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	APD/APF/APG
File Number	41.0804.3.GC01

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

Two (2) redundant three-winding delta primary, resistance grounded wye AQC Reserve Auxiliary Transformers. The high voltage rating shall be 25 kV. The low voltage side X- winding shall be 13.8 kV, and the Y-winding shall be 4.16 kV. The 25 kV primary feed will be supplied from the existing 25 kV switchgear located in the 25 kV enclosure. The 25kV enclosure is located in the switchyard south of the plant. The existing 25 kV switchgear will require modification. The modification will require an added vertical section to 25 kV switchgear A and an added vertical section to switchgear B. The 13.8 kV and the 4.16 kV secondary windings shall supply reserve power to the plant AQC switchgear via cable 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:

4160V cable bus connection from the secondary winding of the Common AQC Reserve Auxiliary Transformer, to the respective 4.16 kV switchgear in Units 1 & 2.

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

15 kV cable bus connection from the secondary winding of the Common AQC Reserve Auxiliary Transformer, to the respective 13.8 kV switchgear in Units 3 & 4.

The 25 kV system shall also consist of the following major components:

Two (2) 25 kV vertical sections with breaker will be added to the existing 25 kV switchgear.

Underground ducts and 25 kV cable from the 25 kV switchgear extensions to the Common Reserve Transformers A & B.

1.4 Reference Drawing

- B&V Conceptual Overall One Line – AQCS Reserve 168908-GCDE-E1005

System Description

1.1 System Identification

- Unit Designation — Common
- System Name — Grounding
- System Code — EEB
- File Number — 41.0804.3.GC02

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 Ghent 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 2 SCRs, PJFFs at all four units, raceways, 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 perimeter 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 predetermined 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 conveyor 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 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.

1.3.3 Fencing

No new permanent fencing is currently anticipated in the Phase II modifications. If any permanent fencing is ultimately included in the scope, such fencing in close proximity to the main ground grid shall be grounded and bonded to the main grid. Fencing remote from the main grid shall be either grounded and bonded to the main grid or locally grounded and isolated from the main grid, whichever process achieves the safety parameters. The grounding and bonding philosophy of the existing fence grounding shall be considered during detailed design.

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, such as traveling screens 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.GC03

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 the event of fire.

1.3 Process Description

The Site Fire Protection System includes various fixed detection and suppression systems. The Ghent 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 (CO2) system. Automatic CO2 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 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 appropriate U1/U2 or U3/U4 main control rooms via 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 annuciation. All of the new fire protection systems will communicate their alarm information to the existing main fire alarm annuicator panel located in the appropriate U1/U2 or U3/U4 main control rooms.

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 existing yard distribution piping may not create a fire protection loop around the areas containing the new PJFFs and associated equipment and may need to be expanded to provide a loop as called out in NFPA. This will be confirmed during detailed design. 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 need.

There is an existing diesel pump in the Unit 1 cooling tower basin. It is assumed the pump is sufficient to provide the amount of pressure and flow needed for the additional systems. In addition, a second electric driven pump and jockey pump will be added. The new pumps will take suction off of a new 300,000 gallon tank which will be placed near the Unit 1 cooling tower. Required additions and modifications to the existing site fire protection to meet NFPA code will be determined during detailed design.

During detailed design the existing fire pumps and water supply will have to be evaluated to determine if they are sufficient to provide the amount of water, pressure and flow needed for the additional systems. If it is determined that the existing pumps are not sufficient to meet the new demands, new pumps and underground mains will be necessary. More than one fire water tank may also be necessary depending on the detailed design review.

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

Suppression systems for the Ghent 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
Ghent Station
Fire Protection System Design Conditions

System Designation	Area or Equipment Protected	System Type	Detection or Actuation Device
Common			
STG-1	PAC Silos (Units 1 &2)	Low Pressure Carbon Dioxide	Carbon Monoxide Detector
Unit 1			
STG1-1	PJFF *	Automatic Water Spray (PreAction)	Spot Heat.
STG1-2	Electrical Equipment Building	Early Warning Detection	Smoke Detectors
STG1-3	Fan VFD Enclosure	Early Warning Detection	Smoke Detectors
Unit 2			
STG2-1	PJFF *	Automatic Water Spray (PreAction)	Spot Heat.
STG2-2	Electrical Equipment Buidling	Early Warning Detection	Smoke Detectors
STG2-3	Fan VFD Enclosure	Early Warning Detection	Smoke Detectors
Unit 3			
STG3-1	PJFF *	Automatic Water Spray (PreAction)	Spot Heat.
STG3-2	Fly Ash Forwarding Equipment Area	Dry Pipe Sprinkler	Quartzoid bulb sprinkler heads
STG3-3	Fan VFD Enclosure	Early Warning Detection	Smoke Detectors
STG3-4	PAC Silos	Low Pressure Carbon Dioxide	Carbon Monoxide Detector
STG3-6	Electrical Equipment Building	Early Warning Detection	Smoke Detectors
Unit 4			
STG4-1	PJFF *	Automatic Water Spray (PreAction)	Spot Heat.
STG4-2	Electrical Equipment Building	Early Warning Detection	Smoke Detectors
STG4-3	PAC Silos	Low Pressure Carbon Dioxide	Carbon Monoxide Detector
STG4-4	Fan VFD Enclosure	Early Warning Detection	Smoke Detectors

*Optional CO2 system pricing can be provided if requested.

System Description

1.1 System Identification

- Unit Designation — Common
- System Name — Site
- System Code — STA
- File Number — 41.0804.3.GC04

1.2 Function

The Site System will provide a stable well-drained site and vehicular access to all added structures as well as maintain acceptable access to existing facilities.

1.3 Process Description

The Roads and Parking System will 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

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

A site-wide storm water drainage system already exists at Ghent station. 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 one significant exception is the area to be occupied by portions of the pulse jet fabric filter (PJFF) and ash handling facility at Unit 4. Construction of these facilities will require extending the existing storm water collection and runoff system to the north, closer to the river, in this area. However, the added impervious or less pervious area is expected to be relatively small and the additional runoff generated within the capacity of the existing site system. This will be confirmed during detailed design.

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. Care will be taken to avoid or at least minimize any impact to the bank (sloped) area adjacent to the river. The conceptual design did not foresee any permit-requiring modifications to the riverbank, but this will be confirmed during detailed design as equipment and structure sizes and locations are confirmed. 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 river, including the north 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 north loop road will, for the most part, be re-established in place. The loop road at the corner northwest of Unit 4 may require some repositioning to maintain loop travel through the Unit 4 area. Depending on the final size and location of equipment in this area, a new section of road will be routed between the ash handling facility at Unit 4 and the river to maintain easy access between the north loop road and the road north of the Unit 3 and 4 cooling towers. This will be finalized during detailed design.

Asphalt paved roads and parking areas will be provided as indicated on the General Arrangement Drawing to access and maintain new equipment. Truck parking or turnouts will be provided near the bulk materials unloading areas to maintain traffic flow around those areas. Suggested locations of roads are shown on the General Arrangement Drawing.

Impacts to overall site parking are expected to be minimal, except in the area of the courtyard between Units 2 and 3. The addition of the Unit 3 PJFF and associated equipment within the courtyard requires relocation of the shop facilities and will impact accessibility by large trucks to the courtyard area. For that reason, a permanent frac tank is included in the arrangement to replace the portable frac tanks normally staged in the courtyard for Unit 3 maintenance. It is also recommended that the two existing sorbent silos at Unit 3 be relocated for better access or be provided with a remote truck unloading station to avoid truck travel in the courtyard area. Local parking areas will be provided adjacent to new structures.

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 41.0804.03.G101

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 18 kV 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 25,000V system:

The existing 25.0 kV indoor 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.

25.0 kV cable in underground duct bank from the existing 25.0 kV switchgear to the Common Reserve Auxiliary Transformers.

Reference Common system AQCS Reserve Power Supply system description: 41.0804.3.GC01 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.

A 120-208V 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-G1DE-E1001
- Conceptual Overall One Line – Common: 168908-GCDE-E1005

System Description

1.1 System Identification

- Unit Designation — Unit 1
- System Name — Communication
- System Code — CMA
- File Number — 41.0804.3.G102

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.

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 Ghent 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 Ghent Unit 1 system.

Raceway and space provisions for telephone/LAN equipment 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.G103

1.2 Function

The existing Emerson Ovation 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 Unit 1 Ghent 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 Primary and Secondary Fan Switches, and the addition of new redundant controllers to control the new AQCS common unit equipment. The AQCS DCS equipment shall communicate by means of redundant network data highways.

The AQCS DCS equipment shall include the following major components:

- AQC Network Cabinet/Fiber Optic Patch Panel.
- Redundant Controllers.
- DCS system cabinets and input/output (I/O) cabinets.

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1.3 Process Description

The AQCS DCS control processors 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 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:

- AQCS Electrical Building.

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.G104

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.G105

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 Unit 1 exhaust ductwork downstream of the existing ID fans. 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 braced-frame construction supported on a series of steel columns, with long-span steel beams or shallow trusses spanning over the existing ductwork. Main beams or trusses will be located so as to support the columns provided as part of the PJFF structure. The structure is intended to have minimal impact on the existing ductwork and is not expected to impact the existing cooling tower electrical building south of Unit 2 cooling tower. Areas beneath the PJFF support structure not occupied by existing ductwork will be reserved for the Unit 1 AQCS Electrical Building and VFD Enclosures, as well as maintenance access to the new booster fans. 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.

The structure will provide support to the PJFF installed above it. The hopper area above the working floor and below the PJFF will be enclosed for weather protection. Lighting, heating, and ventilation will be included. Steel stair towers will be installed at the north and south ends of the structure to allow personnel access to the working floor level (hopper enclosure), to any intermediate PJFF elevations requiring access, and to the top of the PJFF. 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. Any large penetrations in the working enclosure floor will be surrounded by handrail for safety. As unenclosed space, no heating or ventilation will be required in the area below the working floor enclosure.

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, with a separate room intended to house the compressed air system serving the PJFF. 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 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 wall between electrical equipment and the compressor system will be of masonry construction to maintain the necessary code-required fire barrier. 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 battery room and DCS equipment room within the building are expected to be air conditioned to provide the environment required for the equipment. 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 1 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 1
- System Name — Fly Ash
- System Code — ASB
- File Number — 41.0804.3.G106

1.2 Function

At time of this report, design of a new Common Fly Ash Handling Facility serving both Units 1 and 2 is underway under separate contract. It is assumed for purposes of this report that the new ash facility will be completed and in operation at the time Unit 1 AQCS modifications are made.

The Fly Ash System will pneumatically remove fly ash from the pulse jet fabric filter (PJFF) hoppers and transfer it to the existing ash handling system. In addition, the ash handling system will transfer powdered activated carbon (PAC) which is injected upstream of the PJFF and collected in the PJFF hoppers. The collected fly ash byproducts will be conveyed to the existing Unit 1 filter/separator. The collected ash will subsequently be transferred by a pressurized pneumatic blower system to the ash storage and loadout silos at the coal combustion residue (CCR) facility south of Highway 42. The process is shown on drawing 168908-G1ASB-M2022: Unit 1 PFD - Fly Ash Handling.

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)
- Unit 1 filter/separator (existing at time of AQCS modifications)
- Common fly ash storage and loadout silos (existing).

The Fly Ash System will be essentially an extension of the existing vacuum transport system and will service all the PJFF material collection hoppers. Each collection point in the Fly Ash System shall be tied into the existing pneumatic vacuum conveying system via a new branch line from the main ESP conveying header. The existing filter separators and mechanical exhausters were designed to account for the additional ash, PAC, and any remaining sorbent collected in the PJFF hoppers. System capacity and operating margin will be confirmed during detailed design.

Each PJFF 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 will sequentially remove ash from the PJFF hoppers and transfer it to the existing Unit 1 filter separator in the Common Unit 1/Unit 2 Fly Ash Handling Facility. The ash will then be transported via the existing pressure conveying system to the existing storage and loadout silos at the CCR facility.

System Description

1.1 System Identification

- Unit Designation — Unit 1
- System Name — Induced Draft
- System Code — CCE
- File Number — 41.0804.3.G107

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 variable frequency drives (VFD).
- Two new 50 percent nominal capacity, centrifugal booster (ID) fans using variable speed operation as the primary means of flow control accomplished through the use of VFDs.
- New, direct-drive induction motors designed for the full booster fan capacity and operation with VFDs.
- New VFDs designed for the full booster 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 electrical noise to the driven equipment.
- 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 booster fan discharge dampers and damper drives.

- Associated new and existing ductwork and expansion joints upstream and downstream of the 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 wet flue gas desulfurization (WFGD) scrubber and the existing 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 VFDs, 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 VFD. The VFDs 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 separate flow paths of the draft system will be retained with the addition of the PJFF system and booster fans. 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 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 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. The flow path exiting the booster fans will enter the existing WFGD scrubber and 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.G108

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 1
- System Name — Neural Network
- System Code — SGM
- File Number — 41.0804.3.G109

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
• System Name	AQCS Compressed Air
• System Code	CAB
• File Number	41.0804.3.G110

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 a mechanical room within the Unit 1 AQCS Building beneath the PJFF.

System Description

1.1 System Identification

- Unit Designation — Unit 1
- System Name — AQCS Service Water
- System Code — WSC
- File Number — 41.0804.3.G111

1.2 Function

The Air Quality Control System (AQCS) Service Water System will extend the existing service water system 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 for 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
- System Name: Powder Activated Carbon Injection
- System Code: CCH
- File Number: 41.0804.3.G112

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 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.G201

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 25,000V system:

- The existing 25.0 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.
- 25.0 kV cable in underground duct bank from the existing 25.0 kV switchgear to the Common Reserve Auxiliary Transformers.
- Reference Common system AQCS Reserve Power Supply system description: 41.0804.3.GC01 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° 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-G2DE-E1002
- Conceptual Overall One Line – Common: 168908-GCDE-E1005

System Description

1.1 System Identification

• Unit Designation	Unit 2
• System Name	Communication
• System Code	CMA
• File Number	41.0804.3.G202

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.

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 Ghent 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 Ghent Unit 2 system.

Raceway and space provisions for telephone/LAN equipment 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.G203

1.2 Function

The existing Emerson Ovation 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 Unit 2 Ghent 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 Primary and Secondary Fan Switches, and the addition of new redundant controllers to control the new AQCS common unit equipment. The AQCS DCS equipment shall communicate by means of redundant network data highways.

The AQCS DCS equipment shall include the following major components:

- AQC Network Cabinet/Fiber Optic Patch Panel.
- Redundant Controllers.
- DCS system cabinets and input/output (I/O) cabinets.

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1.3 Process Description

The AQCS DCS control processors 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 2 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 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:

- AQCS Electrical Building.
- SCR 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.G204

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.G205

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 2 PJFF Support Structure

The Unit 2 Pulse Jet Fabric Filter Support Structure will be constructed in the area currently occupied by ductwork downstream of the Unit 2 ID fans. A bypass will be installed in the ductwork to allow demolition of the interfering ductwork while Unit 2 remains in operation. At the time of this report, preliminary design is underway for a common Unit 1/Unit 2 dry fly ash handling system to be housed in a building located between the existing ductwork and the abandoned Unit 2 chimney. It is assumed that this building will be in place and operational by the time of Stage II modifications and the design of the Unit 2 PJFF Support Structure will have to take that building into account as well. The structure will also span across the existing plant loop road between the AQC area and the river bank to allow continued vehicle access along the back side of the units. Lastly, the structure will also span over the existing ash/slurry piperack located along the north side of the loop road to avoid any outage in the services carried by the piperack.

The structure will provide support to the PJFF installed above it. The hopper area above the working floor and below the PJFF will be enclosed for weather protection. Lighting, heating, and ventilation will be included within the enclosed area above the support structure.

The support structure itself will be unenclosed and will consist of a structural steel superstructure mounted on a concrete foundation. The concrete foundation will be designed to minimize impact on the riverbank, allowing the structure above to cantilever over the riverbank if necessary to support the PJFF above. The location and arrangement of foundation piles or piers will be determined during detailed design when the final size and weight of the equipment to be supported is confirmed. The cost estimate for Unit 2 is based on a significant concrete structure underground beneath the loop road tying the northernmost foundation to the rest of the foundation to ensure overall stability along the river bank.

The steel superstructure to be mounted on the foundation will consist of braced-frame construction supported on a series of steel columns. Long-span steel beams or shallow trusses will span the north loop road and the piperack, cantilevering over the north foundation if necessary to support the PJFF above. The main beams or trusses will be located so as to support the columns provided as part of the PJFF structure. 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 slab on the superstructure is currently assumed at approximately 45 feet above grade to clear both the piperack and the ash handling facility for purposes of the estimate. This assumption will be confirmed in detailed design. The remaining area under the support structure south of the road will be reserved for the Unit 2 AQCS Electrical Building and VFD Enclosure.

Steel stair towers will be installed at the east and west sides of the structure to allow personnel access to the working floor level (hopper enclosure), to any intermediate PJFF elevations requiring access, and to the top of the PJFF. 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. Any large penetrations in the working floor enclosure will be surrounded by handrail for safety. As unenclosed space, no heating or ventilation will be required in the area under the working floor enclosure. 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 2 AQCS Electrical Building

The Unit 2 AQCS Electrical Building will house additional electrical and control equipment serving the Unit 2 PJFF and the ID fans. The building will also house the compressed air system provided as part of the PJFF. The Electrical Building is intended as a single story pre-engineered metal building on a concrete foundation. The foundation for the building will be integrated with that of the foundation for the PJFF Support Structure surrounding it. The superstructure will consist of steel framing enclosed with insulated metal panel walls and roof. The wall between electrical equipment area and the compressor system room will be of masonry construction to maintain the necessary code-required fire barrier. 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 battery room and DCS equipment room within the building are expected to be air conditioned to provide the environment required for the equipment. 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 2 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 foundation, also integrated with that of the PJFF Support Structure, with necessary utilities and services provided for tie-in to the enclosed equipment. The structure will be furnished with HVAC appropriate for the enclosed equipment and doors pre-installed.

1.3.4 SCR Support Structures

Two 50%-capacity Unit 2 selective catalytic reduction modules will be installed in the locations noted on the arrangement drawings. Both modules will be elevated and will require a substantial support structure. Both support structures will be of braced frame structural steel construction mounted on deep foundations.

For purposes of the estimate, the support structure under the east SCR module was assumed as an independent structure straddling the existing steel framework supporting the Unit 1 SCR. A separate foundation was assumed under each of the four legs of the support tower. At time of detailed design, consideration should be given to integrating the new Unit 2 SCR support tower with the framework supporting the Unit 1 SCR, should excess load capacity remain in that steel and foundation. The savings in new foundations and superstructure may exceed any extra cost in additional design and augmentation of the existing structure. The support tower will also serve as a support point for new ductwork tying the SCR into the existing exhaust stream.

The support tower under the west Unit 2 SCR and interconnecting ductwork will be located in a very congested area bounded by the existing ID fans to the east, the ESP to the north, a coal conveyor bent to the west and Unit 2 boiler building to the south. Foundations will accordingly be relatively complex and will likely consist of a combination of drilled piers and micropiles as allowed by access, interconnected with a concrete foundation. In addition, the SCR is located beneath the existing Unit 3/Unit 4 coal conveyor and all superstructure must be installed beneath the conveyor structure, complicating crane access.

Both towers will be unenclosed and will thus require no HVAC. Both towers will be served by an integral stairwell for personnel access and will support the necessary platforming and jib crane required for servicing the catalyst in the SCR. In addition, both towers will support a prefabricated SCR Electrical Enclosure within its intermediate elevations serving the SCR above. Access to this enclosure will be via the stairs. The enclosure will be pre-manufactured with its own necessary utility connections and HVAC.

1.3.5 SCR Electrical Enclosures

Two SCR Electrical Enclosures, one per SCR, will house the electrical equipment powering and controlling the new Unit 2 SCRs. Each enclosure is intended to be a pre-manufactured enclosure furnished complete with equipment installed. The prefabricated structure will be placed on an intermediate level of the corresponding SCR support structure below the SCC itself. The structure will be furnished with HVAC appropriate for the enclosed equipment and doors pre-installed. Access will be via the stairwell serving the SCR support structure.

System Description

1.1 System Identification

- Unit Designation — Unit 2
- System Name — Fly Ash
- System Code — ASB
- File Number — 41.0804.3.G206

1.2 Function

At time of this report, design of a new Common Fly Ash Handling Facility serving both Units 1 and 2 is underway under separate contract. It is assumed for purposes of this report that the new ash facility will be completed and in operation at the time Unit 2 AQCS modifications are made.

The Fly Ash System will pneumatically remove fly ash from the pulse jet fabric filter (PJFF) hoppers and any ductwork hoppers installed at the SCRs and transfer it to the existing ash handling system. In addition, the ash handling system will transfer powdered 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 Unit 2 filter/separator. The collected ash will subsequently be transferred by a pressurized pneumatic blower system to the ash storage and loadout silos at the coal combustion residue (CCR) facility south of Highway 42. The process is shown on drawing 168908-G2ASB-M2022: Unit 2 PFD - Fly Ash Handling.

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)
- Unit 2 filter/separator (existing at time of AQCS modifications)
- Common fly ash storage and loadout silos (existing).

The Fly Ash System will be essentially an extension of the existing vacuum transport system and will service all the PJFF material collection hoppers plus any dust collection hoppers installed in the ductwork serving the SCRs. Each collection point in the Fly Ash

System will be tied into the existing pneumatic vacuum conveying system via a new branch line from the main ESP conveying header. The existing filter separators and mechanical exhausters were designed to account for the additional ash, PAC, and sorbent collected in the PJFF hoppers. System capacity and operating margin will be confirmed during detailed design.

Each PJFF 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 will sequentially remove ash from the collection hoppers and transfer it to the existing Unit 2 filter separator in the Common Unit 1/Unit 2 Fly Ash Handling Facility. The ash will then be transported via the existing pressure conveying system to the existing storage and loadout silos at the CCR facility.

System Description

1.1 System Identification

- Unit Designation — Unit 2
- System Name — Induced Draft
- System Code — CCE
- File Number — 41.0804.3.G207

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 variable frequency drives (VFD).
- 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 a VFD system.
- New, direct-drive induction motors designed for the full booster fan capacity and operation with a VFD system.
- A new VFD system designed for the full booster 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 electrical noise to the driven equipment.
- New booster fan lubricating oil units.
- New booster fan inlet dampers damper drives that will be used as a means of secondary flow control.

- New booster fan discharge dampers and damper drives.
- New economizer bypass ductwork, expansion joints, and modulating dampers.
- New economizer backpressure dampers
- Associated new and existing ductwork and expansion joints upstream and downstream of the 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, electrostatic precipitators, new selective catalytic reduction (SCR) system, and regenerative air heaters. 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 wet flue gas desulfurization (WFGD) scrubber and the existing 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 a VFD system, 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 VFD system 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 separate flow paths of the draft system will be retained with the addition of the PJFF system and booster fans. 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 WFGD scrubber and existing stack to the atmosphere.

The economizer bypass ductwork and dampers would bypass flue gas around the economizer in the boiler to increase the overall temperature of the flue gas entering the electrostatic precipitators and new SCR system. The bypass ducts would exit the boiler back pass above the economizer and inject the higher temperature flue gas into the electrostatic precipitator inlet duct. The proper reaction temperatures entering the SCR system would be maintained by the modulating dampers in the economizer bypass ducts. Should the flue gas pressure drop across the economizer decrease to a point that does not allow a suitable amount of flue gas to bypass the economizer, backpressure dampers would be modulated to correct this.

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 electrostatic precipitators, the SCR system, the air heaters, the ID fans, the new PJFF, then to the new booster fans. The flow path exiting the booster fans will enter the existing WFGD scrubbers and 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.G208

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 2
- System Name — Neural Network
- System Code — SGM
- File Number — 41.0804.3.G209

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.G210

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 a room within the Unit 2 AQCS Electrical Building beneath the PJFF support structure.

System Description

1.1 System Identification

• Unit Designation	Unit 2
• System Name	AQCS Service Water
• System Code	WSC
• File Number	41.0804.3.G211

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 for 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 — Powder Activated Carbon Injection
- System Code — CCH
- File Number — 41.0804.3.G212

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 2
- System Name Sorbent Injection
- System Code CCH
- File Number 41.0804.3.G213

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 will 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 — Selective Catalytic Reduction
- System Code — CCF
- File Number — 41.0804.3.G214

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 reactors.
- Catalyst.
- NO_x analyzers.
- Diluent (O_2 or CO_2) analyzers.
- Sonic horns and/or soot blowers
- Large Particle Ash (LPA) Screens
- 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 located downstream of the economizer before proceeding to the existing hot side ESP. The ductwork downstream of the ESPs will be modified to direct the flue gas to the ammonia injection site and to the SCR reactors. 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 ammonia injection skids 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 each 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. NO_x 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. Gas-side bypass ducts with modulating dampers that bypass the boiler economizer section would be used to control reaction temperatures. 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.G215

1.2 Function

The Ammonia Supply System shall include the following major components:

- Two existing 90,000-gallon anhydrous ammonia storage tanks, with adequate storage capacity to require refilling no more than one time per 9 days based on ammonia consumption of all four units
- Two existing full-capacity ammonia pumps
- Two ammonia injection skids, each skid consists of two full capacity mass flow meters and ammonia flow control valve trains
- Two ammonia dilution air sets, each set consists of two full capacity ammonia dilution air blowers and two full capacity air pre-heaters.

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 existing Units 1, 3, and 4 and the new Unit 2 ammonia injection skids by the existing ammonia pumps.

Unit 2 ammonia injection system will consist of two ammonia injection skids, and two sets of ammonia dilution air blowers and air pre-heaters. Each ammonia injection skid will consist of two 100% mass flow meters and ammonia flow control valve trains, pipe, valves, and instrumentations. Each ammonia dilution air set 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 auxiliary steam supply header. One ammonia injection skid and one ammonia dilution air set will be located at the SCR reactor 2-1. The other ammonia injection skid and ammonia dilution air set will be located at the SCR reactor 2-2.

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 streams. 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)
  - APF--AC Power Supply (13,800 Volts)
  - APH--DC Power Supply
  - API-—Uninterruptible Power Supply
- File Name 41.0804.03.G301

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:

- 13.8 kV 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 (13,800V) (APF)

The 13,800V 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 13,800V to serve the Unit 3 switchgear buses A & B.
- One neutral grounding resistor on each secondary winding of each auxiliary transformer.

The 13,800V system shall also consist of the following major components:

- Two (2) 13,800V 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 13,800V switchgear shall be arc resistant and of two-high construction. The switchgear shall be located within the AQC Electrical Building
- 15.0 kV cable bus.
- 13.8 kV medium voltage circuit breakers and contactors.

- Four (4) variable frequency drives (VFD) fed from the 13.8 kV SWGR A & B respectively. Each drive will power and control an ID Fan motor. The VFDs will be located within the Fan VFD Enclosure.

1.3.4 DC Power Supply (APH)

The DC Power Supply System will consist of 125 VDC 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-G3DE-E1003
- Conceptual Overall One Line – Common: 168908-GCDE-E1005

System Description

1.1 System Identification

- Unit Designation — Unit 3
- System Name — Communication
- System Code — CMA
- File Number — 41.0804.3.G302

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.

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 Ghent 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 Ghent Unit 3 system.

Raceway and space provisions for telephone/LAN equipment 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.G303

1.2 Function

The existing Emerson Ovation 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 3 workstations located in the Unit 3 Ghent 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 Primary and Secondary Fan Switches, and the addition of new redundant controllers to control the new AQCS common unit equipment. The AQCS DCS equipment shall communicate by means of redundant network data highways.

The AQCS DCS equipment shall include the following major components:

- AQC Network Cabinet/Fiber Optic Patch Panel.
- Redundant Controllers.
- DCS system cabinets and input/output (I/O) cabinets.

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1.3 Process Description

The AQCS DCS control processors 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 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:

- AQCS Electrical Building.

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.G304

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.G305

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 3 modifications, the new structures will not require design in accordance with the Americans with Disability Act Accessibility Guidelines (ADAAG) requirements. This assumption will be confirmed for the replacement Workshop Building at time of detailed design.

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. With the exception of the replacement Workshop Building, none of the new buildings or structures intended for the Phase II Unit 3 modifications is expected to be manned on a continuous basis. Accordingly, and since existing facilities remain in the immediate area, no plumbing or toilets are intended for the new structures other than at the Workshop. Plumbing will be provided in the Workshop as appropriate for the personnel loading expected.

1.3.1 Unit 3 PJFF Support Structure

The Unit 3 Pulse Jet Fabric Filter Support Structure will be constructed in the courtyard area between Unit 2 and Unit 3. This will necessitate the demolition of the existing shop area and the temporary removal of the skywalk between Units 2 and 3. The existing utility corridor and covered walkway at grade will be straddled by the new construction to avoid interruption or relocation of the utilities housed therein. Modification of the enclosure around the walkway will be likely, but the covered walkway will be reestablished upon completion of the Unit 3 construction. Similarly, the skywalk will be rebuilt, although likely somewhat rerouted, upon completion of Unit 3 construction. The elevated structure will also still allow vehicle access to the east wall of the Unit 3 Boiler Building, but large truck access to the sorbent silos in that location will be greatly impacted by the added congestion. For that reason it was assumed for purposes of the estimate that the Unit 3 sorbent silos will be relocated to a location more accessible by truck.

The structure will provide support to the PJFF installed above it. The hopper area above the working floor and below the PJFF will be enclosed for weather protection. Lighting, heating, and ventilation will be included. The support structure itself will be unenclosed and will consist of a structural steel superstructure mounted on a concrete foundation. The steel superstructure 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. 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 ground surface elevation in the courtyard and the bottom of steel superstructure above. The area under the support structure will be reserved for a building housing the Fly Ash Handling Building and the Booster Fan VFD Enclosures, as well as vehicle access lanes to the Unit 3 Boiler Building.

Steel stair towers will be installed at the north and south ends of the structure to 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. Any large penetrations in the working enclosure floor will be surrounded by handrail for safety. As unenclosed space, no heating or ventilation will be required in the area below the working floor enclosure.

1.3.2 Unit 3 Fly Ash Handling Building

At the time of this report, preliminary design is underway for a common Unit 3/Unit 4 dry fly ash handling system to be housed in a building located near Unit 4. Because of the distance between this equipment and the Unit 3 PJFF, it is expected that a separate fly ash transfer system will be required to forward the fly ash collected in the Unit 3 PJFF to the ash storage facility. This equipment, along with the air compressors and receivers required to perform the pulse jet cleaning of the PJFF bags, will be housed in the Unit 3 Fly Ash Handling Building under the PJFF Support Structure. The Fly 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 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 perimeter foundation with a floating interior slab. For purposes of the Unit 3 estimate, drilled piers 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 battery room and DCS equipment room within the building are expected to be air conditioned to provide the environment required for the equipment. The building is intended as a “dry” enclosure and floor drains will be minimized.

1.3.4 ID Fan VFD Enclosures

The VFD Enclosures house the variable frequency drive equipment serving the four new Unit 3 ID fans. Each enclosure is intended to be a pre-manufactured enclosure furnished complete with equipment installed. The prefabricated structure will be placed on a shallow foundation located beneath the PJFF 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

1.3.5 Replacement Workshop

Installation of the Unit 3 structures will require demolition of the existing Workshop Building south of the courtyard to make way for new construction. The functions housed in the demolished structure must be relocated. Accordingly, the estimate includes cost for a new Workshop Building to accommodate the displaced shop facilities.

The new building is assumed as a single-story pre-engineered metal building occupying the same footprint as the existing building. The building will be provided with a primarily unfinished interior, but some office areas of finished construction, HVAC suitable for shop and office conditions, and necessary plumbing and sanitary facilities for an occupied building.

System Description

1.1 System Identification

- Unit Designation — Unit 3
- System Name — Fly Ash
- System Code — ASB
- File Number — 41.0804.3.G306

1.2 Function

At time of this report, design of a new Common Fly Ash Handling Facility serving both Units 3 and 4 is underway under separate contract. It is assumed for purposes of this report that the new ash facility will be completed and in operation at the time Unit 3 AQCS modifications are made.

The Fly Ash System will pneumatically remove fly ash from the pulse jet fabric filter (PJFF) hoppers and transfer it directly to the ash storage and loadout silos at the coal combustion residue (CCR) facility south of Highway 42. In addition, the ash handling system will transfer powdered activated carbon (PAC) which is injected upstream of the PJFF and collected in the PJFF hoppers. The location of the new Unit 3 PJFF is such that the vacuum system located in Common Unit 3/Unit 4 Fly Ash Handling Facility cannot be extended to serve the PJFF. Accordingly, a separate system will be required at the Unit 3 PJFF to collect and forward the fly ash directly to the CCR, bypassing the Common Facility completely. The Common Unit 3/Unit 4 Fly Ash System will continue to collect fly ash from the ESPs and ductwork upstream of the PJFF, but will remain physically and functionally separate from the new Fly Ash System at the PJFF. The process is shown on drawing 168908-G3ASB-M2022: Unit 3 PFD - Fly Ash Handling.

1.3 Process Description

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

- Fly ash feed valves.
- Fly ash conveying equipment.
- Common fly ash and loadout silos (existing).

The Fly Ash System will be a separate and independent system serving only the PJFF material collection hoppers. Each collection point in the Fly Ash System will be tied into a dilute-phase pressure conveying system located under or adjacent to the PJFF. The new dilute-phase transfer system will be sized to transfer all collected fly ash from the 100% capacity PJFF should the existing Unit 3 ESPs ultimately be removed from service. System capacity and operating margin will be determined during detailed design.

Each PJFF 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 will sequentially remove ash from the collection hoppers and transfer it to the existing storage and loadout silos at the CCR facility.

System Description

1.1 System Identification

- Unit Designation — Unit 3
- System Name — Induced Draft
- System Code — CCE
- File Number — 41.0804.3.G307

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.

- Four new 25 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 electrical noise to the driven equipment.
- 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, electrostatic precipitators, 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 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 new centrifugal ID 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. 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 and primary air fans, combustion flue gas will flow from the new PJFF outlet to the inlet duct of each ID fan. The separate flow paths of the draft system will be retained with the addition of the PJFF system. The new ID fans will be sized to achieve 100 percent of the MCR condition with three ID fans in service and 60 percent of the MCR condition with two ID fans in service. The ID fans will discharge into a ductwork header which will exhaust combustion flue gas through the 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 outlet of the steam generator to the electrostatic precipitators, the SCR system, the air heaters, the new PJFF system, then to the new ID fans. The flow path exiting the ID fans will enter the existing WFGD scrubber and stack.

System Description

1.1 System Identification

- Unit Designation: Unit 3
- System Name: Pulse Jet Fabric Filter
- System Code: CCB
- File Number: 41.0804.3.G308

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 new 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 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.G309

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.G310

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), 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 Forwarding Building.

System Description

1.1 System Identification

• Unit Designation	Unit 3
• System Name	AQCS Service Water
• System Code	WSC
• File Number	41.0804.3.G311

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 for 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 — Powder Activated Carbon Injection
- System Code — CCH
- File Number — 41.0804.3.G312

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 upstream of 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)
  - APF--AC Power Supply (13,800 Volts)
  - APH--DC Power Supply
  - API-—Uninterruptible Power Supply
- File Number — 41.0804.03.G401

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:

- 13.8 kV 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 (13,800V) (APF)

The 13,800V 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 13,800V to serve the Unit 4 switchgear buses A, & B.
- One neutral grounding resistor on each secondary winding of each auxiliary transformer.

The 13,800V system shall also consist of the following major components:

- Two (2) 13,800V 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 13.8 kV switchgear shall be arc resistant and of two-high construction. The switchgear shall be located within the AQC Electrical Building.

- 15 kV cable bus.
- 13.8 kV medium voltage circuit breakers and contactors.
- Four (4) variable frequency drives (VFD) fed from the 13.8 kV SWGR A & B respectively. Each drive will power and control a ID fan motor. The VFDs will be located within the ID Fan VFD Enclosure.

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-G4DE-E1004
- Conceptual Overall One Line – Common: 168908-GCDE-E1005

System Description

1.1 System Identification

- Unit Designation — Unit 4
- System Name — Communication
- System Code — CMA
- File Number — 41.0804.3.G402

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.

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 Ghent 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 Ghent Unit 4 system.

Raceway and space provisions for telephone/LAN equipment 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.G403

1.2 Function

The existing Emerson Ovation 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 4 workstations located in the Unit 4 Ghent 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 Primary and Secondary Fan Switches, and the addition of new redundant controllers to control the new AQCS common unit equipment. The AQCS DCS equipment shall communicate by means of redundant network data highways.

The AQCS DCS equipment shall include the following major components:

- AQC Network Cabinet/Fiber Optic Patch Panel.
- Redundant Controllers.
- DCS system cabinets and input/output (I/O) cabinets.

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1.3 Process Description

The AQCS DCS control processors 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 4 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 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:

- AQCS Electrical Building.

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.G404

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.G405

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. .

1.3.1 Unit 4 PJFF Structure

Unlike the PJFFs at Units 1 through 3, the Unit 4 pulse jet fabric filter 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 ID fans. The structure will provide support to the PJFF installed above it. The hopper area above the working floor and below the PJFF will be enclosed for weather protection. Lighting, heating, and ventilation will be included.

At the time of this report, preliminary design is underway for a common Unit 3/Unit 4 dry fly ash handling system to be housed in a building located adjacent to the proposed location for the Unit 4 PJFF. It is assumed that this building will be in place and operational by the time of Stage II modifications and the design of the Unit 4 PJFF foundation will have to take that building into account.

1.3.2 Unit 4 AQCS Electrical Building

The Unit 4 AQCS Electrical Building will house additional electrical and control equipment serving the new PJFF and the ID fans, with a separate room intended to house the compressed air system serving the PJFF. The Electrical Building is intended as a single story pre-engineered metal building mounted to a perimeter 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. The wall between electrical equipment and the compressor system will be of masonry construction to maintain the necessary code-required fire barrier. 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 Unit 4 Booster Fan VFD Enclosure

The VFD Enclosure houses the variable frequency drive equipment serving the four new Unit 4 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.

System Description

1.1 System Identification

- Unit Designation Unit 4
- System Name Fly Ash
- System Code ASB
- File Number 41.0804.3.G406

1.2 Function

At time of this report, design of a new Common Fly Ash Handling Facility serving both Units 3 and 4 is underway under separate contract. It is assumed for purposes of this report that the new ash facility will be completed and in operation at the time Unit 4 AQCS modifications are made.

The Fly Ash System will pneumatically remove fly ash from the pulse jet fabric filter (PJFF) hoppers and transfer it to the existing ash handling system. In addition, the ash handling system will transfer powdered activated carbon (PAC) which is injected upstream of the PJFF and collected in the PJFF hoppers. The collected fly ash byproducts will be conveyed to the existing Unit 4 filter/separator. The collected ash will subsequently be transferred by a pressurized pneumatic blower system to the ash storage and loadout silos at the coal combustion residue (CCR) facility south of Highway 42. The process is shown on drawing 168908-G4ASB-M2022: Unit 4 PFD - Fly Ash Handling.

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)
- Unit 4 filter/separator (existing at time of AQCS modifications)
- Common fly ash and loadout silos (existing).

The Fly Ash System will be essentially an extension of the existing vacuum transport system and will service all the PJFF material collection hoppers. Each collection point in the Fly Ash System will be tied into the existing pneumatic vacuum conveying system arranged in a new branch line from the main ESP conveying header. The existing filter separators and mechanical exhausters were designed to account for the additional ash, PAC, and any remaining sorbent collected in the PJFF hoppers. System capacity and operating margin will be confirmed during detailed design.

Each PJFF 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 will sequentially remove ash from the PJFF hoppers and transfer it to the existing Unit 4 filter separator in the Common Unit 3/Unit 4 Fly Ash Handling Facility. The ash will then be transported via the existing pressure conveying system to the existing storage and loadout silos at the CCR facility.

System Description

1.1 System Identification

- Unit Designation — Unit 4
- System Name — Induced Draft
- System Code — CCE
- File Number — 41.0804.3.G407

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.

- Four new 25 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 electrical noise to the driven equipment.
- 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, electrostatic precipitators, 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 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 new centrifugal ID 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. 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 and primary air fans, combustion flue gas will flow from the new PJFF outlet to the inlet duct of each ID fan. The separate flow paths of the draft system will be retained with the addition of the PJFF system. The new ID fans will be sized to achieve 100 percent of the MCR condition with three ID fans in service and 60 percent of the MCR condition with two ID fans in service. The ID fans will discharge into a ductwork header which will exhaust combustion flue gas through the 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 outlet of the steam generator to the electrostatic precipitators, the SCR system, the air heaters, the new PJFF system, then to the new ID fans. The flow path exiting the ID fans will enter the existing WFGD scrubber and 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.G408

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 new 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 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.G409

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.G410

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 a room within the Unit 4 AQCS Electrical Building.

System Description

1.1 System Identification

- Unit Designation — Unit 4
- System Name — AQCS Service Water
- System Code — WSC
- File Number — 41.0804.3.G411

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 for 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 — Powder Activated Carbon Injection
- System Code — CCH
- File Number — 41.0804.3.G412

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 upstream of 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.