves will isolate the hopper being emptied and provide a controlled flow of fly ash into a branch conveying line(s) servicing a row of hoppers. The branch lines will convey ash to either of two (2 x 50%) main vacuum lines. Note that the percentage indicated represents the design rate not the ash production rate of the boiler at MCR. The design rate is equal to two times the ash production rate. Each vacuum line will be equipped an exhauster blower assembly. Both exhausters can operate concurrently or as a backup for the other when operating one of the two lines. The vacuum conveying lines shall sequentially remove ash from the PJFF hoppers or from the SCR hoppers and transfer it to two filter separators above the new Unit 3 Fly Ash Transfer Tank. From the tank, ash will then be transported via a new pressure conveying system utilizing a single 1 x 100% pressure conveying line, similar to the existing system, to the west silo or to a new fly ash waste silo. The pressure line will be supplied with two (2 x 100%) pressure blower assemblies. A branch from the main pressure line may be added to connect the line to the east silo for additional storage flexibility. Unit 3 ESP ash will continue to be conveyed to the east silo which is designated for saleable ash or to the west silo by the existing ash handling system. The existing west silo connection will not be disabled to provide an alternate destination for the ESP ash if the east silo is unavailable. A new ash silo for all units will provide additional site capacity for non-saleable ash and will include a new fluidizing system, bin vent, new ash conditioners, and a dry ash telescoping spout.

System Description

1.1 System Identification

- Unit Designation — Unit 3
- System Name — Induced Draft
- System Code — CCE
- File Number — 41.0804.3.M307

1.2 Function

The Induced Draft System, in conjunction with the steam generator forced draft fans, provides the static pressure required to induce the flow of combustion gases from the steam generator furnace through the gas path to the stack. The system includes the capability of controlling the flue gas flow rate to maintain furnace draft over the specified load range.

1.3 Process Description

The Induced Draft System will consist of the following major components.

- Two existing, 50 percent nominal capacity, centrifugal induced draft (ID) fans using variable speed operation as the primary means of flow control accomplished through the use of hydrokinetic fluid drives mounted between single-speed motors and fans.
- Two new 50 percent nominal capacity, centrifugal booster fans using variable speed operation as the primary means of flow control accomplished through the use of variable frequency drives.
- New, direct-drive induction motors designed for the full booster fan capacity and operation with variable frequency drives.
- New variable frequency drives designed for the full booster fan capacity.
- New couplings for each booster fan to transmit the rotational energy from the new motors to the fan. Couplings will be an elastomeric type designed to limit the transmission of any VFD generated coupling vibration.
- New booster fan lubricating oil units.
- New booster fan inlet dampers and damper drives that will be used as a means of secondary flow control.

- New ID fan discharge dampers and damper drives.
- Associated new and existing ductwork and expansion joints upstream and downstream of the ID and booster fans.
- Associated new and existing piping, valves, instruments, controls, and accessories.

The ID fans will induce flow of the combustion gases through the steam generator, selective catalytic reduction (SCR) system, regenerative air heaters, and electrostatic precipitators. The new booster fans will then induce flow of the combustion gases through the new pulse jet fabric filter (PJFF) located downstream of the existing ID fans. The new booster fans will also provide sufficient pressure to exhaust the combustion gases through the refurbished Unit 4 wet flue gas desulfurization (WFGD) scrubber and the existing Unit 4 stack. The ID fans and new booster fans would also be used during the steam generator and associated equipment and ductwork purging cycle prior to firing fuel in the furnace or after the steam generator is shut down.

These new centrifugal booster fans will have variable speed capability, using variable frequency drives, that will be used as the primary means of exhaust gas flow control over the unit operating load range. Each of these new fans will be designed for direct connection through an elastomeric coupling to a new motor and associated variable frequency drive. The variable frequency drives will be used to control the speed of the motors and fans depending on the desired capacity from the plant control system. The system will control the ID fans to maintain the furnace pressure at a predetermined value. The system will control the booster fans to maintain the duct pressure between the outlet of the ID fans and the inlet of the new PJFF at a predetermined value. During a severe transient, such as a loss of fuel, the system will be capable of responding to the commands from the Distributed Control System (DCS) in such a manner as to avoid any damage from a negative pressure transient in the steam generator and other draft system components. The secondary means of flow control, the inlet dampers, may need to be used in this case.

In conjunction with the forced draft, primary air fans, and ID fans combustion flue gas will flow from the PJFF outlet to the inlet duct of each booster fan. The booster fans will be sized to achieve 60 percent of the MCR condition with one booster fan in service. The booster fans will discharge into a ductwork header which will exhaust combustion flue gas through the refurbished Unit 4 WFGD scrubber and existing Unit 4 stack to the atmosphere.

Expansion joints will be provided in the new ductwork where required to accommodate movements due to thermal expansion and contraction. This will prevent detrimental stresses in the ductwork, deformation, or failure of structures or equipment due to thermal expansion. Inlet and outlet isolation dampers and a forced lubrication oil unit are provided with each booster fan. The booster fan sound level is attenuated by the use of insulation and lagging of the booster fan casings.

The new and existing ductwork will continue to provide a flow path from the outlet of the steam generator to the SCR system, the air heaters, the electrostatic precipitator, the ID fans, the new PJFF, then to the new booster fans, and exiting the booster fans to the existing Unit 4 WFGD scrubber and Unit 4 stack, which will be re-purposed as Unit 3 dedicated equipment..

System Description

1.1 System Identification

- Unit Designation — Unit 3
- System Name — Pulse Jet Fabric Filter
- System Code — CCB
- File Number — 41.0804.3.M308

1.2 Function

The Particulate Removal System will collect particulate matter from the boiler flue gas stream on filter bags. Particulate matter will also be collected from the powder activated carbon (PAC) and sorbent injection systems in ductwork upstream of the pulse jet fabric filter. The collected particulate will be stored in hoppers until removed by the Fly Ash Handling System.

1.3 Process Description

The Particulate Removal System will include the following major equipment and components:

- Pulse Jet Fabric Filter (PJFF) casing with inlet and outlet transition ducts and expansion joints.
- Fabric filter compartment inlet, outlet dampers, and casing bypass dampers along with seal air system.
- Fabric filters bags and cages.
- Air pulse cleaning system, including headers, valves, and controls.
- Compressors, air driers, and air receivers with 100 percent spare capacity
- Hoppers, including heaters, level detectors, and ports for hopper fluidizing system.
- Permanent and mobile pre-coating system
- Insulation and lagging of fabric filter housing.
- Walk-in or Top door plenum to allow access to the tube sheet for inspection, and maintenance.
- Weather enclosed penthouse with lighting and ventilation.
- Electric hoist on the exterior penthouse level to lift boxes of bags and cages to the penthouse level for maintenance purposes.
- Access provisions required for maintenance, including hoists.
- Associated piping, valves, instruments, controls, and accessories.

The Particulate Removal System consists of compartmentalized PJFF located between the sorbent injection lances and the inlet of the booster fans. The number of compartments is determined by economic compartment sizing, total flue gas flow rate, air-to-cloth ratio, and cleaning system design. The PJFF will be designed with a spare compartment.

Under normal operation, flue gas enters the fabric filter inlet plenum and is distributed to the individual compartments through inlet dampers at each fabric filter compartment. Flue gas will pass upwards through the filter bags where the particulates within the gas stream will collect on the outside of the filter bags and the clean gas exits each fabric filter compartment through an outlet damper into fabric filter outlet plenum. To prevent collapse of the bag, a metal cage is installed on the inside of the filter bags. Filter bags and cages are suspended from a tube sheet at the top of the compartment. Each individual compartment will be provided with inlet and outlet isolation dampers for access or maintenance.

The collected particulate will be cleaned from the filter bags by suddenly inflating the filter bags with a pulse of compressed air over several rows of filter bags, causing the dust on the outside to separate from the bags and drop into hoppers below. The pulsing system will have optimum flow geometry and will be designed with no mechanically actuated parts or acoustic systems that are required to operate for the pulse air cleaning process. The cleaning frequency will be regulated by the control system based on overall fabric filter pressure drop. Online or isolated mode of cleaning of fabric filter will also be regulated by the control system. The fabric filter will be pulse-cleaned utilizing clean, dry, oil free, compressed air supplied by pulse jet air compressors and associated air receivers and dryers.

The dust collected in the fabric filter discharge hoppers will be fluidized and removed by the Fly Ash Handling System. The flue gas from the outlet plenum of the fabric filter will flow through the booster fans and then to the Wet Flue Gas Desulfurization System.

The PJFF shall be designed to achieve particulate matter emissions of 0.01 lb/MBtu. The fabric filter shall be designed to allow for continuous, reliable operation of the boiler at the maximum flue gas flow rate and grain loading with one fabric filter compartment removed from service for maintenance with the fabric filter net cloth velocity not exceeding 4.0 ft/s.

System Description

1.1 System Identification

- Unit Designation — Unit 3
- System Name — Neural Network
- System Code — SGM
- File Number — 41.0804.3.M309

1.2 Function

Neural networks utilize a DCS based computer system that obtains plant data such as load, firing rate, burner position, air flow, CO emissions, etc. The computer system analyzes the impact of various combustion parameters on CO emissions. The system then provides feedback to the control system to improve operation for lower CO emissions.

In addition to burner performance these monitoring systems also allow continuous indication of pulverizer, classifier and fuel delivery system performance to provide early indication of impending component failures or maintenance requirements. This system is also used to improve heat rate and often provides operational cost savings along with CO control.

1.3 Process Description

The Neural Network System uses real-time operational data extracted from the plant DCS to “learn” solutions from plant operational experience to achieve reductions in the emissions produced, while possibly improving the heat rate of the plant.

Neural network computing differs from traditional computing in that engineering, statistical, and first-law principles have been replaced by complex, time-varying, nonlinear relationships. Neural networks do not presume that a relationship is known between process inputs and outputs, but rather determines the relationships by analyzing datasets of input and output.

Neural network equipment will be minimal, consisting of a few computer servers that can be located in the same room as the DCS master equipment

System Description

1.1 System Identification

- Unit Designation — Unit 3
- System Name — AQCS Compressed Air
- System Code — CAB
- File Number — 41.0804.3.M310

1.2 Function

The Air Quality Control System (AQCS) Compressed Air System will provide the clean, dry, oil free compressed air at an adequate pressure and adequate capacity for the pulse jet fabric filter (PJFF), new Unit 3 (existing Unit 4) scrubber equipment, actuators, controls, instrumentation, and other air users in the AQCS addition.

1.3 Process Description

The AQCS Compressed Air System includes the following major equipment and components:

- Two full capacity air compressors.
- Two full capacity air filter/dryers.
- One air receiver.
- Distribution pipe, valve, and fittings
- Controls and instruments

Two full capacity air compressors will be provided to supply air to the air receiver. During normal operation, only one of the compressors will be in service at a time. Air from the compressors is routed to the air filter/dryers that will dry control air to a dew point of -40° F or lower before entering the air receiver. Air will be supplied from the receiver to the PJFF and other users upon demand.

Cross-ties with the existing station and instrument air systems will be installed. These will allow air from either existing system to be used to back-up the AQCS compressed air system. It will also allow AQCS compressed air to be used to back-up the existing systems. The equipment comprising the AQCS Compressed Air System is intended to be located in the Unit 3 Fly Ash Handling Building.

System Description

1.1 System Identification

• Unit Designation	Unit 3
• System Name	AQCS Service Water
• System Code	WSC
• File Number	41.0804.3.M311

1.2 Function

The Air Quality Control System (AQCS) Service Water System will extend the existing service water systems for washdown, makeup, and seal water for equipment in the AQCS areas.

1.3 Process Description

The AQCS Service Water System shall consist of the following major equipment and components:

- Washdown stations
- Distribution piping, valves, and fittings
- Controls and instruments

The source of service water shall be from a branch connection from the existing service water distribution piping. Existing service water quality will be sufficient to protect the AQCS systems.

Service water distribution piping shall supply seal and makeup water to washdown stations servicing all AQCS additions.

System Description

1.1 System Identification

• Unit Designation	Unit 3
• System Name	Sorbent Injection
• System Code	CCH
• File Number	41.0804.3.M312

1.2 Function

The function of the Sorbent Injection System is to remove SO_3 from the flue gas by injecting sorbent into the flue gas ductwork between the ID fan outlet and the pulse jet fabric filter (PJFF) inlet.

1.3 Process Description

The Sorbent Injection System will consist of the following equipment and components:

- Two (2) sorbent storage silos with structural skirted enclosure with all necessary appurtenances.
- Three blower/feeder skid assemblies.
- Rotary valve and motors.
- Feed hoppers.
- Screw feeder and motors.
- Eductors.
- Sorbent distribution manifolds with isolation valves to each lance.
- Custom injection lances with flex hose connections.
- Associated piping, valves, instruments, and accessories.
- Controls and instrumentation.

The Sorbent Injection System will receive bulk sorbent by truck. The sorbent will be unloaded pneumatically into one of the storage silos through a stationary positive pressure dilute phase conveying system. The trucks should be equipped with their own pneumatic unloading system.

The sorbent will be fed from the silo by a rotary valve into a volumetric feeder hopper where it will be temporarily stored. The sorbent will then be conveyed by the feeder screw into the drop tube. The sorbent will be fed through the drop tube directly into the eductor inlet, located below the feeder discharge.

The passing of motive air through the eductor nozzle will produce a vacuum in the eductor inlet, which will help draw the sorbent and air into the mixing zone directly downstream of the mouth. The sorbent will be transported through the piping system and is distributed to an array of injection lances and into the boiler exhaust gas stream to maintain H_2SO_4 emissions below 5 ppmvd @ 3% O_2 based on the flue gas flow rate, temperature and upstream H_2SO_4 concentration.

The number of injection lances will vary based on the width of the receiving duct and the required rate of injection. Each lance will contain valves and instrumentation for verifying flow out of each lance. A marshalling cabinet will allow plant operators to access data collected from the injection lances, flue gas analyzers and other instruments on the injection system. A long residence time for the flue gas, moving through straight sections of ductwork from the injection ports to the downstream filtering equipment, is essential to remove H_2SO_4. A retention time less than two seconds is unfavorable for a sorbent injection system's ability to remove H_2SO_4.

System Description

1.1 System Identification

- Unit Designation — Unit 3
- System Name — Powder Activated Carbon Injection
- System Code — CCH
- File Number — 41.0804.3.M313

1.2 Function

The function of the Powder Activated Carbon (PAC) Injection system is to remove mercury from the flue gas by injecting PAC into the flue gas ductwork between the ID fan outlet and the pulse jet fabric filter inlet.

1.3 Process Description

The PAC Injection System will consist of the following equipment and components:

- Two (2) PAC storage silos with structural skirted enclosure with all necessary appurtenances.
- Three blower/feeder skid assemblies.
- Rotary valve and motors.
- Feed hoppers.
- Screw feeder and motors.
- Eductors.
- PAC distribution manifolds with isolation valves to each lance.
- Custom injection lances with flex hose connections.
- Associated piping, valves, instruments, and accessories.
- Controls and instrumentation.

The PAC Injection System will receive bulk PAC by truck. The PAC will be unloaded pneumatically into one of the storage silos through a stationary positive pressure dilute phase conveying system. The trucks will be equipped with their own pneumatic unloading system or by a secondary blower located at the silos.

The PAC will be fed from the silo by a rotary valve into a volumetric feeder hopper where it will be temporarily stored. The PAC will then be conveyed by the feeder screw into the drop tube. The variable speed motor for the screw feeder allows for adjustment of the PAC feed rate. The PAC will be fed through the drop tube directly into the eductor inlet, located below the feeder discharge.

The passing of motive air through the eductor nozzle will produce a vacuum in the eductor inlet, which will help draw the PAC and air into the mixing zone directly downstream of the mouth. The PAC will be transported through the piping system and is distributed to an array of injection lances to evenly distribute the carbon into the existing flue gas stream to maintain Hg emissions below 1 lb/TBtu based on the flue gas flow rate, temperature and upstream Hg concentration.

The injection lances are placed in the ductwork stream before the pulse jet fabric filter (PJFF). The number of injection lances will vary based on the width of the receiving duct and the required rate of injection. Each lance will contain valves and instrumentation for verifying flow out of each lance. A marshalling cabinet will allow plant operators to access data collected from the injection lances, flue gas analyzers and other instruments on the injection system. A long residence time for the flue gas, moving through straight sections of ductwork from the injection ports to the downstream filtering equipment, is essential to remove Hg. A retention time less than two seconds is unfavorable for a PAC injection system's ability to remove Hg. The PJFF removes the activated carbon particles along with the adsorbed mercury.

System Description

1.1 System Identification

- Unit Designation — Unit 4
- System Name — AQCS Power Supply
- System Codes — APB--AC Power Supply (120/208 Volts)

  APC--AC Power Supply (480 Volts)

  APD--AC Power Supply (4160 Volts)

  APH--DC Power Supply

  API--Uninterruptible Power Supply
- File Number — 41.0804.03.M401

1.2 Function

The function of the Auxiliary Power Supply System shall be to distribute electrical power to various pieces of equipment, devices, and cabinets, and to provide overcurrent and fault protection.

1.3 Process Description

1.3.1 AC Power Supply (120/208V) (APB)

Power shall be provided to 120V single-phase and 208V three-phase loads by ac panelboards rated 120/208V, three-phase, four-wire. The panelboards shall also provide branch circuit protection and a means of disconnect for the branch circuit loads through manually operated thermal magnetic circuit breakers. Power shall be provided to the panelboards by low voltage transformers, with 480V three-phase primary (APC) and 120/208V secondary with directly grounded neutral. The system shall be designed to provide 100 percent of the required continuous loads with 20 percent spare kVA.

1.3.2 AC Power Supply (480V) (APC)

Power shall be provided to 480V three-phase loads by the following major power system components, in general:

- 4160V to 480V dry type secondary unit substation (SUS) transformers with high resistance grounded wye secondary grounding.
- 480V, 3-phase, 3-wire, metal enclosed double-ended SUS switchgear.
- 480V, 3-phase, 3-wire, motor control centers (MCCs).
- 480V, 3-phase, 3-wire, panelboards.
- 480V to 480Y/277V and 120/208V dry type transformers for lighting and receptacle loads.
- 480 Y/277V and 120/208V, 3-phase, 4-wire panelboards for lighting and receptacle loads.

The 480V secondary of the SUS transformers shall be connected high resistance grounded wye. All SUS transformers shall be indoor, dry type transformers furnished with AN or ANAF cooling rating and a 150 ^{o}C temperature rise.

The AC Power Supply (480 V) System will be designed to feed the facility's low voltage loads. Each SUS transformer and associated low voltage switchgear line-up will be sized to serve its maximum coincidental operation load. All SUS, MCCs and panelboards will be initially designed with a minimum of 20 percent spare circuit breakers.

1.3.3 AC Power Supply (4160V) (APD)

The 4160V systems shall consist of the following major components:

- One three-winding delta primary, resistance grounded wye/wye Main Auxiliary Transformer. The high voltage rating shall be 22kV and the low voltage rating 4160V to serve the Unit 4 switchgear buses A, B, C, & D.
- One neutral grounding resistor on each secondary winding of each auxiliary transformer.

The 4160V system shall also consist of the following major components:

- Four (4) 4160V metal-clad, single-ended switchgear with a main breaker on each bus connecting it to the AQC Main Auxiliary Transformer and a secondary main breaker connecting the switchgear bus to the Common AQC Reserve Auxiliary Transformer. The 4160V switchgear shall be arc resistant and of two-high construction. Two of the switchgear shall be located within the AQC Electrical Building, and the other two will be located within the FGD Electrical Building.

- 4160V cable bus.

- 4160V medium voltage circuit breakers and contactors.

- Two (2) variable frequency drives (VFD) fed from the 4160 SWGR A & B respectively. Each drive will power and control an Booster Fan motor. The VFDs will be located within the Booster Fan VFD Enclosure.

- Unit 4 cable feeds to the existing Unit 4 scrubber auxiliary systems will be abandoned. These existing Unit 4 electrical loads will be powered from the existing Unit 3 auxiliary bus. Unit 3 will use the existing Unit 4 scrubber and associated auxiliary system. These Unit 4 scrubber loads will then be powered from the existing Unit 3 auxiliary bus.

The existing 13,800V system:

- The existing 13.8 kV outdoor metal-clad, switchgear shall be modified with an extension to feed the Common AQC Reserve Transformers. The Common AQC Reserve transformers have a 4160V secondary which will provide reserve power to the Unit 4 AQC 4160V Switchgear A, B, C, and D.

- 13.8 kV cable in underground duct bank from the existing 13.8kV switchgear to the Common Reserve Auxiliary Transformers..

- Reference Common system AQCS Reserve Power Supply system description: 41.0804.3.MC01 for additional detail.

1.3.4 DC Power Supply (APH)

The DC Power Supply System will consist of 125VDC lead acid station batteries, two (2) full-capacity redundant solid-state chargers per battery and a Main distribution panel.

The DC Power Supply System will consist of a station battery system located in a dedicated battery room. The system will utilize flooded type batteries with trays under the batteries. These batteries will provide DC power to the plant DCS, critical FGD System loads, and control power for the auxiliary electrical system equipment. The battery will be connected to a main distribution panel and continuously charged by two fully redundant battery chargers.

Under normal conditions, the battery chargers supply dc power to the dc loads. The battery chargers receive 480VAC power from the motor control centers. The chargers will continuously float-charge the battery while supplying power to the dc loads. Under abnormal or emergency conditions when 480VAC power is not available, the battery supplies dc power to the dc loads. Recharging of discharged batteries occurs whenever 480VAC power becomes available. The rate of charge is dependent upon the characteristics of the battery, battery chargers, and the connected dc load during charging. Each station battery charger shall be capable of charging the fully discharged battery within 8 hours with battery load present.

The battery will be located in a dedicated battery room that is a space conditioned area so that suitable temperatures can be maintained, thus helping to ensure long battery life. Battery temperature for sizing calculations shall be 77^{o}F. The battery shall be sized in accordance with IEEE 485. An exhaust fan(s) shall be furnished for limiting the concentration of hydrogen gas in each battery room. The equalizing voltage shall be used to determine the hydrogen gas emission for fan sizing. Climate control and exhaust fans shall be provided that are suitable for the environment.

1.3.5 Uninterruptible Power Supply (API)

A UPS shall be provided in the AQC Electrical Building for Unit 1. The UPS shall provide reliable power to the control system equipment, other equipment needing a regulated power supply, and other critical equipment needing a reliable power supply. . The UPS system shall be able to handle full load capacity for four (4) hours.

One (1) 120V AC Main UPS Distribution Panel shall be mounted with the chargers and UPS inverter. The panels shall be mounted within the AQS Electrical Building.

A120-208V AC distribution panel for the instrumentation shall be located in the AQC Electrical Building. This distribution panel shall be fed from a 480V:120-208V isolation transformer. The isolation/regulating transformer will regulate the output voltage and provide isolation and noise attenuation based on normal AC input. The voltage regulation shall be + - 1% with -10% to +20% input variation.

Each transformer will be fed from an automatic transfer switch (ATS) which will be fed from each of the 480V MCCs in the building. The ATS shall consist of a double throw power transfer switch mechanism and microprocessor controller of the same manufacturer to provide automatic operation. The ATS shall be switched automatically via voltage sensing and have the capacity to be transferred manually both locally and remotely. The distribution panels shall include circuit breakers in series with fast acting fuses for branch circuit protection.

Each UPS and isolation/regulating transformer shall include 20% spare capacity and distribution panelboards shall have 20% spare branch breakers/fuses for future use by the Purchaser.

1.4 Reference Drawings

- Conceptual Overall One Line – Unit 1: 168908-M4DE-E1004
- Conceptual Overall One Line – Common: 168908-MCDE-E1005

System Description

1.1 System Identification

- Unit Designation — Unit 4
- System Name — Communication
- System Code — CMA
- File Number — 41.0804.3.M402

1.2 Function

The function of the Communication System shall be to provide station personnel with a reliable and convenient means of plant paging and party line communications, and to provide raceway and other provisions for telephone/LAN wiring and equipment and closed circuit television (CCTV).

1.3 Process Description

The Communication System shall include microprocessor-based page/party equipment, raceway, and page/party communication cable as manufactured by Gai-Tronics Corporation. The new microprocessor-based system shall be fully adaptable to the existing system installed at Mill Creek Unit 4 and shall provide self-diagnostic monitoring of the new system for system integrity. The page/party equipment shall provide two-way voice communication on each party line and shall utilize a page line for voice transmission over a plant-wide speaker system. While a conversation is taking place on a party line, other conversations may be held on other party lines or the page line. Each page/party handset station shall have five party lines and one page line. Page/party handset stations and speakers shall be strategically located throughout the plant site. The power supply for the page/party equipment shall be 120 volts ac, from the normal AC System.

The new system shall interface with the existing Mill Creek Unit 4 system.

Raceway and space provisions for telephone/LAN equipment and CCTV shall be provided. Base equipment shall be located in the common control room and peripheral equipment shall be strategically located.

System Description

1.1 System Identification

- Unit Designation — Unit 4
- System Name — Control and Monitoring
- System Code — COA
- File Number — 41.0804.3.M403

1.2 Function

The existing Honeywell Experion Distributed Control System (DCS) will be expanded to incorporate control and monitoring of the new AQCS and FGD wet scrubber equipment. Also, the existing Unit 4 Scrubber DCS will be switched over to Unit 3 DCS. The resulting DCS shall provide a means to control in manual and automatic the AQCS equipment individually, as well as in coordination with other plant systems. The DCS shall be central to all plant operations and control the various systems and subsystems, including those required for the new AQCS and FGD wet scrubber equipment. The existing DCS will be the central location in the plant for alarm management, historical data archiving, report generation, and data trending. The primary operator interface to the DCS shall be the existing Unit 4 workstations located in the Mill Creek Main Control Room. The existing unit protection system will be retained in the existing DCS to protect critical plant equipment, including critical Booster fan and draft system interlocks.

No local operator stations are included in the conceptual design for the AQCS areas.

- The new AQCS and FGD wet scrubber DCS shall consist of extending DCS universal control networks (UCNs) 03 and 13, and addition of new high performance managers (HPMs) to control the new AQCS and fGD wet scrubber equipment. The AQCS and FGD wet scrubber DCS equipment shall communicate by means of redundant UCN data highways.

The AQCS DCS equipment shall include the following major components:

- Redundant UCNs.
- Redundant HPMs.
- DCS system cabinets and input/output (I/O) cabinets.

The existing Unit 4 Scrubber DCS equipment to switch over to Unit 3 DCS shall include the following major components:

- HPM 25 to UCN 03
- HPM27/28 to UCN 13

1.3 Process Description

The AQCS and FGD wet scrubber DCS control processors in the HPM shall contain the control logic for the AQCS equipment. Analog control loop logic and discrete logic shall be implemented in the redundant control processors. The Main Control Room DCS operator interface equipment shall be used as the means to control and monitor plant AQCS and FGD wet scrubber processes and process equipment. The DCS configuration will provide interface to all AQCS and FGD wet scrubber processes and equipment from either the Unit 4 designated operator workstations.

The AQCS and FGD wet scrubber DCS equipment shall interface with the existing DCS to allow retrieval of historic plant data, trend process parameters, and to develop specialized displays of plant information. The operator graphics shall be developed based on the AQCS and FGD wet scrubber systems to be controlled, and displayed in a hierarchical format.

The configuration of the AQCS and FGD wet scrubber DCS equipment shall take into account redundancy wherever the failure or loss of a component could cause plant upset or loss of generation capacity. Total control processor loading for all required control parameters and communication functions shall be limited to no more than 80 percent loading on each redundant pair. Each input/output cabinet shall contain 20 percent installed spare modules to allow for future expansion.

DCS HPM processor and I/O cabinets shall be located in space-conditioned rooms in the following locations to allow control and instrument cabling to be managed within buildings, minimizing the amount of cable installed between buildings:

- Unit 4 AQCS Electrical Building.
- Unit 4 FGD Electrical Building
- Common Reserve Power Distribution Center (PDC).

Control processors, power supplies, input/output cards, and other associated hardware shall be a common form factor to provide flexibility of mounting individual control system devices on common rack or carrier. Process controllers, input/output modules, mounting racks or carriers, communication hardware, power supplies, ventilation fans, and other required accessories shall be housed in industrial enclosures with NEMA rating appropriate for the mounting location of the cabinet.

System Description

1.1 System Identification

- Unit Designation: Unit 4
- System Name: Lighting
- System Code: LTA
- File Number: 41.0804.3.M404

1.2 Function

The function of the Lighting System is to provide station personnel with illumination for station operation under normal conditions, egress under emergency conditions, and emergency operational lighting to perform tasks during a power outage of the normal source. The permanent lighting may be used for construction lighting in areas where early installation is practical. Additional construction lighting shall be provided using temporary luminaires and construction power distribution grid. The system also provides 120 volt convenience outlets for portable lamps and tools.

1.3 Process Description

Luminaires for areas with finished acoustical ceilings, if any, shall be fluorescent static troffers. The lighting system for continuously occupied control rooms shall utilize the same type static troffer, except with a dimming ballast and 1/2 inch square louvered low iridescent parabolic diffuser for glare control. Fluorescent lamps shall be energy effiicent 3000K, T8 and not exceed four feet and shall be low mercury content. Ballasts shall be energy efficient electronic type with less than 10 percent harmonic content.

Low bay, wall and stanchion mount luminaires shall be used in outdoor areas and unfinished, hazardous and non-hazardous, enclosed areas of the station. Metal halide luminaires shall be used in the industrial and high bay areas of the plant. Metal halide luminaires shall comply with the Energy Independence and Security Act of 2007, and therefore, all metal halide ballasts and lamps 400 watts and under shall be pulse start metal halide type. Except for high bay areas, pulse start metal halide luminaires shall be enclosed and gasketed with threaded glass refractors. Luminaires located in hazardous areas shall be Underwriters Laboratories (UL), or other North American third party testing lab, listed for the National Electrical Code (NEC) classification. High bay luminaires shall be enclosed and have aluminum or glass reflectors. Luminaires in wet locations or in wash down areas shall be in National Electrical Manufacturers Association (NEMA) 4 enclosures. Approximately 25 percent of the non-hazardous industrial area metal halide luminaires shall be provided with a quartz auxiliary lamp option to provide immediate illumination upon starting and restrike conditions.

Emergency lighting shall be provided for interior building egress paths, interior stairways, selected areas around electrical equipment, and local control room. The emergency lighting luminaires for the plant areas shall be powered from individual battery pack units with halogen lamps. Emergency lighting shall provide 90 minutes of operation per the NFPA Life Safety Code 101. Emergency operational lighting for control room area lighting shall be powered by connecting selected fluorescent luminaires to the plant UPS system.

Exit light luminaires shall use light emitting diode (LED) lamps for most areas, with compact fluorescent lamps used in hazardous rated areas, and shall be located in the egress pathways and ground level exit doors of enclosed buildings. The exit luminaires shall be powered from normal ac power and integral batteries for emergency service.

Roadway luminaires shall be pulse start metal halide, cutoff cobra head type mounted on aluminum or galvanized steel poles with helix steel or concrete anchor foundations.

Power used to supply fluorescent and pulse start metal halide luminaires shall be 277 volt ac, except for the possible use of 120 volt ac power for some small remote buildings where 277 volt ac power is not readily available or economically feasible. Luminaires shall be powered from the panelboards, with alternate luminaires or rows of luminaires fed from alternate panelboard circuit breakers. Power used to supply convenience receptacles shall be 120 volts ac. Power used to supply roadway and area lighting shall be 480 or 277 volts ac.

Lighting is not required for roof top PRVs. However, one 120 volt ac ground fault current interrupter receptacle shall be installed on the roof and suitable for access to all the PRV's. A photoelectric controlled light fixture shall be installed near any roof top access doors.

Convenience receptacles shall be grounded duplex type and located throughout the station. The convenience receptacles shall be a minumum of 15 inches above the floor in office areas and 36 inches above the floor in industrial areas. The convenience outlets shall be spaced, at the same elevation, to provide access to any point in the industrial areas with a 100 foot extension cord. Convenience outlets for use without extension cords shall be located in finished areas such as offices, control room, and laboratory. Each outlet shall have the grounding pole located at the top of the device. Each office shall have a minimum of two receptacles on opposite walls. No more than eight receptacles shall be connected to a branch circuit breaker. Receptacles shall be circuited to alternating circuits within an area. Weatherproof snap action covers shall be installed on all receptacles located outdoors and in wet indoor areas. In general, receptacles for outdoor and plant indoor wet areas shall be standard 125 volt, 20 amp, 2-pole with ground, NEMA 5-20R type. Selected receptacles in finished and industrial areas shall have GFCI protection in accordance with the NEC. In areas with hazardous atmospheres, convenience outlets shall be suitable for the NEC class, division, and group requirements.

Operation of the Lighting System is dependent upon the visual requirements of the station operating personnel. The general lighting for interior process areas shall be manually switched on and off at panelboard circuit breakers. The lighting for smaller enclosed areas within the buildings shall be manually switched on and off at local light switches near personnel entrance doors. The OFF position of the toggle switch shall be in the downward position. The lighting for continuously occupied control rooms shall be controlled from dimmer switches. The exterior process area lighting shall be controlled through common contactors that automatically operate between sunset and sunrise via photoelectric controllers. The lighting contactors shall have a hand-off-auto (HOA) switch for daytime maintenance override. Luminaires with integral photocells shall be provided for roadway luminaires and luminaires at exterior personnel entrances only. Separate photo-electrically controlled electrically held lighting contactors with a HOA switch shall be provided for exterior lighting in different areas of the plant.

Luminaires shall be installed at a minimum height of 7 feet 0 inches above the floor to provide an unobstructed way of exit travel from any point in the buildings. Luminaires shall be designed and installed with consideration for maintenance and access. Luminaires shall be installed in locations where maintenance shall not be blocked by structural steel, piping, raceway, grating, etc.

Lighting cable powered from 277 volt ac and all branch circuits installed outdoors shall be XHHW-2 . All 120 volt ac branch circuits installed indoors in heated spaces shall be THHN cable. Pre-assembled and prewired cable assemblies shall be used only in finished environments.

Lighting and receptacle branch circuit voltage drop shall not exceed 3%. This shall include the voltage drop from the last outlet in the branch circuit to the lighting panelboard. In addition, 120 volt branch circuits longer than 75 feet shall use 10 AWG and 277 volt branch circuits longer than 200 feet shall use 10 AWG conductors.

General access interior structure lighting for permanent structures required during construction shall be provided using the permanent luminaires connected to the construction power grid, where practical. Any additional lighting required for construction operation shall be provided by the construction contractor.

The Lighting System shall comply with the regulatory requirements of Occupational Safety and Health Administration (OSHA) and applicable building codes.

Lighting shall be designed in accordance with the Illuminating Engineering Society of North America (IESNA) to provide the illumination levels recommended by the following standards and organizations:

- American National Standards Institute (ANSI)/IESNA RP-7, Industrial Lighting.
- ANSI/IESNA RP-8, Roadway Lighting.

- OSHA.
- National Fire Protection Association (NFPA), National Electric Code (NFPA 70).
- NFPA, Life Safety Code (NFPA 101).
- Local Building Code (latest adopted version).

The following criteria shall also be considered in the lighting system design:

- Illumination calculations shall be based upon the mean lumen output of the respective lamps (lamp lumen depreciation [LLD]).
- Illumination calculations shall be based upon a luminaire dirt depreciation (LDD) factor.
- Interior illumination calculations shall be based upon a room surface dirt depreciation (RSDD) factor.
- Illumination calculations shall be based upon the luminaire ballast factors of the light fixtures utilized in the design.
- The illumination calculations shall be determined at a 30 inch workplane height above the floor.

System Description

1.1 System Identification

- Unit Designation — Unit 4
- System Name — Buildings and Enclosures
- System Code — BSA
- File Number — 41.0804.3.M405

1.2 Function

The function of the Buildings and Enclosures System will be to provide support, enclosure, and access to the systems contained within each structure's boundaries.

1.3 Description

The various structures associated with the Buildings and Enclosures will generally consist of the following six components:

- Foundation--provides support and carries the loads to the subsurface.
- Structural frame--provides support for the contained systems and stability for the entire structure.
- Architectural--provides isolation of systems, enclosure, and protection from natural phenomena, where required, through walls, partitions, ceilings, and roofs.
- Access--provides means of ingress and egress and allow for access to the contained systems and equipment through doors, stairs, floors, elevators, cranes, and hoists.
- Space Conditioning -- provides the required heating, ventilating and air conditioning for the buildings.
- Drains and Plumbing--provides plumbing, floor and equipment drains and floor trenches and sumps for the enclosed equipment and facilities.

The buildings and structures will be designed to accommodate the function and arrangement of the systems they enclose. Building arrangements will take into consideration maintenance and operating access requirements as well as the equipment itself. Suitable design features will be provided to prevent or contain oil or chemical spills where appropriate. All occupied buildings will be designed to meet NFPA 100 Life

Safety egress requirements. Administrative areas will be designed in accordance with the Americans with Disability Act Accessibility Guidelines (ADAAG) requirements, but operating and maintenance areas throughout either site will not be required to meet ADA requirements.

HVAC systems will be designed to maintain the indoor conditions suitable for the equipment and operations enclosed under the design ambient conditions in the Project Design Memorandum for the Project site. Ventilation, heating, and cooling equipment will be located to ensure relatively uniform temperature distribution throughout the space. Air conditioning for control and electrical equipment will be designed to meet appropriate filtration levels and noise criteria. Fire protection systems meeting appropriate NFPA and building code requirements will be provided for each building where required.

Two different arrangements of the new equipment proposed for Phase II have been developed and both remain under consideration. The impact on existing structures in the Unit 4 area will be different depending on the arrangement ultimately selected. For that reason a description of each arrangement and the new structures will be presented separately.

1.4 Unit 4 Arrangement A

In Arrangement A the new equipment proposed by Phase II is located along a north-south axis extending south of the existing Reagent Preparation Building. This arrangement includes a PJFF (two 50% units), a Unit 4 Fly Ash Handling Building, a Unit 4 AQC Electrical Building, two new booster fans and a supporting Fan VFD Enclosure, a wet FGD module and associated Pump and Electrical Buildings, and a new Unit 4 Chimney. To install the new equipment in this location the existing ammonia storage facility and an associated electrical building must be relocated.

1.4.1 Unit 4 PJFF Structure

The Unit 4 pulse jet fabric filter(s) need not be installed at an elevation higher than grade. Accordingly, no separate superstructure beyond that supplied as part of the PJFF itself is required. A concrete foundation supported on drilled piers will be provided for the PJFF similar to any other piece of furnished “equipment” such as the booster fans or the chimney.

1.4.2 Unit 4 Fly Ash Handling Building

The Unit 4 Fly Ash Handling Building will house the new fly ash handling equipment required for Unit 4, as well as the equipment for the AQCS Compressed Air System. The Ash Handling Building is intended as a single story pre-engineered metal building on a concrete foundation. The concrete foundation will be supported or drilled piers or micropiles and will contain equipment pads for mounting of equipment. The superstructure will consist of steel framing enclosed with insulated metal panel walls and roof. The interior will be of unfinished construction. Personnel and overhead doors will be located and sized to access equipment for maintenance as well as provide personnel access. HVAC will include heating and ventilation, except as otherwise required by specific equipment.

1.4.3 Unit 4 AQCS Electrical Building

The Unit 4 AQCS Electrical Building will house additional electrical and control equipment serving the new PJFF and the booster fans. The Electrical Building is intended as a single story pre-engineered metal building mounted to a small foundation with a floating interior slab. For purposes of the Unit 4 estimate, drilled piers or micropiles were assumed under the columns of the building to minimize excavations and impact to existing undergrounds, but shallow soil-supported foundations may be deemed acceptable at time of detailed design. The superstructure will consist of steel framing enclosed with insulated metal panel walls and roof. The interior will be of unfinished construction and doors will be located and sized to access equipment for maintenance as well as provide personnel access. HVAC will be as required for the equipment enclosed, but will at minimum include heating and ventilation. The building is intended as a “dry” enclosure and floor drains will be minimized.

1.4.4 Unit 4 Booster Fan VFD Enclosure

The VFD Enclosure houses the variable frequency drive equipment serving the two new Unit 4 booster fans. The enclosure is intended to be a pre-manufactured enclosure furnished complete with equipment installed. The prefabricated structure will be placed on a shallow foundation with necessary utilities and services provided for tie-in to the enclosed equipment. The structure will be furnished with necessary HVAC appropriate for the enclosed equipment and doors pre-installed

1.4.5 Unit 4 Wet FGD Module and Associated Buildings

The wet flue gas desulfurization module is expected to be furnished as an item of field-assembled “equipment” and the module itself will not require a separate enclosure. However, the slurry recirculation piping, pumps, and associated support equipment located outside the module are normally housed in a separate enclosure. Electrical power and control equipment required for the FGD system is also normally provided its own separate enclosure outside the module. Final arrangement of these three structures will be determined at time of detailed design. However, the general description of the FGD Pump Building and FGD Electrical Building are as follows.

To enclose the elevated portions of the recirc piping, the FGD Pump Building is expected to be a multi-level “stick-built” (individually designed and site constructed) steel frame building. Framing will be enclosed in insulated metal wall and roof panel. Reagent preparation will be completed in the existing Reagent Prep Building, thus no ball mills or dry limestone conveying will be housed in the building. Similarly, gypsum dewatering will be completed elsewhere and equipment enclosed will primarily support slurry handling and reclaim operations. Pumps and other heavy equipment will be concentrated at ground level within the building, with the majority of elevated floors consisting of grating.

The Pump Building will house an enclosed stairwell for primary access plus an exposed secondary stairwell as the second means of egress. An elevator and a material/equipment hoist will provide additional access for personnel and material to elevated floors. As a custom designed building, doors and maintenance aisles will be located to match the equipment arrangement and drop areas. The building will be heated and ventilated, but air conditioning is not expected to be required. The interior will be of unfinished construction. Due to the relatively isolated location of the Unit 4 FGD area, it is assumed that a single unisex toilet and washroom will be provided in the Pump Building, with potable water supply and a sewage lift station to forward sewage to the existing onsite sanitary facilities.

To avoid plugging of floor drains with spilled slurry or gypsum, non-sanitary building drainage will be accomplished with floor trenches with removable covers for cleaning. Trenches will be directed to a common sump provided with baffles to allow collected water to “decant” to the plant drains system, leaving the majority of solids behind.

The FGD Electrical Building will house the electrical and control equipment serving the new FGD process. Although the electrical equipment is sometimes located within a separate room in the FGD Pump Building, the expense of the extra stick-built room usually makes a separate single story pre-engineered metal building preferable. The foundation is expected to consist of a drilled pier foundation enclosing a floating slab. The superstructure will consist of steel framing enclosed with insulated metal panel walls and roof. The interior will be of unfinished construction and doors will be located and sized to access equipment for maintenance as well as provide personnel access. HVAC will be as required for the equipment enclosed, but will at minimum include heating and ventilation. The building is intended as a “dry” enclosure and floor drains will be minimized.

1.4.6 Existing Ammonia Storage Station

The equipment as located for Arrangement A will require that the existing ammonia receiving and storage facility be relocated. This includes the unloading, storage, and containment structure as well as the adjacent electrical structure serving the ammonia equipment. Both of these buildings consist of concrete foundations with pre-engineered metal building superstructures; an enclosed building in the case of the electrical structure and a partially enclosed “pole barn” over the ammonia storage facility itself.

For purposes of the estimate, it is assumed that new concrete foundations will be required for these buildings in the area to which they will be relocated. The foundations will be shallow footing foundations, with curbing as containment around the ammonia tanks. The ammonia tanks themselves will be mounted on separate concrete saddle-type soil-supported footings. The existing superstructures for both these buildings will be relocated to the new foundations and the existing foundations demolished as required to support new construction.

1.5 Unit 4 Arrangement B

In Arrangement B the new equipment proposed by Phase II is located along an east-west axis located south of the existing Unit 4 Boiler Building. This arrangement includes the same PJFF (two 50% units), Fly Ash Handling Building, AQC Electrical Building, two new booster fans and Fan VFD Enclosure, wet FGD module and associated Pump and Electrical Buildings, and new Chimney as Arrangement A. To install the new equipment in this location the existing Unit 4 Aux Boiler Building, Sample Lab, and Office Annex Building must be relocated or demolished. In addition the existing Unit 4 Scrubber Switchgear Building, which will remain in service for Unit 3, must be accommodated in the arrangement

1.5.1 Unit 4 PJFF Structure

To avoid relocating the Unit 4 Scrubber Switchgear Building, the Unit 4 pulse jet fabric filter(s) will be installed on an elevated structure spanning the building. The remaining area under the elevated structure will be reserved for the new Unit 4 Fly Ash Handling Building and the Unit 4 AQC Electrical Building. The elevated structure will be unenclosed and will consist of a structural steel superstructure mounted on a concrete foundation. The concrete foundation will be supported on drilled piers located beneath the columns supporting the structure.

The steel superstructure will consist of braced-frame construction supported on a series of steel columns. The steel framework will be topped with a steel deck supporting a six-inch nominal thickness concrete slab to be used as the working floor for the PJFF. The elevation of the superstructure will clear the top of the existing Switchgear Building, requiring no significant changes to the existing building. Steel stair towers at the northeast and southwest corners of the structure will allow personnel access to the working floor level. The structure will be designed to accommodate the maintenance hoists supplied with the PJFF, allowing replacement bags and maintenance material to be transported from grade. The working floor and any large penetrations will be surrounded by handrail for safety. As an unenclosed structure, no heating or ventilation will be required.

1.5.2 Unit 4 Fly Ash Handling Building

The Unit 4 Fly Ash Handling Building for Arrangement B will essentially be the same as that described for Arrangement A and will be located under the PJFF support structure.

1.5.3 Unit 4 AQCS Electrical Building

The Unit 4 AQCS Electrical Building for Arrangement B will essentially be the same as that described for Arrangement A and will be located under the PJFF support structure.

1.5.4 Unit 4 Booster Fan VFD Enclosure

The VFD Enclosure for Arrangement B will be the same as that described for Arrangement A.

1.5.5 Unit 4 Wet FGD Module and Associated Buildings

The WFGD Module and associated Pump Building and FGD Electrical Building will essentially be the same as that described for Arrangement A, although orientation and arrangement may differ.

1.5.6 Existing Unit 4 and Site Support Structures

Installation of Arrangement B will require relocation or demolition of the Aux Boiler Building, Sample Lab, and Office Annex Building to make way for new construction. The auxiliary boiler in the Aux Boiler Building has previously been removed and only the shell of the building remains. This building will be demolished and not replaced.

Both the Sample Lab and the Annex Building are of masonry construction on concrete foundations, and salvage or relocation of these structures would be problematic at best. Accordingly, new structures will be erected as replacements and these structures will be demolished. The tentative location of these structures is in the area north of the Unit 2 Boiler Building currently occupied by the existing warehouse. The existing warehouse would then be replaced with a new warehouse and loading dock located in the lower-tiered area between the coal delivery loop and the Unit 2 cooling tower.

At time of detailed design, further investigation will be required to determine the feasibility of remodeling the existing warehouse shell for use as a combined Lab and Annex facility. For purposes of the estimate, it is assumed that the existing warehouse will be demolished in favor of two new buildings housing the Sample Lab and Office Annex functions. These two buildings are assumed as single-story pre-engineered metal buildings each occupying the same footprint as the corresponding existing building. Both buildings will be provided with finished interiors, full HVAC suitable for continuous manned structures, and will be designed per ADAAG requirements. The new warehouse will also be assumed for purposes of the estimate to be a new tall single-story pre-engineered building of the same size as the warehouse being replaced. A concrete loading dock will also be included as part of the new warehouse foundation.

System Description

1.1 System Identification

- Unit Designation Unit 4
- System Name Fly Ash
- System Code ASB
- File Number 41.0804.3.M406

1.2 Function

The Fly Ash System will pneumatically remove fly ash from the pulse jet fabric filter (PJFF) hoppers. In addition, the ash handling system will handle powder activated carbon (PAC) and sorbent (trona/lime) which are injected upstream of the PJFF and collected in the PJFF hoppers. The collected fly ash byproducts will be conveyed to the existing west silo or a new fly ash silo. The process is shown on drawing 168908-M4ASB-M2022: Fly Ash, Unit 4.

1.3 Process Description

The Fly Ash System includes the following major equipment and components:

- Fly Ash feed valves.
- Fly Ash conveying equipment.
- New Fly Ash Transfer Tank.
- West fly ash silo (existing) and new fly ash silo

A new Fly Ash System shall service all the PJFF material collection hoppers. Each PJFF hopper in the Fly Ash System shall be tied to a new pneumatic vacuum conveying system via branch lines under each hopper row. Each hopper will be equipped with a manual hopper isolation valve and new automatic feed valve. The automatic feed valves will isolate the hopper being emptied and provide a controlled flow of fly ash into a branch conveying line(s) servicing a row of hoppers. The branch lines will convey ash to either of two (2 x 50%) main vacuum lines. Note that the percentage indicated represents the design rate not the ash production rate of the boiler at MCR. The design rate is equal to two times the ash production rate. Each vacuum line will be equipped an exhauster blower assembly. Both exhausters can operate concurrently or as a backup for the other when operating one of the two lines. The vacuum conveying lines will sequentially remove ash from the PJFF hoppers or from the SCR hoppers and transfer the ash to two filter separators above the new Unit 4 Fly Ash Transfer Tank. From the tank, ash will be transported to the west silo or to a new fly ash waste silo via a new pressure conveying system utilizing two (2 x 50%) pressure conveying lines, similar to the existing system. Each pressure conveying line will be supplied with a pressure blower assembly. Branches from the main pressure lines may be added to connect the line to the east silo for additional storage flexibility. Unit 4 ESP ash will continue to be conveyed to the east silo which is designated for saleable ash or to the west silo by the existing ash handling system. The existing west silo connection will not be disabled to provide an alternate destination for the ESP ash if the east silo is unavailable. A new ash silo for all units will provide additional site capacity for non-saleable ash and will include a new fluidizing system, bin vent, new ash conditioners, and a dry ash telescoping spout.

Two alternate arrangements for Unit 4 are currently under consideration: Arrangement A with the AQC train on a north-south axis and Arrangement B on an east-west axis. The location of the PJFF and the amount of ductwork and conveying line will differ between the two arrangements, which may result in design detail differences in the fly ash conveying system for the two arrangements.

In Arrangement A, the new PJFF is located well south of the existing Unit 4 ESP Fly Ash System and the duct upstream of the PJFF is relatively long, with several changes in elevation. This may result in additional ash pickup points in the ductwork and will likely result in a significantly longer transfer distance

For Arrangement B, the location of the new PJFF is relatively close to the existing Unit 4 Fly Ash System and Ash Transfer Tank, plus the new ductwork upstream of the PJFF is relatively short.

The final orientation and composition of the Unit 4 Fly Ash System will be determined at time of detailed design pending the Unit 4 arrangement selected.

System Description

1.1 System Identification

- Unit Designation — Unit 4
- System Name — Induced Draft
- System Code — CCE
- File Number — 41.0804.3.M407

1.2 Function

The Induced Draft System, in conjunction with the steam generator forced draft fans, provides the static pressure required to induce the flow of combustion gases from the steam generator furnace through the gas path to the stack. The system includes the capability of controlling the flue gas flow rate to maintain furnace draft over the specified load range.

1.3 Process Description

The Induced Draft System will consist of the following major components.

- Two existing, 50 percent nominal capacity, centrifugal induced draft (ID) fans using variable speed operation as the primary means of flow control accomplished through the use of hydrokinetic fluid drives mounted between single-speed motors and fans.

- Two new 50 percent nominal capacity, centrifugal booster fans using variable speed operation as the primary means of flow control accomplished through the use of variable frequency drives.

- New, direct-drive induction motors designed for the full booster fan capacity and operation with variable frequency drives.

- New variable frequency drives designed for the full booster fan capacity.

- New couplings for each booster fan to transmit the rotational energy from the new motors to the fan. Couplings will be an elastomeric type designed to limit the transmission of VFD generated coupling vibration.

- New booster fan lubricating oil units.

- New booster fan inlet dampers and damper drives that will be used as a means of secondary flow control.

- New ID fan discharge dampers and damper drives.
- Associated new and existing ductwork and expansion joints upstream and downstream of the ID and booster fans.
- Associated new and existing piping, valves, instruments, controls, and accessories.

The ID fans will induce flow of the combustion gases through the steam generator, selective catalytic reduction (SCR) system, regenerative air heaters, and electrostatic precipitators. The new booster fans will then induce flow of the combustion gases through the new pulse jet fabric filter (PJFF) located downstream of the existing ID fans. The new booster fans will also provide sufficient pressure to exhaust the combustion gases through the new wet flue gas desulfurization (WFGD) scrubber and the new wet stack. The ID fans and new booster fans would also be used during the steam generator and associated equipment and ductwork purging cycle prior to firing fuel in the furnace or after the steam generator is shut down.

These new centrifugal booster fans will have variable speed capability, using variable frequency drives, that will be used as the primary means of exhaust gas flow control over the unit operating load range. Each of these new fans will be designed for direct connection through an elastomeric coupling to a new motor and associated variable frequency drive. The variable frequency drives will be used to control the speed of the motors and fans depending on the desired capacity from the plant control system. The system will control the ID fans to maintain the furnace pressure at a predetermined value. The system will control the booster fans to maintain the duct pressure between the outlet of the ID fans and the inlet of the new PJFF at a predetermined value. During a severe transient, such as a loss of fuel, the system will be capable of responding to the commands from the Distributed Control System (DCS) in such a manner as to avoid any damage from a negative pressure transient in the steam generator and other draft system components.. The secondary means of flow control, the inlet dampers, may need to be used in this case.

In conjunction with the forced draft, primary air fans, and ID fans combustion flue gas will flow from the PJFF outlet to the inlet duct of each booster fan. The booster fans will be sized to achieve 60 percent of the MCR condition with one booster fan in service. The booster fans will discharge into a ductwork header which will exhaust combustion flue gas through the new WFGD scrubber and new wet stack to the atmosphere.

Expansion joints will be provided in the new ductwork where required to accommodate movements due to thermal expansion and contraction. This will prevent detrimental stresses in the ductwork, deformation, or failure of structures or equipment due to thermal expansion. Inlet and outlet isolation dampers and a forced lubrication oil unit are provided with each booster fan. The booster fan sound level is attenuated by the use of insulation and lagging of the booster fan casings.

The new and existing ductwork will continue provide a flow path from the outlet of the steam generator to the SCR system, the air heaters, the electrostatic precipitator, the ID fans, the new PJFF, then to the new booster fans, and exiting the booster fans to the new WFGD scrubber and new stack.

System Description

1.1 System Identification

- Unit Designation — Unit 4
- System Name — Pulse Jet Fabric Filter
- System Code — CCB
- File Number — 41.0804.3.M408

1.2 Function

The Particulate Removal System will collect particulate matter from the boiler flue gas stream on filter bags. Particulate matter will also be collected from the powder activated carbon (PAC) and sorbent injection systems in ductwork upstream of the pulse jet fabric filter. The collected particulate will be stored in hoppers until removed by the Fly Ash Handling System.

1.3 Process Description

The Particulate Removal System will include the following major equipment and components:

- Pulse Jet Fabric Filter (PJFF) casing with inlet and outlet transition ducts and expansion joints.
- Fabric filter compartment inlet, outlet dampers, and casing bypass dampers along with seal air system.
- Fabric filters bags and cages.
- Air pulse cleaning system, including headers, valves, and controls.
- Compressors, air driers, and air receivers with 100 percent spare capacity
- Hoppers, including heaters, level detectors, and ports for hopper fluidizing system.
- Permanent and mobile pre-coating system
- Insulation and lagging of fabric filter housing.
- Walk-in or Top door plenum to allow access to the tube sheet for inspection, and maintenance.
- Weather enclosed penthouse with lighting and ventilation.
- Electric hoist on the exterior penthouse level to lift boxes of bags and cages to the penthouse level for maintenance purposes.
- Access provisions required for maintenance, including hoists.
- Associated piping, valves, instruments, controls, and accessories.

The Particulate Removal System consists of compartmentalized PJFF located between the sorbent injection lances and the inlet of the booster fans. The number of compartments is determined by economic compartment sizing, total flue gas flow rate, air-to-cloth ratio, and cleaning system design. The PJFF will be designed with a spare compartment.

Under normal operation, flue gas enters the fabric filter inlet plenum and is distributed to the individual compartments through inlet dampers at each fabric filter compartment. Flue gas will pass upwards through the filter bags where the particulates within the gas stream will collect on the outside of the filter bags and the clean gas exits each fabric filter compartment through an outlet damper into fabric filter outlet plenum. To prevent collapse of the bag, a metal cage is installed on the inside of the filter bags. Filter bags and cages are suspended from a tube sheet at the top of the compartment. Each individual compartment will be provided with inlet and outlet isolation dampers for access or maintenance.

The collected particulate will be cleaned from the filter bags by suddenly inflating the filter bags with a pulse of compressed air over several rows of filter bags, causing the dust on the outside to separate from the bags and drop into hoppers below. The pulsing system will have optimum flow geometry and will be designed with no mechanically actuated parts or acoustic systems that are required to operate for the pulse air cleaning process. The cleaning frequency will be regulated by the control system based on overall fabric filter pressure drop. Online or isolated mode of cleaning of fabric filter will also be regulated by the control system. The fabric filter will be pulse-cleaned utilizing clean, dry, oil free, compressed air supplied by pulse jet air compressors and associated air receivers and dryers.

The dust collected in the fabric filter discharge hoppers will be fluidized and removed by the Fly Ash Handling System. The flue gas from the outlet plenum of the fabric filter will flow through the booster fans and then to the Wet Flue Gas Desulfurization System.

The PJFF shall be designed to achieve particulate matter emissions of 0.01 lb/MBtu. The fabric filter shall be designed to allow for continuous, reliable operation of the boiler at the maximum flue gas flow rate and grain loading with one fabric filter compartment removed from service for maintenance with the fabric filter net cloth velocity not exceeding 4.0 ft/s.

System Description

1.1 System Identification

• Unit Designation	Unit 4
• System Name	Neural Network
• System Code	SGM
• File Number	41.0804.3.M409

1.2 Function

Neural networks utilize a DCS based computer system that obtains plant data such as load, firing rate, burner position, air flow, CO emissions, etc. The computer system analyzes the impact of various combustion parameters on CO emissions. The system then provides feedback to the control system to improve operation for lower CO emissions.

In addition to burner performance these monitoring systems also allow continuous indication of pulverizer, classifier and fuel delivery system performance to provide early indication of impending component failures or maintenance requirements. This system is also used to improve heat rate and often provides operational cost savings along with CO control.

1.3 Process Description

The Neural Network System uses real-time operational data extracted from the plant DCS to "learn" solutions from plant operational experience to achieve reductions in the emissions produced, while possibly improving the heat rate of the plant.

Neural network computing differs from traditional computing in that engineering, statistical, and first-law principles have been replaced by complex, time-varying, nonlinear relationships. Neural networks do not presume that a relationship is known between process inputs and outputs, but rather determines the relationships by analyzing datasets of input and output.

Neural network equipment will be minimal, consisting of a few computer servers that can be located in the same room as the DCS master equipment.

System Description

1.1 System Identification

- Unit Designation — Unit 4
- System Name — AQCS Compressed Air
- System Code — CAB
- File Number — 41.0804.3.M410

1.2 Function

The Air Quality Control System (AQCS) Compressed Air Systems will provide the clean, dry, oil free compressed air at an adequate pressure and adequate capacity for the pulse jet fabric filter (PJFF), WFGD equipment, actuators, controls, instrumentation, and other air users in the AQCS addition.

1.3 Process Description

The AQCS Compressed Air System includes the following major equipment and components:

- Two full capacity air compressors.
- Two full capacity air filter/dryers.
- One air receiver.
- Distribution pipe, valve, and fittings
- Controls and instruments

Two full capacity air compressors will be provided to supply air to the air receiver. During normal operation, only one of the compressors will be in service at a time. Air from the compressors is routed to the air filter/dryers that will dry control air to a dew point of -40° F or lower before entering the air receiver. Air will be supplied from the receiver to the PJFF and other users upon demand.

Cross-ties with the existing station and instrument air systems will be installed. These will allow air from either existing system to be used to back-up the AQCS compressed air system. It will also allow AQCS compressed air to be used to back-up the existing systems. The equipment comprising the AQCS Compressed Air System is intended to be located in the Unit 4 Fly Ash Handling Building.

System Description

1.1 System Identification

• Unit Designation	Unit 4
• System Name	AQCS Service Water
• System Code	WSC
• File Number	41.0804.3.M411

1.2 Function

The Air Quality Control System (AQCS) Service Water System will extend the existing service water systems for washdown, makeup, and seal water for equipment in the AQCS areas.

1.3 Process Description

The AQCS Service Water System shall consist of the following major equipment and components:

- Washdown stations
- Distribution piping, valves, and fittings
- Controls and instruments

The source of service water shall be from a branch connection from the existing service water distribution piping. Existing service water quality will be sufficient to protect the AQCS systems.

Service water distribution piping shall supply seal and makeup water to washdown stations servicing all AQCS additions.

System Description

1.1 System Identification

- Unit Designation Unit 4
- System Name Sorbent Injection
- System Code CCH
- File Number 41.0804.3.M412

1.2 Function

The function of the Sorbent Injection System is to remove SO_3 from the flue gas by injecting sorbent into the flue gas ductwork between the ID fan outlet and the pulse jet fabric filter (PJFF) inlet.

1.3 Process Description

The Sorbent Injection System will consist of the following equipment and components:

- Two (2) sorbent storage silos with structural skirted enclosure with all necessary appurtenances.
- Three blower/feeder skid assemblies.
- Rotary valve and motors.
- Feed hoppers.
- Screw feeder and motors.
- Eductors.
- Sorbent distribution manifolds with isolation valves to each lance.
- Custom injection lances with flex hose connections.
- Associated piping, valves, instruments, and accessories.
- Controls and instrumentation.

The Sorbent Injection System will receive bulk sorbent by truck. The sorbent will be unloaded pneumatically into one of the storage silos through a stationary positive pressure dilute phase conveying system. The trucks should be equipped with their own pneumatic unloading system.

The sorbent will be fed from the silo by a rotary valve into a volumetric feeder hopper where it will be temporarily stored. The sorbent will then be conveyed by the feeder screw into the drop tube. The sorbent will be fed through the drop tube directly into the eductor inlet, located below the feeder discharge.

The passing of motive air through the eductor nozzle will produce a vacuum in the eductor inlet, which will help draw the sorbent and air into the mixing zone directly downstream of the mouth. The sorbent will be transported through the piping system and is distributed to an array of injection lances and into the boiler exhaust gas stream to maintain H_2SO_4 emissions below 5 ppmvd @ 3% O_2 based on the flue gas flow rate, temperature and upstream H_2SO_4 concentration.

The number of injection lances will vary based on the width of the receiving duct and the required rate of injection. Each lance will contain valves and instrumentation for verifying flow out of each lance. A marshalling cabinet will allow plant operators to access data collected from the injection lances, flue gas analyzers and other instruments on the injection system. A long residence time for the flue gas, moving through straight sections of ductwork from the injection ports to the downstream filtering equipment, is essential to remove H_2SO_4. A retention time less than two seconds is unfavorable for a sorbent injection system's ability to remove H_2SO_4.

System Description

1.1 System Identification

- Unit Designation — Unit 4
- System Name — Powder Activated Carbon Injection
- System Code — CCH
- File Number — 41.0804.3.M413

1.2 Function

The function of the Powder Activated Carbon (PAC) Injection system is to remove mercury from the flue gas by injecting PAC into the flue gas ductwork between the ID fan outlet and the pulse jet fabric filter inlet.

1.3 Process Description

The PAC Injection System will consist of the following equipment and components:

- Two (2) PAC storage silos with structural skirted enclosure with all necessary appurtenances.
- Three blower/feeder skid assemblies.
- Rotary valve and motors.
- Feed hoppers.
- Screw feeder and motors.
- Eductors.
- PAC distribution manifolds with isolation valves to each lance.
- Custom injection lances with flex hose connections.
- Associated piping, valves, instruments, and accessories.
- Controls and instrumentation.

The PAC Injection System will receive bulk PAC by truck. The PAC will be unloaded pneumatically into one of the storage silos through a stationary positive pressure dilute phase conveying system. The trucks will be equipped with their own pneumatic unloading system or by a secondary blower located at the silos.

The PAC will be fed from the silo by a rotary valve into a volumetric feeder hopper where it will be temporarily stored. The PAC will then be conveyed by the feeder screw into the drop tube. The variable speed motor for the screw feeder allows for adjustment of the PAC feed rate. The PAC will be fed through the drop tube directly into the eductor inlet, located below the feeder discharge.

The passing of motive air through the eductor nozzle will produce a vacuum in the eductor inlet, which will help draw the PAC and air into the mixing zone directly downstream of the mouth. The PAC will be transported through the piping system and is distributed to an array of injection lances to evenly distribute the carbon into the existing flue gas stream to maintain Hg emissions below 1 lb/TBtu based on the flue gas flow rate, temperature and upstream Hg concentration.

The injection lances are placed in the ductwork stream before the pulse jet fabric filter (PJFF). The number of injection lances will vary based on the width of the receiving duct and the required rate of injection. Each lance will contain valves and instrumentation for verifying flow out of each lance. A marshalling cabinet will allow plant operators to access data collected from the injection lances, flue gas analyzers and other instruments on the injection system. A long residence time for the flue gas, moving through straight sections of ductwork from the injection ports to the downstream filtering equipment, is essential to remove Hg. A retention time less than two seconds is unfavorable for a PAC injection system's ability to remove Hg. The PJFF removes the activated carbon particles along with the adsorbed mercury.

System Description

1.1 System Identification

- Unit Designation — Unit 4
- System Name — Chimney
- System Code — CCA
- File Number — 41.0804.3.M414

1.2 Function

The function of the Chimney will be to discharge combustion gas to the atmosphere at a sufficient elevation to provide adequate diffusion as required by the air permit.

1.3 Description

The Chimney will consist of a reinforced concrete shell surrounding, protecting, and supporting a single liner carrying flue gas for atmospheric dispersal. The chimney will consist of the following five components:

- Foundation--provides support and carries the loads to the subsurface
- Structural Shell--provides support for the contained liners and systems and stability for the entire structure
- Gas Path Liner--direct the combustion gases from the inlet breechings to the top exhaust outlets
- Access--provides means of ingress and egress to allow for access to the contained systems through doors, hoist, service car, ladders, and platforms
- Drains and Plumbing--provides wastewater drains at the base of the Chimney liner and at the base of the liners

Two conceptual locations for the Unit 4 Chimney has been shown on the Site Arrangement drawings, one for Arrangement A and one for Arrangement B. The ultimate location of the Chimney will depend on the arrangement selected. The Chimney itself is identical for either arrangement. The gas path liner in the Chimney has been preliminarily sized at an inside diameter of 25.0 feet and a discharge elevation of 600 feet above grade. Final dimensions are subject to air modeling and permitting.

The gas path liner will be designed and constructed of a material suitable for the makeup and temperatures of the exhaust gas downstream of the AQCS equipment. As described in Chimney Alternatives, File 43.0810, the liner material has been preliminarily recommended to be fiberglass-reinforced plastic (FRP). The estimated Chimney cost to be included in the Phase II estimate will be determined accordingly. All appurtenances necessary to result in a complete gas dispersal system will be provided, including the following:

- Obstruction lighting in accordance with applicable FAA requirements
- Interior steel and grating platforms provided at the top of the Chimney and at mid levels as required for access to test ports and operation of CEMS equipment and for service of obstruction lighting.
- Flanged liner ports with removable covers as required for CEMS equipment and for all regulatory emission testing and monitoring
- Doors, ladders, equipment hoist, and personnel vertical lift service car as required to access, operate, and maintain systems located in the Chimney
- Interior service lighting and power receptacles necessary to support operation and maintenance of systems located in the Chimney
- A condensate collection system to collect and transport collected liquids from the base of the liner to the plant waste system

The final size, arrangement, and details of each chimney will be determined during the detailed design based on load requirements, equipment enclosure and access, and regulatory and permitting restrictions.

System Description

1.1 System Identification

- Unit Designation Unit 4
- System Name Wet Flue Gas Desulfurization
- System Code CCC
- File Number 41.0804.3.M415

1.2 Function

The function of the Wet Flue Gas Desulfurization (WFGD) System is to remove sulfur dioxide (SO_2) from the combustion gas using a WFGD system.

1.3 Process Description

The WFGD System for each unit will include the following major components for each unit:

- Absorber module.
- Integral absorber reaction tank
- Absorber reaction tank mixers.
- Absorber recycle pumps and corresponding spray headers to meet stated emission limits plus one spare per module
- Absorber slurry bleed pumps with 100% spare capacity
- Mist eliminators, mist eliminator wash header and nozzles
- Mist eliminator wash tank
- Mist eliminator wash pumps with 100% spare capacity
- Emergency quench system
- Oxidation air blowers with 100% spare capacity
- Oxidation air piping, lances and accessories.
- Primary dewatering hydrocyclone classifiers with spare capacity

- Hydrocyclone overflow tank
- Chloride bleed pumps with 100% spare capacity
- Hydrocyclone underflow tank or absorber slurry holding tank with agitator mixer
- Underflow slurry or absorber slurry transfer pumps with 100% spare capacity
- WFGD system piping, valves, and fittings.
- Ductwork connections
- Electrical, controls and instrumentation.

The WFGD process consists of spraying limestone slurry into the flue gas stream to remove the SO_2. Limestone slurry will be pumped from the existing limestone slurry storage tank by existing limestone slurry feed pump. A recirculation loop will control the flow of slurry into the absorber module and continually circulate the slurry from the limestone slurry feed pump discharge to the absorber and back to the limestone slurry tank to prevent line plugging. Limestone slurry will be fed to the reaction tank from the recirculation loop based upon absorber demand.

Flue gas discharged from the booster fans will enter the wet absorber module and pass upwards through a slurry spray consisting of finely ground limestone particles. Upon contact with the slurry, the flue gas will be cooled and become saturated. The sulfur dioxide in the flue gas will be absorbed into the slurry. The scrubbed flue gas will pass upwards through the mist eliminator stages which will minimize the carryover of solids and moisture droplets from the absorber to the downstream ductwork. Flue gas will then exit at the top of the wet absorber module. The particles and moisture droplets removed from the scrubbed flue gas will coalesce and drop into the absorber reaction tank. The mist eliminator will be cleaned with water sprays supplied from the mist eliminator wash tank and pumps. The absorber reaction tank will be integral part of the bottom of the absorber module. The absorber recycle pumps will take suction from the reaction tank and supply the limestone slurry spray to the spray nozzles located within the absorber module. The slurry will discharge from the spray nozzles, absorb sulfur dioxide from the flue gas, and fall by gravity into the reaction tank where the reaction products of the sulfur dioxide and limestone will be immediately oxidized with air supplied from the oxidation air blowers to produce solid gypsum crystals. Before entering the reaction tank, the oxidation air will be quenched with filtered water supplied from the make-up water system. To maintain the operating level of the absorber reaction tank, water will be supplied from the Makeup Water System or existing reclaim water system. The solids concentration within the absorber reaction tank will be maintained by the absorber slurry bleed pumps.

The absorber slurry bleed pumps will operate to remove a portion of the gypsum/limestone slurry from the reaction tank and pump the slurry material to the hydrocyclone classifier. The hydrocyclone classifiers will separate the coarse solids (underflow) and the fine solids (overflow) into two flow streams. The underflow stream will contain a high concentration of large gypsum crystals, and the overflow slurry will contain a low concentration of fine solids consisting mainly of inert limestone minerals and unreacted limestone. The overflow slurry will exit from the top of the hydrocyclone classifier and will flow by gravity into the hydrocyclone overflow tank. From the hydrocyclone overflow tank, the overflow slurry will flow by gravity to the absorber tank or to the reclaim water system. In order to limit the amount of chlorides in the reaction tank to 12,000 mg/L, a portion of the overflow slurry will be removed by the chloride bleed pumps and sent to existing wastewater treatment system

The underflow slurry will exit the bottom of the hydrocyclone classifier and flow by gravity to the hydrocyclone underflow tank. From the hydrocyclone underflow tank, the underflow slurry will be transported to the existing dewatering system by underflow slurry transfer pumps. The hydrocyclone underflow tank can also be used as an absorber slurry holding tank during outage and maintenance of the absorber module.

Emergency quench water spray nozzles will be available within the exhaust gas ductwork at the inlet to the wet absorber module to protect the scrubber internals and mist eliminators in the event of failure of the recycle pumps or high flue gas temperatures resulting from an air heater failure or other thermal excursion. This system will also protect the FRP liner (assuming that is the liner material chosen) in the chimney farther downstream from the same thermal excursion. In the event of air heater failure or an electrical system failure that stops operation of the recycle pumps, a system will be required to open this quench water valve with a water source available to spray water for a period of 30 minutes into the scrubber modules. The equipment supplier shall provide the details of this protection system.

System Description

1.1 System Identification

- Unit Designation — Unit 4
- System Name — Freeze Protection
- System Code — EEA
- File Number — 41.0804.3.M416

1.2 Function

The Freeze Protection System will provide heating for predetermined above grade water and water slurry lines in unheated areas to protect them from freezing. Process lines will also be heat traced where required to maintain minimum process temperatures.

1.3 Process Description

Freeze protection will consist of the use of insulation, electric heating cables and/or operating procedures to prevent operational problems and damage due to freezing of media in piping, vessels and equipment. The electric heat tracing cable is intended to replace the heat lost through the insulation system, not to heat the pipe, vessel or piece of equipment. Since it is not practical to heat trace all piping, vessels and equipment that may be subject to freezing, operating procedures may be applied that dictate draining systems or recirculation of the media to prevent freezing for equipment or systems not critical to unit operation. Freeze protection will be applied to all piping subject to freezing.

Freeze protection/process heat tracing panels will be provided in buildings local to the heat tracing loads. Each panel will include supply 120 V or 208 V freeze protection/process heat tracing circuits fed from 30 kVA or 45 kVA, 480-208/120 V three phase transformers.

System Description

1.1 System Identification

- Unit Designation — Unit 4
- System Name — Continuous Emission Monitoring System
- System Code — SAA
- File Number — 41.0804.3.M417

1.2 Function

The function of the Continuous Emissions Monitoring System (CEMS) is to sample analyze and measure the combustion gases for oxygen, sulfur dioxide, oxides of nitrogen, carbon dioxide, moisture, stack flow, opacity, temperature and mercury..

1.3 Process Description

The CEMS is used to determine compliance with regulatory emission requirements for Unit 4. The CEMS is designed to comply with Environmental Protection Agency Code of Federal Regulations (CFR) as stated in the requirements of 40 CFR Part 60 including Appendix B, and 40 CFR Part 75.

The CEMS takes measure of the following flue gas constituents and characteristics:

- Flue Gas Outlet Chimney:
  - Sulfur Dioxide.
  - Nitrogen Oxides.
  - Carbon Dioxide.
  - Stack Gas Flow.
  - Mercury.
- Wet Spray Tower Absorber Module Inlet:
  - Sulfur Dioxide.
  - Carbon Dioxide.

The CEMS is a dilution extractive type with all measurements taken on a dilution basis. The CEMS for Unit 4 is installed in an environmentally-controlled walk-in enclosure. The enclosure will be located close to or within the shell at the base of the Unit 4 chimney. (Note: CEMS not shown on the Site Arrangement). The gas sample is extracted through a probe and transported in its original state to the analyzers through a freeze protected sample line. The gas sample is transported and regulated to the analyzers. Opacity is measured directly in accordance with 40 CFR Part 60.

A controller and a data-logging device are provided to control all sampling, calibration, and back-purging, and to provide initial data reduction and backup data storage. The controller transfers adjusted data to a CEMS data acquisition and handling system (DAHS), including a report generating system and software, will be located in the CEMS shelter. The DAHS will log emissions data and generate summary reports as required by applicable regulatory agencies and plant operations.

Calibration gases are used to verify the accuracy of the gas analyzers. Calibration is performed automatically by the data logger once every 24 hours. Additionally, calibration is required quarterly for EPA compliance.

The flue gas flow is measured at the stack with direct mounted probes. The gas flow is used to calculate mass emission rates and boiler heat input in accordance with 40 CFR Part 75.

Opacity is measured at the Pulse Jet Fabric Filter (PJFF) outlet ducts. The opacity analyzers are double-pass, cross duct transmission meters that measure light transmittance through the flue gas.

System Description

1.1 System Identification

- Unit Designation — Unit 4
- System Name — WFGD Makeup Water
- System Code — WSG
- File Number — 41.0804.3.M418

1.2 Function

The WFGD Makeup Water System receives, stores, and pumps water from the Clearwell pond for distribution to the WFGD and associated systems.

1.3 Process Description

The WFGD Makeup Water System will consist of the following major components:

- Makeup Water Pumps (existing)
- Makeup Water Strainers (existing)
- WFGD Makeup Water pipe, valves, and fittings
- Controls and instruments

The source of makeup water will be the Clearwell pond. Existing pumps will pump water as necessary to the WFGD systems. Existing strainers will remove debris from the water as necessary to protect the WFGD systems.

Makeup water distribution piping will supply all WFGD and associated BOP systems.