

	SYSTEM DESCRIPTION	FILE NO. 141643.43.0259
	FGD REAGENT PREPARATION SYSTEM (ZP)	AEP 031406-D

AMERICAN ELECTRIC POWER

Big Sandy Unit 2

FGD Reagent Preparation System (ZP)

FILE NO: 141643.43.0259

SYSTEM DESCRIPTION

ISSUE DATE AND REVISION NO.
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1.0 Description of Process

1.1 General

The function of the Flue Gas Desulfurization (FGD) Reagent Preparation System is to convert the purchased limestone product delivered to the plant site into a reagent slurry for use in the FGD Absorber System (ZA).

1.2 System Design

The system employs two independent 100 percent-capacity reagent preparation trains. Limestone product from the limestone reagent storage pile is fed to the Reagent Preparation System by the FGD Reagent Unloading, Transfer, and Storage System (ZU).

The limestone product is fed from each limestone silo onto its associated weigh belt feeder prior to delivery to the ball mill. The weigh belt feeder controls the rate of limestone fed into the ball mill. Reclaim water from the FGD Reclaim Water System (ZC) is added to the mill and ball mill slurry tank proportional to the limestone feed rate.

The ball mills are horizontal, wet, overflow discharge type mills partially filled with steel grinding balls. A low speed drive rotates the mill circulating the balls inside. The motion of the balls grinds the limestone very finely and produces a 60 to 65 weight percent slurry. The reagent slurry classifier underflow is recycled to the ball mill and a portion of the total reclaim water is added to the ball mill inlet to assist in the grinding process.

The slurry is then discharged from the ball mill to a ball mill slurry tank. Reclaim water is added to the ball mill slurry tank to achieve the desired slurry density based on sample density analysis and feedback control. The ball mill slurry pumps then pump the tank contents to the reagent slurry classifier, which consists of a bank of hydrocyclone classifiers. The underflow and overflow lines flow from the classifier to the distribution box. In normal operation, the distribution box will send the underflow slurry back to the ball mill for additional grinding and the overflow slurry to the reagent storage tank. When the level in the ball mill slurry tank reaches the low level alarm, the overflow line will then discharge back to the ball mill slurry tank. If the low-low level is reached, the

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underflow line will also return slurry back to the ball mill slurry tank. Agitators in the ball mill slurry tanks and reagent storage tanks maintain the limestone slurry in suspension.

The limestone slurry in the reagent storage tanks is circulated in a continuous loop by the reagent feed pumps. A portion of the slurry in the loop is fed to the JBR absorber reaction tank to maintain the pH in the absorber for proper reaction between the limestone and SO₂. The FGD Reagent Preparation System is designed to provide enough slurry for the Unit 2 absorber.

Tank and piping drains, leaks, drips, and floor wash down are collected in the reagent preparation area sump, located in the FGD Sumps System. The Reagent Preparation Area sump collects equipment and maintenance drains by means of trenches from the FGD Reagent Preparation System (ZP).

Components within these systems that use the reagent preparation area sump are: the drains and overflows from the ball mill slurry tanks, flushing of the ball mill slurry pump suction piping, drains and overflows from the reagent storage tanks, and flushing of the reagent feed pump suction piping. The sump pumps normally return the collected drains to either of the reagent storage tanks. The operator also has the option of discharging the water to the dilution tanks.

The FGD Reagent Preparation System operating conditions are presented in Table 1.

The reagent slurry produced is erosive and mildly corrosive. The slurry's erosive characteristic is due to the level of suspended solids in the slurry and the angular nature of the slurry particles. The corrosive characteristic is a result of the use of reclaim water with relatively high chloride levels as the makeup water source.

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Table 1. FGD Reagent Preparation System Operating Conditions

Parameter	Value
Limestone	89% purity CaCO ₃
Reagent Slurry	
Grind size	90% passing 200 mesh
Weight percent solids, wt%	30
Capacity, tph (dry wt)	43.6
Reagent feed rate to JBR at design conditions (gpm)	376 to Unit 2
Reclaim Water	
Weight percent solids, wt%	2 – 3
Temperature, °F	40 to 130
pH	4.0 to 7.0
Chloride, ppm (max.)	12,000

2.0 Description of Major Equipment

The FGD Reagent Preparation System contains the following components:

- Limestone silos with dust collectors
- Weigh belt feeders
- Ball mills
- Ball mill slurry tanks
- Ball mill slurry tank agitators
- Ball mill slurry pumps
- Reagent slurry classifiers (hydrocyclones)
- Distribution boxes
- Reagent storage tanks
- Reagent storage tank agitators

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- Reagent preparation area sump
- Reagent preparation area sump agitators
- Reagent preparation area sump pumps
- Reagent feed pumps
- Slurry piping
- Slurry valves

2.1 Limestone Silos

2.1.1 Component Identification

Component Name: Limestone Silos A and B
Component Identification No.: 02-ZU-SL-8101
02-ZU-SL-8201

2.1.2 Function

The limestone silos store bulk limestone product. The long rectangular design of the discharge chute provides the means to dispense the limestone product into the ball mills via the weigh belt feeders.

2.1.3 Description

Two limestone silos are provided, each furnished complete with a slide gate and pulse-jet fabric type dust collector. Commercial grade limestone is fed to the top of the silo by conveyor(s) from the FGD Reagent Unloading, Transfer, and Storage System (ZU).

2.1.4 Sizing Criteria

Each silo is sized for approximately 12 hours (540 tons) of limestone storage when burning the design 4.5 lb/MMBtu coal. The combined limestone silo capacity is approximately 24 hours (1080 tons) of limestone storage.

2.1.5 Materials Selection

The liner ring and cone is fabricated of wear resistant material. The materials used are the manufacturer's standard for this service.

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2.2 Weigh Belt Feeders

2.2.1 Component Identification

Component Name: Weigh Belt Feeders A and B
Component Identification No.: 02-ZU-CV-8101
02-ZU-CV-8201

2.2.2 Function

The weigh belt feeders receive material from the limestone silo and meter the material to the ball mill at a variable rate.

2.2.3 Description

Two weigh belt feeders are provided, one for each limestone silo. The weigh belt feeders are short-pulley-center belt conveyors with continuous loading skirt, material bed depth regulating gate, and discharge chute.

2.2.4 Sizing Criteria

The weigh belt feeders are designed to feed up to a maximum of 44 tons per hour of coarse limestone product.

2.2.5 Materials Selection

The weigh belt feeder structural frame and feeder pulleys are fabricated of carbon steel materials. The feeder belt is fabricated from a minimum Grade 2 synthetic rubber top and bottom with a synthetic fiber core.

2.3 Ball Mills

2.3.1 Component Identification

Component Name: Ball Mills A and B
Component Identification No.: 02-ZP-BM-8101
02-ZP-BM-8201

2.3.2 Function

The ball mills convert the commercially delivered limestone product into a limestone slurry for use in the flue gas absorber.

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2.3.3 Description

Two horizontal wet type, overflow discharge ball mills are provided. Each ball mill produces sufficient reagent slurry to supply the reagent demand of the FGD system Unit 2 at design conditions.

Each ball mill is connected to its drive motor by an oil-lubricated gear reducer. The lubrication oil is continuously circulated between the gear reducer and the air-cooled lube oil cooler by the ball mill lube oil pumps. Ball mill motors are medium voltage (4 kV) and rated at 1200 hp.

2.3.4 Sizing Criteria

The ball mills are sized to operate 24 hours a day and process 43.6 stph of dry limestone product with a design feed size of 3/4 inch by 0 inch. The design grind fineness is 90 percent less than 200 mesh (74 μ m).

2.3.5 Materials Selection

Ball mill shells are stress-relieved carbon steel. Heads are cast iron with integral cast trunnions. The ball mill chamber walls and heads are lined with a rubber lining. The lining lifting bars are rubber. The grinding balls are carbon steel.

2.4 Ball Mill Slurry Tanks

2.4.1 Component Identification

Component Name: Ball Mill Slurry Tanks A and B
Component Identification No.: 02-ZP-TK-8101
02-ZP-TK-8201

2.4.2 Function

The ball mill slurry tanks receive the overflow from the ball mill and provide adequate net positive suction head (NPSH) for the ball mill slurry pumps.

2.4.3 Description

Two ball mill slurry tanks are provided, one for each ball mill.

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Each ball mill slurry tank is an above-grade, shop-fabricated, cylindrical, open-top tank. The tanks are designed to support the top-entry ball mill slurry tank agitator. The tanks are provided with an overflow, vent, drain, one 30 inch manway, and an 8 inch by 16 inch removable panel. The tanks are equipped with wall mounted anti-swirl baffles.

2.4.4 Sizing Criteria

The active volume of each ball mill slurry tank provides approximately 5 minutes of storage time at the design output of the ball mill slurry pump assuming no recycle from the reagent slurry classifier. In setting the active tank volume, the minimum slurry level takes into consideration the minimum submergence of the ball mill slurry tank agitator. The tank overflow piping is sized to evacuate the maximum anticipated total inflow from the ball mill output and distribution box return to prevent the tanks from overflowing to grade.

2.4.5 Materials Selection

The ball mill slurry tanks are fabricated from ASTM A36 carbon steel. The tank interior is protected with a natural rubber lining, and the tank exterior is protected with a primer and finish coating.

2.5 Ball Mill Slurry Tank Agitators

2.5.1 Component Identification

Component Name: Ball Mill Slurry Tank Agitators A and B
Component Identification No.: 02-ZP-AG-8101
02-ZP-AG-8201

2.5.2 Function

The ball mill slurry tank agitators keep the slurry solids contained in the ball mill slurry tank in suspension.

2.5.3 Description

Two ball mill slurry tank agitators are provided, one for each ball mill slurry tank. Each ball mill slurry tank agitator is a top-entry, gear-driven, axial flow type agitator with a long cantilevered shaft. Each agitator's electric motor drive, speed

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reducer, and shaft bearings are located on support steel at the top of the ball mill slurry tank.

Depending on the vendor and design selected, the agitator impeller may be either three- or four- bladed.

The agitator mix pattern is downward toward the tank floor. The ball mill slurry tanks are fitted with two to four baffles designed to minimize swirl effects caused by the agitator mixing dynamics.

2.5.4 Sizing Criteria

Each agitator is sized to produce off-bottom motion of all slurry particles. The design conditions are 55 to 65 weight percent limestone slurry with a mean diameter of 74 μm in diameter and a particle specific gravity of 2.71.

2.5.5 Materials Selection

The agitator shaft and blades are carbon steel covered with natural rubber.

2.6 Ball Mill Slurry Pumps

2.6.1 Component Identification

Component Name:	Ball Mill Slurry Pumps A1, A2, B1, B2
Component Identification No.:	02-ZP-PP-8101-01
	02-ZP-PP-8101-02
	02-ZP-PP-8201-01
	02-ZP-PP-8201-02

2.6.2 Function

The ball mill slurry pumps transfer slurry from the ball mill slurry tanks to the reagent slurry classifiers.

2.6.3 Description

Four ball mill slurry pumps are provided, two for each ball mill train. Each ball mill slurry pump is a vertically split case, end suction, belt driven centrifugal slurry pump. These pumps handle an abrasive slurry with up to 65 weight percent

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solids. They are equipped with mechanical shaft seals. The pumps are equipped with variable-speed drives. The pump motors are 125 hp with a nameplate rating of 460V.

2.6.4 Sizing Criteria

Each ball mill slurry pump is sized to provide 100 percent of the design reagent slurry requirements for the JBR. Pump sizing criteria is set by the ball mill supplier as part of the process design.

2.6.5 Materials Selection

The ball mill slurry pumps are fabricated from materials suitable for the corrosive and erosive nature of the reagent slurry. The pump casings are hard metal or hard metal-lined. The pump impellers are abrasion-resistant high-chrome cast iron.

2.7 Reagent Slurry Classifiers

2.7.1 Component Identification

Component Name: Reagent Slurry Classifiers A and B
Component Identification No.: 02-ZP-HC-8101
02-ZP-HC-8201

2.7.2 Function

The reagent slurry classifiers classify the slurry from the ball mill to meet the required grind fineness.

2.7.3 Description

Two reagent slurry classifiers are provided, one for each ball mill train.

The reagent slurry classifiers consist of a cluster of hydrocyclones operating in series around a central feed chamber. Each hydrocyclone can be manually isolated from the feed chamber by a knifegate valve. The individual hydrocyclone overflows (fine particle product slurry) and underflows (oversize particle slurry) are collected in the common overflow and underflow launders.

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Slurry in the overflow launder and underflow launder is directed to the distribution box.

2.7.4 Sizing Criteria

Reagent slurry classifier sizing is set by the ball mill supplier as part of its overall process design. A minimum of one spare hydrocyclone to a maximum of 20 percent spare hydrocyclones are provided in each reagent slurry classifier.

2.7.5 Materials Selection

The individual hydrocyclones have carbon steel bodies with replaceable rubber linings. The replaceable hydrocyclone discharge apexes are fabricated of nitride-bonded silicon carbide. The central feed chamber and inlet and outlet launders are fabricated of carbon steel with rubber linings.

2.8 Distribution Boxes

2.8.1 Component Identification

Component Name: Distribution boxes A and B
Component Identification No.: 02-ZP-QQ-8102
02-ZP-QQ-8202

2.8.2 Function

The distribution boxes are used to control the slurry liquid level in the ball mill slurry tanks by regulating the amount of classifier product that is returned to the tank. This control ensures that the ball mill slurry pumps have sufficient net positive suction head (NPSH).

2.8.3 Description

Two distribution boxes are provided, one for each ball mill train.

The distribution boxes are above-grade, open-top, rectangular vessels located at an elevation above the ball mill slurry and reagent storage tanks. The vessels are divided into three compartments. The underflow and overflow hoses from the reagent slurry classifier are controlled by actuating arms that move the ends of the hose into the appropriate compartment. One compartment returns slurry to

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the ball mill for additional grinding, one returns slurry to the ball mill slurry tank, and one sends slurry to the reagent storage tank. The underflow line typically empties into the compartment that returns the slurry back to the ball mill. The overflow line typically empties into the compartment that sends the slurry to the reagent storage tanks. Both of these lines can move to the middle compartment to fill up the ball mill slurry tank if necessary.

2.8.4 Sizing Criteria

The distribution box sizing is set by the ball mill supplier (FFE Minerals) as part of its overall process design.

2.8.5 Materials Selection

The distribution box vessels are fabricated of carbon steel, and the vessel inside walls and floor are rubber lined.

2.9 Reagent Storage Tanks

2.9.1 Component Identification

Component Name: Reagent Storage Tanks A and B
Component Identification No.: 02-ZF-TK-8001-01
02-ZF-TK-8001-02

2.9.2 Function

The reagent storage tanks provide storage and surge capacity for the limestone slurry produced by the two ball mill trains as well as adequate net positive suction head (NPSH) for the reagent feed pumps.

2.9.3 Description

Two reagent storage tanks are provided. Both ball mill trains have separate inlets into each tank. The reagent storage tanks are above-grade, field erected, cylindrical, open-top tanks. Each reagent storage tank is equipped with a structural steel assembly/walkway for support of the reagent storage tank agitator. The tanks are provided with an overflow, drain, one 30-inch manway, and an 8 inch by 16 inch removable panel. Each tank is equipped with wall-mounted anti-swirl baffles. Each tank is supported on a concrete ring wall

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foundation with compacted backfill covered by lean concrete crowned at the tank center.

2.9.4 Sizing Criteria

Each tank volume provides 6 hours reagent slurry supply at the design reagent consumption rate of 33.3 short tons per hour (dry) at 30 percent solids by weight. The approximate size of each reagent storage tank is 32 feet in diameter by 34 feet in straight side height. The active volume of each reagent storage tank is approximately 135,400 gallons. The gross capacity of each tank is approximately 204,600 gallons, which allows adequate height to ensure that each agitator operates with the proper submergence during discharge of the entire useful volume of the tank. Each tank's overflow piping is sized to evacuate the maximum anticipated total inflow from the distribution boxes and reagent area sump to prevent the tanks from overflowing to grade.

2.9.5 Materials Selection

Each reagent storage tank is constructed from ASTM A36 carbon steel and is rubber lined to protect the tank interior from corrosion and erosion. Each tank also has an exterior primer and finish coating to protect the tank exterior.

2.10 Reagent Storage Tank Agitators

2.10.1 Component Identification

Component Name: Reagent Storage Tank Agitators A and B
Component Identification No.: 02-ZF-AG-8001-01
02-ZF-AG-8001-02

2.10.2 Function

The reagent storage tank agitators keep the slurry solids contained in the reagent storage tank in suspension.

2.10.3 Description

Two agitators are provided, one for each reagent storage tank. Each reagent storage tank agitator is a top-entry, gear-driven, axial flow type agitator with a

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long, cantilevered shaft. Depending on the vendor and design selected, the agitator impellers may either be three- or four-bladed.

The agitator mix pattern is downward toward the tank floor. The reagent feed tanks are fitted with two to four baffles designed to minimize swirl effects caused by the agitator mixing dynamics.

2.10.4 Sizing Criteria

Each reagent storage tank agitator is sized to produce off-bottom motion of all slurry particles. The design conditions are 30 weight percent limestone slurry with 90 percent of the particles less than 74 μm in diameter with a slurry specific gravity of 1.23 and a particle specific gravity of 2.71.

2.10.5 Materials Selection

The agitator shaft and blades are carbon steel covered with natural rubber.

2.11 Reagent Feed Pumps

2.11.1 Component Identification

Component Name: Reagent Feed Pumps A and B
Component Identification No.: 02-ZF-PP-8001-01
02-ZF-PP-8001-02

2.11.2 Function

The reagent feed pumps transfer limestone reagent slurry from the reagent storage tanks to the JBR absorbers.

2.11.3 Description

Two reagent feed pumps are provided, with each pump capable of drawing reagent slurry from either reagent storage tank. Each reagent feed pump is a vertically split case, end-suction, constant speed, belt-driven, centrifugal slurry pump. Each pump handles abrasive slurry with up to 30 weight percent solids and is equipped with mechanical shaft seals. The pump motors have a nameplate rating of 460V.

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2.11.4 Sizing Criteria

Each reagent feed pump is sized to provide 100 percent of the design reagent slurry requirements for the Unit 2 JBR. The pumps are sized to maintain the velocity of the slurry in the reagent feed loop piping in the range of 4 to 10 ft/sec while the reagent feed to the JBR varies from 4 to 10 ft/sec as well.

2.11.5 Materials Selection

The reagent feed pumps are fabricated from materials suitable for the corrosive and erosive nature of the reagent slurry. Each pump casing is hard metal or hard metal-lined. The pump impeller is abrasion-resistant, high-chrome cast iron.

2.12 Reagent Preparation Area Sump

2.12.1 Component Identification

Component Name: Reagent Preparation Area Sump
Component Identification No.: None

2.12.2 Function

The reagent preparation area sump collects wastewater via trenches from the ball mills, ball mill slurry tank drains, and the reagent storage tank drains. Also, this sump periodically collects drains from the flushing operation of the ball mills, ball mill slurry pumps and piping, and reagent feed pumps and piping.

2.12.3 Description

The sump is a below-grade, reinforced concrete structure coated with a lining suitable for the corrosive nature of the wastewater.

2.12.4 Sizing Criteria

The active volume of the reagent preparation area sump is (Later) gallons. The active volume of the sump is based on maintaining the sump pumps to a maximum of 4 starts per hour. The maximum uncontrollable inlet flow for the sump is considered the flushing of lines and pumps in the system. In setting the active tank volume, the minimum slurry level takes into consideration the minimum submergence of the reagent preparation sump agitator.

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2.12.5 Material Selection

The sump is reinforced concrete structure coated with a protective lining suitable for the corrosive nature of the wastewater.

2.13 Reagent Prep Area Sump Agitator

2.13.1 Component Identification

Component Name: Reagent Prep Area Sump Agitator
Component Identification No.: 02-ZP-AG-8001

2.13.2 Function

The sump agitators keep the slurry solids contained in the sumps in suspension.

2.13.3 Description

One agitator is provided for the sump.

The sump agitator is a top-entry, gear-driven, axial flow type agitator with a long, cantilevered shaft. The agitator's electric motor drive, speed reducer, and shaft bearings are located on support steel over the sump. Depending on the vendor and design selected, the agitator impeller may be either three- or four-bladed. The agitator's mix pattern is downward toward the sump floor.

2.13.4 Sizing Criteria

The agitator is sized to produce off-bottom motion of all slurry particles in the sump. For the reagent preparation area sump, the design conditions are 30 weight percent limestone slurry with 90 percent of the particles less than 74 μm in diameter. The specific gravity of the slurry is 1.23 and a particle specific gravity of 2.71.

2.13.5 Materials Selection

The agitator shaft and blades are carbon steel covered with natural rubber.

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2.14 Reagent Prep Area Sump Pumps

2.14.1 Component Identification

Component Name: Sump Pumps
Component Identification No.: 02-ZP-PP-8001-01
02-ZP-PP-8001-02

2.14.2 Function

The function of the FGD reagent preparation sump pumps is to transfer the collected drains to either of the reagent storage tanks. The operator also has the option to the byproduct slurry tank.

2.14.3 Description

Two 100 percent submersible sump pumps are provided for the reagent preparation area sump.

The sump pumps are submersible, constant speed pumps designed for slurry service and fitted with mechanical seals. The nameplate rating of the motors is 460V.

2.14.4 Sizing Criteria

Each reagent preparation area sump pump is sized to provide 100 percent of the design transfer requirements for the sump. The pumps are sized to maintain the velocity of the slurry in the sump pump piping in the range of 4 to 10 ft/sec for the required maximum sump input flow rate. The maximum input flow rate for reagent preparation area sump is the maintenance flush water.

2.14.5 Materials Selection

Pumps are of heavy-duty design with metallurgy (28% Cr) designed for the given application. The pumps have mechanical seals. The pump discharge line is heavy-duty slurry hose from the pump discharge to a flange located at the top of the sump.

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2.15 Slurry Piping

2.15.1 Component Identification

Component Name: Slurry Piping

Component Identification No.: None

2.15.2 Function

The slurry piping transports limestone reagent slurry and reclaim water between the components of the FGD Reagent Preparation System.

2.15.3 Description

The slurry piping is pressure piping with materials of construction specifically selected for the abrasive and corrosive nature of the process flows conveyed. For primary flow slurry lines (i.e., suction and discharge piping on the reagent feed pumps), the pipe material is abrasion-resistant FRP. For secondary flow slurry lines (i.e., drain lines to sumps), the pipe material is non-abrasion-resistant FRP.

2.15.4 Sizing Criteria

For pipe conveying limestone slurry, the pipe sizes are selected to maintain the slurry velocity in the range of 4 to 10 ft/sec. Where practical, the slurry velocity is maintained in the more restrictive range of 5 to 8 ft/sec. Within the more restrictive range, there is less potential for the line to plug due to material settling out and the rate of abrasive wear is lower.

For pipe conveying reclaim water, the pipe size is selected to maintain the water velocity in the range of 3 to 12 ft/sec. The higher velocity range is acceptable due to the much lower solids content of the filtrate.

2.15.5 Materials Selection

Piping handling slurries with greater than 3 weight percent solids are fabricated of FRP with an internal abrasion-resistant lining at least 0.070 inch thick.

Piping handling slurries with 3 weight percent solids or less are fabricated of FRP without an internal abrasion-resistant lining.

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2.16 Slurry Valves

2.16.1 Component Identification

Component Name: Slurry Valves
Component Identification No.: Various

2.16.2 Function

Slurry valves are used for component isolation, flow control, or a combination of both services.

2.16.3 Description

Knife-gate valves are used for component isolation in slurry service due to the erosive nature of the process fluid. Flow control applications in slurry service require the use of pinch valves. Butterfly valves are considered acceptable for use in slurry flow control if the solids content is less than 5 weight percent.

2.16.4 Sizing Criteria

Valve sizing is compatible with the slurry line in which the valve resides. The maximum slurry velocity is described in Section 2.12.4.

2.16.5 Materials Selection

The materials for the slurry valves are listed in Table 2.

Table 2. Slurry Valves – Materials of Construction

Component	Material
Knife Gate Valves	
Valve body	Rubber-lined ductile iron
Valve gate	Alloy 2205 duplex stainless steel
Ball Valves (for instrumentation isolation)	
Valve body	FRP
Ball	FRP
Butterfly Valves	
Valve body	Rubber-lined carbon steel

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Component	Material
Disc	Rubber-lined ductile iron
Pinch Valves	
Valve body	Ductile iron
Elastomer sleeve	Gum rubber

3.0 Description of Major Interlocks and Alarms

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

4.0 Description of System Operation and Control

4.1 Instrumentation and Control

The FGD Reagent Preparation System equipment is controlled by the FGD System Distributed Control System (DCS), which allows control of the individual FGD Reagent Preparation System components in the remote automatic and remote manual modes.

In addition to control of individual components, the DCS provides overall process control of the following:

- Reagent storage tank level
- Ball mill slurry tank level
- Reagent slurry solids content
- JBR Absorber pH

a. Ball mill slurry tanks

The measurement of slurry level inside the ball mill slurry tanks is continuously monitored and recorded by the DCS.

Each ball mill slurry tank provides a surge volume for the limestone slurry classification equipment. When the actual level in the tanks falls below the setpoint, the distribution box sends the overflow slurry to the ball mill slurry tanks. When

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the actual tank levels rise above the setpoint, the distribution box sends the overflow slurry to the reagent storage tanks.

b. Reagent storage tanks

The measurement of slurry level inside the reagent storage tanks is continuously monitored and recorded by the DCS.

To maintain a ready inventory of limestone slurry for use in the JBR reaction tank, an automatic level control system is provided for the reagent storage tanks. When the actual level in the storage tanks falls below the setpoint, the limestone feed rate of the weigh belt feeder is increased by increasing belt speed. When the actual storage tank levels rise above the setpoint, the limestone feed rate is decreased. If the actual storage tank levels rise to the high level alarm setpoint, the DCS stops the weigh belt feeder and places the limestone slurry train in a recycle mode.

Reducing the limestone slurry level in the reagent storage tanks is accomplished by pumping reagent slurry to the JBR absorber reaction tank with the reagent feed pumps. This slurry flow rate is dependent only on the pH inside the JBR absorber reaction tank and does not respond to actual limestone slurry level in the reagent storage tanks.

c. Distribution boxes

When one ball mill is operational, the distribution boxes divert reagent slurry to either one or both reagent storage tanks. If desired, either tank can be manually valved in and out of service. When both ball mills are operational, both distribution boxes can divert reagent slurry to both reagent storage tanks or to an individual tank.

4.2 System Operation

The limestone product is fed from each limestone silo onto its associated weigh belt feeder prior to delivery to the ball mill. The weigh belt feeder controls the rate of limestone fed into the ball mill. Reclaim water from the FGD Reclaim Water System is added to the mill and/or ball mill slurry tank proportional to the limestone feed rate and for density control.

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The ball mills produce a 60 to 65 weight percent limestone slurry. The reagent slurry classifier underflow is recycled to the ball mill and a portion of the total reclaim water is added to the ball mill inlet to assist in the grinding process.

The slurry is then discharged from the ball mill to a ball mill slurry tank where the remainder of the reclaim water is added. The ball mill slurry pumps then pump the tank contents to a reagent slurry classifier, which consists of a bank of hydrocyclone classifiers. The underflow that contains the coarse material removed by the classifier is returned to the ball mills for additional grinding. The overflow and underflow lines flow from the classifier to the distribution box. In normal operation, the distribution box will send the underflow slurry back to the ball mill for additional grinding and the overflow slurry to the reagent storage tank. When the level in the ball mill slurry tank reaches the low level alarm, the overflow line will then discharge back to the ball mill slurry tank. If the low-low level is reached, the underflow line will also return slurry back to the ball mill slurry tank.. Agitators in the ball mill slurry tanks and reagent storage tanks maintain the limestone slurry in suspension.

The limestone slurry in the reagent slurry storage tanks is circulated in a continuous loop by the reagent feed pumps. A portion of the slurry in the loop is fed to the JBR absorber reaction tank to react with the SO₂ absorbed from the flue gas.

The DCS provides for automatic sequential start of an inactive ball mill train and automatic sequential shutdown of an active train.

In the remote automatic control mode, the DCS opens/closes or starts/stops the individual components according to programmed sequences and interlocks as directed by the control logic. In the remote manual control mode, the individual pumps, agitators, and valves can be opened/closed or started/stopped by the operator. The protective interlocks remain in service during remote manual operation.

4.3 Functional Constraints

One 100 percent ball mill train operates 24 hours a day; however, both trains can be operated simultaneously if desired to rapidly fill the reagent storage tanks.

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The feed rate to the train is variable and a function of the slurry level in the reagent slurry storage tank.

4.4 Redundancy

Two 100 percent ball mill trains are provided. Either of the two trains can produce sufficient reagent slurry to supply the reagent demand of the Unit 2 FGD System at the maximum continuous rate (MCR) design conditions burning 4.5 lb/MMBtu SO₂ coal. Each ball mill train has a dedicated limestone feed system consisting of a storage silo and a weigh belt feeder.

Within each ball mill train, there are two 100 percent capacity low-pressure (LP) ball mill lube oil pumps, one 100 percent capacity high-pressure (HP) ball mill lube oil pump, one ball mill slurry tank, and two 100 percent capacity ball mill slurry pumps.

Each reagent slurry classifier (hydrocyclone cluster) consists of multiple hydrocyclones that can be independently manually valved in and out of service. At least 20 percent of the hydrocyclones in each cluster are spare.

The reagent feed system includes two 100 percent capacity reagent feed pumps and two reagent storage tanks. When the unit is burning the 4.5 lb/MMBtu SO₂ coal at MCR design conditions, each reagent feed pump is capable of supplying the required reagent slurry to the absorbers. The reagent storage tanks are sized such that the total storage capacity of both tanks is 12 hours based on entire site reagent slurry consumption.

System components of the reagent preparation area sump consist of the sump, two full-capacity submersible sump pumps, and a single top-entry agitator. Two 100 percent capacity sump pumps are provided in the sump based on the normal anticipated flow rate. In the event of excessive flow into the sump, both pumps are operated simultaneously.

5.0 Description of Provisions for Flushing and Testing

This section to be updated when more information becomes available from FFE Minerals.

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6.0 Description of Provisions for Maintenance

This section to be updated when more information becomes available from FFE Minerals.

7.0 Description of Hazardous Area/Materials

This section to be updated when more information becomes available from FFE Minerals.

8.0 References

8.1 Flow Diagrams

Black & Veatch Drawing No.	AEP Drawing No.
141643-02ZF-M2256A	02-518007-D
141643-02ZP-M2259A	02-518009A-D
141643-02ZP-M2259B	02-518009B-D
141643-02ZZ-M2266A	02-518011A-D
141643-02ZU-M2264A	02-518012A-B

8.2 General Arrangements

This section to be updated when more information becomes available.

8.3 Electrical One-Line Drawings

This section to be updated when more information becomes available.

8.4 Descriptive Articles

This section to be updated when more information becomes available.

8.5 Codes and Standards

The significant codes and standards which apply to the FGD Reagent Preparation System are as follows:

- American Society for Testing and Materials (ASTM)

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- American Society of Mechanical Engineers (ASME)
- American Petroleum Institute (API) Standard 650 "Welded Steel Tanks for Oil Storage"
- Hydraulic Institute
- National Electrical Manufacturers Association (NEMA)
- Institute of Electrical and Electronic Engineers (IEEE)
- American Gear Manufacturers Association (AGMA)
- American National Standards Institute (ANSI)
- American Welding Society (AWS)

8.6 Regulatory Requirements

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