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|  | SYSTEM DESCRIPTION            | FILE NO. 141643.43.0258 |
|  | FGD OXIDATION AIR SYSTEM (ZO) | AEP 031406-D            |

## **AMERICAN ELECTRIC POWER**

**Big Sandy Unit 2**

### **FGD Oxidation Air System (ZO)**

**FILE NO: 141643.43.0258**

**SYSTEM DESCRIPTION**

**ISSUE DATE AND REVISION NO.**  
**03/14/06-D**

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## 1.0 Description of Process

### 1.1 General

The primary function of the Flue Gas Desulfurization (FGD) Oxidation Air System is to provide the air needed to oxidize the bisulfite ions to sulfate ions in the jet bubbling reactor (JBR) absorber. This is part of a process that results in the production of a gypsum ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ) byproduct solid.

The secondary function of the FGD Oxidation Air System is to assist in slurry agitation and to maintain the froth zone which maximizes efficiency.

### 1.2 System Design

The FGD Oxidation Air System conveys air from the FGD oxidation air blowers to the air spargers located in the JBR in the FGD Absorber System (ZA). The oxidation air is cooled/quenched by water from the Service Water System (SW) prior to entering the JBR absorber to prevent scaling at the injection nozzles.

The FGD Oxidation Air System employs three, 50 percent capacity oxidation air blowers. Two blowers are online during normal operation of the JBR and one is on standby as a common spare. The blower intake air is filtered upstream of the blower by inlet air filters (one air filter for each oxidation air blower). Filtration is 98 percent removal efficiency for 2 micron and larger particulates.

An annubar-type flow element, thermocouple, and pressure transmitter are mounted in the JBR main oxidation air header. These flow elements provide a temperature and pressure adjusted flow signal to the Distributed Control System (DCS) for monitoring.

The oxidation air blowers are located in the Oxidation Air Blower Building due to noise considerations and for ease of maintenance. The inlet filter/silencers and blower lube oil coolers will be located outside of the building.

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## 2.0 Description of Major Equipment

### 2.1 FGD Oxidation Air Blowers

#### 2.1.1 Component Identification

Component Name: FGD Oxidation Air Blowers

Component Identification No.:

02-ZO-CP-8001-01 through 02-ZO-CP-8001-03: Oxidation Air Blowers

02-ZO-ST-8001-01 through 02-ZO-ST-8001-03: Air Filters

#### 2.1.2 Function

The oxidation air blowers take outdoor air for use in the JBR absorber and increase the air pressure from atmospheric to the 10 psi required by the JBR at the 78,500 lbs/hr (dry air).

#### 2.1.3 Description

Each blower is a packaged, centrifugal type blower complete with blower motor, flexible couplings, gearbox, local control panel, inlet air filter, oil pumps, oil cooler, sound enclosure, and oil reservoir piped and mounted on a common skid. Each oxidation air blower has its own skid-mounted PLC. The blowers are located in the Oxidation Air Blower Building due to noise considerations. Motors are medium voltage (4kV) with WP2 enclosures.

#### 2.1.4 Sizing Criteria

The blowers are sized to supply a minimum of four times the stoichiometric air required to oxidize the bisulfite ( $\text{SO}_3^{2-}$ ) ions to sulfate ( $\text{SO}_4^{2-}$ ) ions in the JBR. Each blower is sized to develop sufficient pressure to overcome all line losses, as well as to overcome the head of the JBR absorber. Each blower is sized as indicated in Table 2-1.

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**Table 2-1. FGD Oxidation Air Blower System Design Conditions**

|                        |                        |
|------------------------|------------------------|
| Blower capacity        | 78,500 lbs/h (dry air) |
| Inlet pressure         | 14.40 psia             |
| Inlet temperature (°F) | -20 to 97              |
| Outlet pressure (psig) | 10.0                   |

### **2.1.5 Materials Selection**

Blower materials are the manufacturer's standard for the intended service, and conform to the applicable standards.

### **2.1.6 Inlet Filter/Silencer**

An Inlet filter/silencer is provided for each blower by the manufacturer. The filter/silencer is located outside of the oxidation air blower building with piping to transfer the air to the intake of the blower. The filter is rated at 150% of the maximum design flow at 98% overall removal of particles at 2 microns and larger. This is achieved with a two-stage cartridge-type filtering system. The first stage is a pre-filter with a 98% efficiency at 10 microns. The second stage is the primary filter with a 99.97% removal at 2 microns.

### **2.1.7 Inlet Guide Vanes**

Inlet Guide Vanes (IGV) are provided for each blower by the manufacturer. The IGVs are controlled by the PLC using data supplied by the discharge annubar-type flow element. They have a mechanical pointer for local indication of the device position, and a continuous position transmitter to monitor the control device position from full open to close.

### **2.1.8 Lube Oil System**

The lube oil system is provided for each blower by the manufacturer. The lube oil system consists of an oil reservoir, shaft driven oil pump, auxiliary electric oil pump, reverse rotation protection, air-cooled oil cooler, duplex/dual oil filters. The oil reservoir is a carbon steel baseplate/reservoir capable of holding 55 gallons of lube oil. The main oil pump is driven off of the blower gearbox low speed shaft.

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The auxiliary oil pump is 460 V 3 phase and will be controlled by the PLC. The auxiliary oil pump runs before startup of the blower, to insure the blower is properly lubricated. The auxiliary oil pump also operates on a low oil pressure signal to the PLC. The reverse rotation valving is provided by the manufacturer to protect the equipment in the event of the blower operating in the reverse direction. The air-cooled oil cooler is used to maintain a constant oil temperature for the bearings. This is accomplished by using a three-way thermostatic control valve. The air-cooled oil cooler fan is controlled by a temperature switch in the lube oil process line. The duplex/dual oil filter element is a full flow, replaceable cartridge type installed in the oil piping after the oil cooler. The filter is a 10 micron oil filter with a pressure drop of less than 5 psi with a clean oil filter.

#### **2.1.9 Programmable Logic Controller**

The Programmable Logic Controller (PLC) is provided by the manufacturer. The PLC is an Allen Bradley Controllogix for the oxidation air blowers.

#### **2.1.10 Vibration Monitoring System**

The vibration monitoring is provided by the manufacturer using velocity transducers, proximity probes, and a Bently Nevada 3500 monitoring system. Each blower fast shaft radial bearing has X and Y proximity probes. The fast shaft thrust bearing will have an axial proximity probe. The main drive motor bearings will have velocity transducers, since they are anti-friction bearings. The monitor is mounted in a separate NEMA 4X enclosure.

#### **2.1.11 Acoustic Sound Enclosure**

The sound enclosure is a partial enclosure covering the blower housing end of the skid. The acoustic enclosure has removable panels to ease in maintenance of the blower. The acoustic enclosure also has an exhaust fan that will operate continuously with the starting of the oxidation air blower.

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## **2.2 Piping and Valves**

### **2.2.1 Component Identification**

Component Name: Piping and Valves

Component Identification No.: Various

### **2.2.2 Function**

The FGD Oxidation Air System piping and valves convey the required volume of oxidation air at the required pressure to the JBR.

### **2.2.3 Description**

The piping and valve components are arranged to convey oxidation air to the JBR. Each blower has a butterfly valve to isolate the blower from the main header it feeds. Each blower also has an inlet and discharge expansion joint, a wafer style check valve, and a blowoff valve with a silencer. The JBR has a main oxidation air header that conveys the oxidation air from the blower to the side headers that encircle the JBR. Each of the two side headers connects to 14 separate oxidation air sparger connections on the sidewall of the JBR absorber.

Where personnel may come in contact with the piping, the piping is insulated as necessary to meet OSHA and AEP personal protection requirements.

### **2.2.4 Sizing Criteria**

Piping and valves are designed and constructed to supply air at the rate specified in Table 2-1. The main header piping and valves are designed and constructed to supply air at the rate specified in the previous table while maintaining an air velocity less than 4,000 ft/min.

### **2.2.5 Materials Selection**

Piping material for the FGD Oxidation Air System is seamless or seam welded carbon steel. The piping and valves are ANSI standard 125/150 psi rated materials.

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### **3.0 Description of Major Interlocks**

Specific interlocks, trips, and alarms will be determined during detail design.

## **4.0 Description of System Operation and Control**

### **4.1 Instrumentation and Control**

Each Oxidation Air Blower is controlled by a local mounted PLC with a DCS interface to the plant control room. The PLC allows control of the individual blower components by the DCS in the remote automatic and remote manual modes. The PLC is an Allen Bradley Control Logix.

In the remote automatic control mode, the PLC starts/stops the blower components according to programmed sequences and interlocks as directed by the control logic. In the remote manual control mode, the individual components are started or stopped by the operator. The protective interlocks remain in service during remote normal operation.

During normal operation, two FGD oxidation air blowers operate continuously. If the flow transmitter in the header senses low flow, the DCS is annunciated. The operator must then decide whether to start the standby blower.

Inlet flow control allows for flow adjustment based on ambient conditions. Blower turndown based on coal sulfur content is not allowed.

Each blower building is provided with a Bentley Nevada 3500 vibration monitoring system using X,Y, and Z proximity probes for the compressor rotor and velocity transducers on the motor bearings. The monitor is mounted in a separate NEMA 4X enclosure. Motor and blower bearings are outfitted with 100 ohm platinum RTDs. Motor stator windings are likewise outfitted with RTDs.

### **4.2 System Operation**

To be completed during detail design.

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### 4.3 Redundancy

There are two 50 percent capacity blower packages and one spare 50 percent blower package common to the JBR absorber. All three blowers are headered together into a common discharge. Each blower has a discharge isolation butterfly valve for maintenance.

### 5.0 Descriptions of Provisions for Flushing and Testing

To be completed during detail design.

### 6.0 Description of Provisions for Maintenance

To be completed during detail design.

### 7.0 Description of Hazardous Area/Materials

To be completed during detail design.

### 8.0 References

#### 8.1 Flow Diagrams

| Black & Veatch Drawing No. | AEP Drawing No. |
|----------------------------|-----------------|
| 141643-02ZO-M2258A         | 02-5 1 8008A-B  |
| 141643-02ZO-M2266B         | 02-5 1 8008B-B  |
| 141643-02ZO-M2266C         | 02-5 1 8008B-B  |

#### 8.2 General Arrangements

| Worley Parson Drawing No. | AEP Drawing No. |
|---------------------------|-----------------|
|                           |                 |

#### 8.3 Electrical One-Line Drawings

Later

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## 8.4 Descriptive Articles

Later

## 8.5 Codes and Standards

Applicable codes and standards for the FGD Oxidation Air System include the following:

- National Electrical Manufacturers Association (NEMA)
- American National Standards Institute (ANSI)
- American Society of Testing and Materials (ASTM)
- American Society of Mechanical Engineers (ASME)
- Institute of Electrical and Electronic Engineers (IEEE)
- American Gear Manufacturers Association (AGMA)

## 8.6 Regulatory Requirements

The FGD Oxidation Air System complies with all applicable state laws, local ordinances, and requirements of the Federal Occupational Safety and Health Standards, 29 CFR 1910, General Industry and 29 CFR 1926, Construction Industry.