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J.H. Campbell Unit 3

Air Quality Control System Maintenance and Malfunction Abatement Plan

JHC3-AQCS-MMAP

Revision 3.0

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Document Owner: Michael E. Gruber II, Environmental Services

INTERNAL

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Revision History

Revision	Approval Date	Implementation Date	Revision Description
3.0	06/02/2020	06/02/2020	• Added MMAP details for SCR • Removed reference to EUASHNEW; this emission limit no longer exists, and applicable portions have been incorporated into EUBYPRODUCT • Revised entire document format for consistency

Approvals

Area	Title	Signature	Approval Date
Environmental Regulatory & Strategy	Air Quality Lead	James M. Walker (Electronic approval on file.)	06/01/2020
JH Campbell	Env and Tech Services Manager	Joseph J. Firlit (Electronic approval on file.)	06/02/2020
Generation Planning	AQCS West Lead	Scott A. Reeves (Electronic approval on file.)	06/02/2020

Scope

This Maintenance and Malfunction Abatement Plan (MMAP) covers the monitoring, maintenance and operational requirements associated with the air quality control systems (AQCS) for Boiler Unit 3 and the associated AQCS material handling equipment at the J.H. Campbell (JHC) Generating Complex. The AQCS covered by this MMAP include Selective Catalytic Reduction (SCR), Activated Carbon Injection (ACI), Spray Dry Absorbers (SDA) and Pulse Jet Fabric Filter (PJFF). The MMAP also covers all supporting material handling and dry flyash (DFA)/byproduct handling control systems associated with the SDA and PJFF. This MMAP will assist in preventing, detecting and correcting malfunctions or equipment failures which could result in emissions exceeding applicable limitations. This document summarizes plant System Descriptions (SD), Standard Operating Procedures (SOP), Alarm Response Procedures (ARP) and computer-integrated Maintenance Programs (MP) which the plant follows for operation, maintenance and abatement response purposes.

Purpose

The J.H. Campbell MI-ROP-B2835-2020_EUBOILER3, Special condition III.3, states that:

The permittee shall not operate EUBOILER3 unless a malfunction and abatement plan (MAP) as described in Rule 911(2), for the emission control equipment (PJFF baghouse, ACI, SDA and SCR) is implemented and maintained. The MAP shall at a minimum specify the following:

a. A complete preventative maintenance program including identification of the supervisory personnel responsible for overseeing the inspection, maintenance, and repair of air-cleaning devices, a description of the items or conditions that shall be inspected, the frequency of the inspections or repairs, and an identification of the major replacement parts that shall be maintained in inventory for quick replacement.

b. An identification of the source and air-cleaning device operating variables that shall be monitored to detect a malfunction or failure, the normal operating range of these variables, and a description of the method of monitoring or surveillance procedures.

c. A description of the corrective procedures or operational changes that shall be taken in the event of a malfunction or failure to achieve compliance with the applicable emission limits.

MI-ROP-B2835-2020 conditions EUSDA_U3.III.2, EUACI_U123.III.2 and EUBYPRODUCT.III.2 also require implementation and maintenance of a MAP for material handling equipment (EUSDA_U3, EUACI_U123 and EUBYPRODCUT) associated with Boiler 3 and those requirements are also covered in this MMAP.

Source Description

J.H. Campbell Unit 3 is a coal-fired 8,240 mmBtu per hour dry bottom, wall-fired boiler with fuel oil startup capabilities. Emission controls include: low-nitrogen oxide (NOx) burners and SCR for NOx control, ACI for mercury (Hg) control, SDA for acid gas and sulfur dioxide (SO_2) control and PJFF for particulate matter (PM) control. The table below identifies major plant equipment and controls to be included in the MMAP.

Equipment	Emissions Unit ID in ROP	Description	Control
Boiler Unit 3	EUBOILER3	8240 mmBtu/hr	SCR, ACI, SDA, PJFF
ACI Sorbent Silos (2)	EUACI_U123	Unit 3 mercury sorbent storage	Bin Vent Filters
Lime Silos (3)	EUSDA_U3	Unit 3 pebble lime storage	Bin Vent Filters
Vertical Ball Mills (3)	EUSDA_U3	Unit 3 pebble lime mills	Spray Scrubbers
Recycle Ash Silos (2)	EUSDA_U3	Unit 3 recycle ash system	Bin Vent Filters
Recycle Mix Tanks (4)	EUSDA_U3	Unit 3 recycle ash system	Spray Scrubbers
Transfer Silos (2)	EUBYPRODUCT[1]	Unit 3 byproduct system	Filter Separators, Bin Vent Filters
Disposal Silos (3)	EUBYPRODUCT	Unit 3 byproduct system	Filter Separators, Bin Vent Filters

Regulatory Analysis

The table below is a summary of the short term emission limits applicable for J.H. Boiler Unit 3: (for a complete list of emission limits applicable for J.H. Campbell Boiler Unit 3 see MI-ROP-B2835-2020).

Emission Limit	Regulatory Driver
Particulate Matter (PM) Limits	
0.030 lb/mmBtu (30-day rolling average)	MATS regulation
0.015 lb/mmBtu (30-day rolling average)	EPA Consent Decree
Opacity Limits	
<20% boiler opacity except for one (1) six-minute average per hour of not more than 27%[2]	EPA Consent Decree R 336.1301 NSPS Subpart Da
<5% ancillary silos and transfer equipment	ROP
Sulfur Dioxide (SO_2) Limits	
1.2 lb/mmBtu (continuous)	NSPS Subpart Da
0.20 lb/mmBtu (30-day rolling average)	MATS regulation
0.085 lb/mmBtu (30-day rolling average)	EPA Consent Decree
0.070 lb/mmBtu (365-day rolling average)	EPA Consent Decree

[1] EUBYPRODUCT is made up of four transfer tanks total: TT#1 and TT#2 are associated with the JHC Boiler 1&2. TT3A and TT3B are associated with JHC Boiler 3.

[2] The Unit uses a Continuous Opacity Monitor System (COMS) for boiler opacity compliance determinations and results are used as an indicator of compliance with Particulate Matter emission limits.

Regulatory Analysis, cont'd

Emission Limit	Regulatory Driver
Hydrochloric Acid (HCl) Limit[3]	
0.0020 lb/mmBtu	MATS regulation
Mercury (Hg) Limit	
1.2 lb/TBtu (30-day rolling average)	MATS regulation
Nitrogen Oxide (NOx) Limits	
0.70 lb/mmBtu (3- hour rolling average)	NSPS Subpart Da
0.100 lb/mmBtu (30-day rolling average)	EPA Consent Decree
0.08 lb/mmBtu (90-day rolling average)	EPA Consent Decree

MMAPs

Selective Catalytic Reduction

Two (2) dedicated SCRs are installed on the Unit 3 Boiler to control NOx emissions. Injection grids and static mixers evenly distribute a reducing agent (dilute ammonia vapor) into the boiler outlet flue gas ductwork upstream of the SCRs. As flue gas passes over layers of catalyst contained within the SCR, NOx in the flue gas is converted into water vapor and gaseous diatomic nitrogen (H_2O and N_2). The porous ceramic catalyst provides a site for the reduction reaction to take place and is not itself consumed during the reaction. The Unit 3 SCR catalyst is contained within standard-sized steel modules or frames (roughly 3'x6'x6') arranged in a 10x12 array per level per reactor which are designed to house up to four levels of catalyst.

The SCR is controlled and monitored from a central Distributed Control System (DCS) which records and alarms (as applicable) the monitored parameters described below. The site documents for operation, maintenance and malfunction abatement of the SCR are System Description (SD) and System Operating Procedure (SOP), as well as the Alarm Response Procedures (ARPs). These documents are found on the Campbell SharePoint site or shared network drive. The operating parameters described in this MMAP can be changed through the site change management process in alignment with the site operating procedures for this equipment.

SCR Operation

Startup

The NOx reduction reaction is highly temperature dependent and ineffectual at very low flue gas temperatures. Flue gas is generally routed to the SCR shortly after startup and ammonia flow initiated when load increases above net zero and flue gas temperature increases above the SCR Minimum Injection Temperature (MIT).

Operation

The SCR is normally continuously operated consistent with technological limitations, manufacturer's specifications, good engineering and maintenance practices and good pollution control practices.

[3] HCl emission compliance is demonstrated by measuring SO2 emissions via CEMs as a surrogate.

Bypass

The Unit 3 Boiler SCR is equipped with limited bypass capability; the SCR cannot by bypassed at full load and is not bypassed during normal operation. The SCR is generally bypassed only at zero net load/low temperatures.

Shutdown

Shut down of the SCR is integrated into the boiler shutdown procedures.

Monitoring Parameters

NOx Emission Rate

Non-certified NOx monitors are installed at the inlet and outlet of the SCR and a Part-75 certified CEMS-NOx monitor is installed at the stack to continuously monitor and record NOx emissions. Outlet emission targets are set by Plant Operations to ensure a compliance margin with regulatory limits. Alarms from the CEMS are set in the DCS accordingly.

SCR Inlet Temperature

SCR flue gas inlet temperatures are monitored to ensure reaction temperature are adequate. Ammonia is generally not injected below the reactor's MIT to avoid formation of byproducts that can cause downstream equipment fouling. High flue gas temperatures can damage the catalyst and cause loss of catalytic potential. The SCR inlet temperature is monitored with multiple redundant elements. Alarms are set in the DCS accordingly.

Differential Pressure (dP)

Some differential pressure is expected; each catalyst layer increases the overall reactor dP. The DCS will alarm upon high dP. Increasing dP may indicate catalyst pluggage or a change in flue gas properties.

Ammonia Flow

Ammonia flow is normally controlled by the DCS and varies with plant load and inlet/outlet NOx concentrations. Injection rates are monitored to ensure adequate NOx removal is achieved.

Dilution Air Flow

Two dilution air fans, one in standby mode, provide a source of air to dilute the reducing agent (ammonia vapor) to allow better dispersion in to the flue gas upstream of the SCR and to keep the diluted ammonia vapor outside of the flammability range (15-28%). The actual flowrate of dilution air is monitored but is not a critical parameter.

Dilution Air Temperature

Dilution air is heated by a steam or electric air heater; one in standby mode. The temperature of the dilution air is controlled to 225F to keep the dilute ammonia in vaporous/dry form. The exact temperature is not critical to the process.

Sonic Horns

Forty-eight (6-six per level x 4 levels x 2 reactors) sonic horns operate in continuous rotation to agitate any settled ash back into the flue gas stream to keep the SCR catalyst as free from pluggage as possible. The DCS is programmed to auto-test the horns daily and Operations performs scheduled field checks to ensure continued availability.

Malfunction Abatement

During otherwise normal operation, an operator may experience some abnormal conditions that will require immediate attention. Prompt response to alarms or abnormal conditions can save the system from equipment damage and non-compliance with environmental regulations. All pollution control equipment will be restored to normal operation as quickly as possible in response to any noted abnormal condition, according to the vendor manuals, site SDs, SOPS and ARPs. The following sections identify abnormal process conditions or operating problems, possible causes, and corrective actions to recover from the condition.

Low NOx Removal Efficiency

Insufficient Ammonia Injection

Verify ammonia flowrates for conditions. Verify ammonia supply pressure and concentrations.

Poor Ammonia Distribution

Conduct SCR tuning and adjust injection grid valves to improve. Inspect injection grid at next opportunity.

High Inlet NOx

Perform boiler combustion adjustments and periodic tuning as needed. Check for changes in fuel supply and mill performance.

Catalyst Deactivation

Conduct periodic catalyst sampling and testing and replace catalyst layers as needed during outage of opportunity.

Catalyst Pluggage

Verify increased dP over catalyst during operation and inspect at next opportunity. Remove accumulated ash or replace catalyst layer as needed.

Instrument Malfunction

Verify inlet and outlet NOx readings. Calibrate or repair as needed.

High SCR Inlet Temperature

High Flue Gas Exit Temperatures

Check boiler combustion conditions and correct as needed. Check soot blower and water cannon operation. Reduce load as needed.

High SCR Differential Pressure

Ash Accumulation

Verify with increasing dP. Check sonic horn status. Verify adequate sonic horn supply pressure. Inspect reactor and sonic horns at next opportunity. Remove ash or replace catalyst layer as needed.

Excessive Inlet Gas Velocity

Ensure SCR inlet pressure and temperature are within design ranges. Reduce load as needed.

Instrument Malfunction

Verify SCR dP using ports available and/or collaborate readings with other plant instrumentation.

Loss of Dilution Air Flow

Dilution Air Fan Trip

There are two fans available; the standby fan is programmed to start automatically. Determine cause for trip and repair.

Dilution Air Fan Declining Operation

Check fan inlet filters; couplings and lubricants.

Dilution Air Fan Low Air Flow

The exact amount of dilution air flow is not critical. If low air flow is not corrected by normal maintenance, both fans may be placed in service to increase air flow until fan overhaul is completed.

Preventative and Predictive Maintenance

Responsible Person(s)

System Engineer:

The System Engineer has designated responsibilities for determining and establishing predefined Maintenance Plans.

Maintenance Lead:

The Maintenance Lead for the respective SCR equipment will ensure that the activities defined in the Maintenance Plans are carried out and documented on the schedule identified or more frequently as needed.

Maintenance Plans

Maintenance plans will include vendor recommended periodic maintenance activities to be performed for each piece of equipment on an appropriate schedule or during system outages of adequate length. The inspection results and maintenance activities/corrective actions will be documented and maintained electronically. All appropriate information including vendor manuals shall be maintained for reference and training.

Outage Inspections

All visual inspections of the SCR reactor and associated ductwork will occur at least once every 36 months during either a periodic outage or an outage of adequate length. These visual inspections of the SCR reactor and associated ductwork are only required to be completed once in a 36-month period, even if more than one outage of adequate length or periodic outage occurs within a 36-month period.

Inspections shall include the following

- Inspect and address signs of air or moisture in leakage.
- Check and repair access door gaskets as needed.
- Inspect and map catalyst pluggage and as-found ash layout; remove ash as necessary.
- Obtain catalyst samples as scheduled or deemed necessary.
- Inspect sonic horns, ammonia injection grid. ammonia flow control unit and static mixers. Repair as needed.

Activated Carbon Injection

The ACI system injects a dry sorbent (activated carbon) into the flue gas stream for mercury control. Requirements for the ACI system are included in the permit under emission unit EUACI_U123. Activated carbon is injected into the flue gas ductwork upstream of the SDAs for the purpose of mercury adsorption. Mercury adsorption into the sorbent starts in the gas stream at the point of injection and continues as the ash/sorbent coats the pulse jet bags. A portion of the fly ash/sorbent is recycled through the SDA process which increases sorbent usage efficiency.

The JHC Unit 3 ACI system consists of the following major equipment: Two (2) sorbent storage silos, and four (4) sorbent injection blower trains. The site documents for operation, maintenance and malfunction abatement of the ACI are System Description (SD) and System Operating Procedure (SOP), as well as associated Alarm Response Procedures (ARPs). These documents are located on the Campbell SharePoint site or shared plant network drive. The operating parameters described in this MMAP can be changed through the site change management process in alignment with the site operating procedures for this equipment.

ACI Operation

Startup

The ACI system is started when the coal mill feed is initiated and therefore is normally in operation when coal is fired into the boiler unit.

Operation

In order to maintain a high level of effectiveness and efficiency, the ACI system will be operated in accordance with the guidelines and instructions in the vendor manuals and plant operating procedures, unless otherwise deemed appropriate based on operational experience or system conditions.

Shutdown

Shutdown of the ACI system is operator initiated and integrated into the boiler shutdown sequence.

Monitoring Parameters

Sorbent Silo Bin Vent Differential Pressure (dP)

Differential pressure (dP) transmitters are installed on the bin vent filters and are monitored continuously and logged through the DCS. There is a high set-point alarm.

Sorbent Silo Visible Emissions

Non-certified visible emissions observations of the sorbent storage silo bin vent filter exhaust will be performed daily when the ACI system is in operation. The observations will be recorded in the proper system log.

Sorbent Silo Levels

Each sorbent storage silo is equipped with a high-level alarm; the hopper levels are monitored continuously and logged through the DCS.

Mercury (Hg) Emission Levels

Mercury emissions are continuously monitored at the stack with Hg-CEMS. Outlet emission targets are set by Plant Operations to ensure a compliance margin with regulatory limits. Alarms from the Hg-CEMS are set in the DCS accordingly.

Activated Carbon Injection rate

The injection rate of activated carbon is controlled by DCS logic and varies with load, coal quality, and outlet Hg levels. Flowrate shall be adequate to meet the Hg emission limit and is monitored on the DCS.

Malfunction Abatement

During otherwise normal operation, an operator may experience some abnormal conditions that will require immediate attention. Prompt response to alarms or abnormal conditions can save the system from equipment damage and non-compliance with environmental regulations. All control equipment will be restored to normal operations as quickly as possible in response to any noted abnormal condition, according to the vendor manuals and site-specific operating procedures and alarm response procedures.

High Bin Vent Differential Pressure

Loss of Cleaning Function

Initiate a cleaning cycle. If the differential pressure drops, then check dP instrumentation and DCS for explanation to loss of auto cleaning. If the differential pressure does not drop, then check air supply and diaphragm valve operation/condition and repair as needed.

Bin Vent Filter Visible Emissions

Incorrectly Installed Bag or Bag Failure

Swap to redundant equipment and remove from service until corrective action complete. Check bag life and inspect bag installation and filter housing integrity. Follow Compliance Assurance Monitoring (CAM) Plan and report visible emissions observations in proper log.

Low Mercury Removal Efficiency

Insufficient Sorbent Injection

Verify adequate activated carbon flow for conditions. Verify associated ACI system operation parameters and address or repair as required. Swap to redundant ACI injection system until issues are addressed.

High Inlet Mercury

Review most recent coal analysis to confirm. Verify coal is within specification and address with fuel purchasing department as necessary.

Preventative and Predictive Maintenance

Responsible Person(s)

System Engineer:

The System Engineer has designated responsibilities for determining and establishing predefined Maintenance Plans.

Maintenance Lead:

The Maintenance Lead for the respective ACI equipment will ensure that the activities defined in the Maintenance Plans are carried out and documented on the schedule identified or more frequently as needed.

Maintenance Plans

Maintenance plans will include vendor recommended periodic maintenance activities to be performed for each piece of equipment on an appropriate schedule or during system outages of adequate length. The inspection results and maintenance activities/corrective actions will be documented and maintained electronically. All appropriate information including vendor manuals shall be maintained for reference and training.

Outage Inspections

The ACI system equipment does not require a unit outage for maintenance and inspection, however sorbent injection lances are typically visually inspected in situ during periodic outages or other outages of adequate length. All visual inspections will occur at least once every 36 months during either a periodic outage, outage of adequate length, or other time period adequate for inspection. These visual inspections of the ACI are only required to be completed once in a 36-month period, even if more than one outage of adequate length or periodic outage, or other time period adequate for inspections occurs in a 36-month period.

Spray Dry Absorber

The SDA system injects a sorbent slurry into the flue gas stream for the purpose of SO_2 and acid gas reduction. Requirements for this system are included in the permit under emission unit EUSDA_U3. Pebble lime is processed in the SDA material preparation system to create a lime slurry that is sprayed by high-speed atomizers into the flue gas within SDA vessels. The lime slurry reacts with SO_2 and other acid gases in the flue gas to create a particulate byproduct that is collected downstream in the PJFF.

The SDA system consists of the following major equipment: four SDA vessels, six rotary atomizers [four in operation and two spares], four atomizer head tanks with agitators, eight atomizer lube oil chiller packages [one in operation one spare for each atomizer], and eight atomizer cooling air fans [one in operation and one spare for each atomizer].

The SDA lime preparation system consists of the following major equipment: three pebble lime storage silos [each equipped with bin vent filters], three vertical ball mills [each equipped with dust and vapor (D&V) scrubbers], and two lime slurry storage tanks [with agitators].

The SDA recycle system consists of the following major equipment: two SDA recycle ash silos [each equipped with bin vent filters], four filter/separator assemblies [two assemblies per recycle ash silo, each equipped with bin vent filters], four recycle ash mix tanks [two per recycle ash silo each with D&V scrubber and agitator], two recycle slurry storage tanks [with agitators], and three recycle silo fluidizing blowers.

The site documents for operation, maintenance and malfunction abatement of the SDA, SDA lime prep, and SDA recycle ash systems are System Description (SD) and System Operating Procedures (SOPs) as well as the Alarm Response Procedures (ARPs) and are located on the Campbell Share Point site or shared plant network drive. The operating parameters described in this MMAP can be changed through the site change management process in alignment with the site operating procedures for this equipment.

SDA Operation

Startup

Startup of the SDA is dependent upon meeting certain boiler permissives as identified in the SOP. In general, the SDA is brought online as quickly as possible after coal combustion start-up within technical limitations.

Operation

In order to maintain a high level of effectiveness and efficiency, the SDA is operated in accordance with the guidelines and instruction in the vendor manuals and by operating procedures, unless deemed appropriate based on operational experience or system conditions.

Shutdown

Shutdown of the SDA is operator initiated and integrated into the boiler shutdown procedures.

Monitoring Parameters

Lime Storage Silo Bin Vent Differential Pressure (dP)

Differential pressure (dP) transmitters are installed locally on the bin vent filter and will be monitored by Environmental Operators through the local PLC. The PLC is programmed with high dP alarm set points.

Lime Storage Silo Visible Emissions

Non-certified visible emission observations of bin vent filter exhaust and the pressure/vacuum relief device exhaust will be performed daily when EUSDA_U3 is in operation. The observations will be recorded in the proper system log.

Lime Storage Silo Levels

Each lime storage silo is equipped with a high-level alarm (90% of storage capacity) to prevent overfilling.

Vertical Ball Mill Visible Emissions

Non-certified visible emission observations of the vertical ball mill D&V spray scrubber exhaust will be performed daily when EUSDA_U3 is in operation. The observations will be recorded in the proper system log.

Recycle Ash Silo Bin Vent Differential Pressure (dP)

Differential pressure (dP) transmitters are installed on the bin vent filters located on each recycle ash silo and are continuously monitored and logged in the DCS. The DCS is programmed with high dP alarm set points.

Recycle Ash Silo Filter/Separator Assembly Differential Pressure (dP)

Differential pressure (dP) transmitters are installed on each of the four filter/separator assemblies and are continuously monitored and logged in the DCS. The DCS is programmed with high dP alarm set points.

Recycle Ash Visible Emissions

Non-certified visible emission observations of SDA recycle ash silo bin vent filters, silo pressure/vacuum relief devices and filter/separator pressure/vacuum relief devices will be performed daily when EUSDA_U3 is in operation. The observations will be recorded in the proper log.

Recycle Ash Silo Level

Each recycle ash silo is equipped with a high-level alarm (90% of storage capacity) to prevent overfilling.

Recycle Ash Mix Tank D&V Scrubber Visible Emissions

Non-certified visible emission observations of SDA recycle ash mix tank D&V scrubber exhaust will be performed daily when EUSDA_U3 is in operation. The observations will be recorded in the proper log.

SDA Vessel Temperature

The inlet and outlet temperature of the SDA vessels are continuously monitored. Lower outlet temperatures indicate that the atomizer is spraying.

SO_2 Emissions

Inlet (process monitor) and outlet (SO_2-CEMS) SO_2 emissions are continuously monitored. Outlet emission targets are set by Plant Operations to ensure a compliance margin with regulatory limits. Alarms from the CEMS are set in the DCS accordingly.

Slurry Injection Rate

The injection rate of lime/recycle slurry and solids percentage shall be adequate to meet the SO_2 emission target. Injection rates and percent solids are continuously monitored on the DCS.

Atomizer Motor Power

The motor power of the SDA atomizers is continuously monitored on the DCS to indicate the motors are operating and the atomizers are running.

Malfunction Abatement

During otherwise normal operation, an operator may experience some abnormal conditions that will require immediate attention. Prompt response to alarms or abnormal conditions can save the system from equipment damage and non-compliance with environmental regulations. All control equipment will be restored to normal operations as quickly as possible in response to any noted abnormal condition, according to the vendor manuals and site-specific operating procedures and alarm response procedures. The following section identifies abnormal process conditions or operating problems, possible causes and corrective actions to recover from the condition.

High Bin Vent or Filter/Separator Differential Pressure (dP)

Loss of Cleaning Function

Initiate a cleaning cycle. If the differential pressure drops, then check dP instrumentation and DCS for an explanation to the loss of auto cleaning. If the differential pressure drop does not drop, then check air supply and diaphragm valve operation/condition and repair as needed.

Instrument Malfunction

Check dP sensing lines for blockage and blow out as needed. Check and calibrate dP instrumentation.

Low Bin Vent or Filter Separator Differential Pressure (dP)

Bag Failure or Loss

Inspect bag filters at first opportunity; replace or re-fit bags as required.

Instrument Malfunction

Check dP sensing lines for blockage and blow out as needed. Check and calibrate dP instrumentation.

Bin Vent Filter/Filter Separator Visible Emissions

Incorrectly Installed Bag or Bag Failure

Swap to redundant equipment and remove from service until corrective action complete. Check bag life and inspect bag installation and filter housing integrity. Follow CAM Plan and report visible emissions observations in proper log.

Low SDA Efficiency

Plugged Atomizer

Clean, inspect and replace atomizer spray nozzles as needed.

Inadequate Slurry Flow

Check atomizer head tank levels. Inspect head tanks for sedimentation, build up and/or plugged lines and repair as needed.

Preventative and Predictive Maintenance

Responsible Person(s)

System Engineer:

The System Engineer has designated responsibilities for determining and establishing predefined Maintenance Plans.

Maintenance Lead:

The Maintenance Lead for the respective SDA equipment will ensure that the activities defined in the Maintenance Plans are carried out and documented on the scheduled identified or more frequently as needed.

Maintenance Plans

Maintenance plans will include vendor recommended periodic maintenance activities to be performed for each piece of equipment on an appropriate schedule or during system outages of adequate length. The inspection results and maintenance activities/corrective actions will be documented and maintained electronically. All appropriate information including vendor manuals shall be maintained for reference and training.

Outage Inspections

All visual inspections of the SDA vessels and associated ductwork will occur at least once every 36 months during either a periodic outage or an outage of adequate length. These visual inspections of the SDA vessels and associated ductwork are only required to be completed once in a 36-month period, even if more than one outage of adequate length or periodic outage occurs within a 36-month period.

Pulse Jet Fabric Filter

Two (2) parallel Pulse Jet Fabric Filters are installed on the Unit 3 Boiler to control particulate emissions. As flue gas leaves the boiler it passes through the SCR and air preheaters and is then split into two separate trains/four inlet ducts where activated carbon is injected. The flue gas then enters the four SDA vessels where a lime slurry in injected. The flue gas then enters the PJFF through interconnecting duct work and an inlet manifold distributes the gas into compartments where fabric filter bags are held. As the flue gas enters the compartments, the gas velocity decreases and some of the larger particulates fall into the ash hopper. The remainder of the particulate-laden flue gas passes through the fabric filter bag, accumulating the particulate on the exterior surface of the filter bags. The filtered flue gas leaves each compartment into the clean side outlet plenum and through the outlet ductwork to the ID fans for discharge to the atmosphere through the stack.

Each PJFF has 12 compartments that hold 1,176 bags per compartment, for a total of 28,224 bags. The particulate matter that accumulates on the exterior of the bag increases the differential pressure between the clean and dirty side of the fabric filter tube sheet. The particulate is periodically removed by directing a pulse of clean air down the inside of the bag. The pulse directed down through the bag momentarily stops the flow of particulate-laden flue gas and flexes the bag; this resulting acceleration/deceleration of the bag surface dislodges the collected particulate which falls into the flyash hopper. A rotating manifold/nozzle assembly is used to deliver the cleaning air pulse to the bags in each fabric filter compartment. Only a very small percentage of the filter bags are cleaned at any given time (typically with a single pulse). A low-pressure positive displacement blower is used for the supply of clean air to pulse the bags.

The unit is equipped with bypass poppet dampers; these dampers provide an alternate gas passage around the temperature sensitive bags in the event of emergency upset conditions. The collected ash is conveyed from the bottom of the hoppers to the dry flyash transfer towers. The PJFF is controlled and monitored from a central Distributed Control System (DCS); which records differential pressure readings and system alarms, along with other operational parameters.

The site documents for operation, maintenance and malfunction abatement of the PJFF are System Description (SD) and System Operating Procedure (SOP), as well as the Alarm Response Procedures (ARPs). These documents are found on the Campbell SharePoint site or share plant network drive. The operating parameters described in the MMAP can be changed through the site change management process in alignment with the site operating procedures for this equipment.

In order to maintain a high level of effectiveness and efficiency, the PJFF will be operated in accordance with the guidelines and instructions in the vendor manuals and plant operating procedures, unless otherwise deemed appropriate based on operational experience or system conditions.

PJFF Operation

Startup

Leak Test

Upon completion of a major filter bag replacement, a leak detection test will be completed. The purpose of this test is to locate any areas where particulate laden flue gas may reach the clean side of the fabric filter tube sheet. The leak test will be performed by injecting a fluorescent powder into the flue gas upstream of the fabric filter and using a black light to look for the powder on the clean side of the bags. Wherever this powder is found denotes the location of a fabric filter bag leak.

Pre-coat Procedure for New Bags

New filter bags after a major replacement initiative may require pre-coating prior to the initial operation to facilitate proper operation and longevity of the fabric filter. The pre-coat of the new bags provides protection during initial start-up in the event of boiler upsets and/or acid condensation.

Boiler Start-up

System (PJFF) Operating and General Boiler Operating Procedures for Start-up shall be followed.

Operation

In order to maintain a high level of effectiveness and efficiency, the PJFF system will be operated in accordance with the guidelines and instructions in the vendor manual, unless otherwise deemed appropriate based on operational experience or system conditions. Plant System Operating Procedures will be followed.

Shutdown

Normal Shutdown

Shut-down of the PJFF is operator initiated and integrated into the boiler shutdown procedures.

Emergency Bypass Shutdown

This shut-down method is intended to protect the filter bags from upset conditions, which can cause filter bag damage as well as fire. It can be initiated manually by an Operator from the DCS screen. Additionally, an emergency bypass shut-down will be initiated when either of the two following conditions exists:

High-High Fabric Filter Inlet Temperature

Upon reaching the High-High inlet temperature alarm set point for 10 minutes, the PJFF will go into emergency bypass mode which then initiates the boiler shut-down procedure controlled by an operator. The alarm has a delay to avoid nuisance shutdowns/alarms.

High-High-High Fabric Filter Inlet Temperature

Reaching the High-High-High inlet temperature alarm set point any length of time will override the High-High temperature timer and initiate a boiler sequence shutdown. There is a delay to avoid nuisance shut-downs.

Monitoring Parameters

The PJFF operation is controlled and monitored from a central Distributed Control System (DCS). Alarms are an integral part of the system instrumentation. They warn Operators of impending problem situations. In all cases, alarms will be investigated and responded to in accordance with the Manufacturer's procedures and Owner's Alarm Response Procedures (ARPs).

A PJFF unit overview report will be recorded weekly, when in operation. The overview report will contain the PJFF operating parameters identified in this MMAP as appropriate at the time of the report generation. These weekly reports will be retained for a period of not less than 5 years.

Differential Pressure

Differential pressure (dP) transmitters are installed at the inlet and outlet of the PJFF and on each of the twenty-four (24) filter compartments. They will be monitored continuously and logged through the DCS. Automatic bag cleaning frequency is based on the overall PJFF unit dP cleaning set point. There is a "start cleaning" set point, and a "stop cleaning set point." All available compartments are cleaned in a programmed sequence, which repeats until the differential pressure across the PJFF falls below a lower set point value, at which time the cycle will stop. These cleaning set points for the fabric filter are based upon actual operating conditions. There is a dP high alarm a High-High alarm set-point. Operators will acknowledge all alarms and respond according to the ARPs. A sequence for automatic cleaning also exists, based on timing of last cleaning event and dP.

Broken Bag Detectors

Broken bag detectors are installed on the clean side of each of the twenty-four filter compartments and will be monitored continuously and logged through the DCS. Operators will use the broken bag detectors as a trouble shooting tool and acknowledge all alarms and respond according to the ARPs.

Ash Hopper Levels

Each ash hopper is equipped with a high-level alarm; the hopper levels are monitored continuously and logged through the DCS. Operators will use the ash hopper alarms as a trouble shooting tool and acknowledge all alarms and respond according to the ARPs.

Filter Compartment Temperatures

Temperature sensors are installed on the inlet of the twenty-four filter compartments and will be monitored continuously and logged through the DCS. Alarms are generated for high inlet temperature. Additionally, a High-High set point will initiate flue gas bypass of the filter compartment within 10 minutes, if not resolved, initiating an operator-controlled boiler shutdown by procedure. The High-High-High set point will initiate flue gas bypass of the PJFF and a shutdown after a 3 second delay. Operators will acknowledge all alarms and respond according to the ARPs.

Cleaning Air System Pressure

The cleaning air system is equipped with pressure indicating transmitters that will be monitored and logged through the DCS system. An alarm will be generated for low pressure cleaning air. A spare blower will automatically start if the low-pressure alarm is activated. Operators will acknowledge all alarms and respond according to the ARPs.

Malfunction Abatement

During otherwise normal operation, an operator may experience some abnormal conditions that will require immediate attention. Prompt response to alarms or abnormal conditions can save the system from an emergency bypass of flue gas and equipment damage. The PJFF will be restored to normal operation as quickly as possible in response to any noted abnormal condition. The following section identifies abnormal process conditions or operating problems, possible causes, and corrective actions to recover from the condition.

High Fabric Filter Differential Pressure

Loss of Cleaning Function

Initiate a cleaning cycle. If the pressure drop responds, check dP instrumentation and DCS for an explanation to the loss of auto cleaning. If the pressure drop does not respond, check the air supply and diaphragm valves.

dP Instrument Malfunction

Check compartment dP sensing lines for blockage and blow out if necessary. Check and calibrate dP instrument.

Excessive Dust Concentration in Gas Stream

Check for change in boiler operation or fuel.

Decrease in Bag Permeability

Inspect bags at first opportunity. Pull samples and analyze filter cake. Examine process operation prior to increase in pressure drop.

Compartment Damper Problem

Check damper, limit switches and actuators, where applicable.

Overfilled Hoppers

Check hopper levels for blockage of gas stream to bags. Check hopper valves and ash pipe for blockage.

Low Fabric Filter Differential Pressure

Bag Failure or Loss

Inspect compartments at first opportunity, replace or refit bags as required.

dP Instrument Malfunction

Check compartment dP sensing lines & dP instrument.

Reduced Gas Volume

Check boiler load.

Dust Detected in Compartment Outlet

Instrument Malfunction

Check and calibrate instrument.

Incorrectly Installed Bag or Bag Failure

Attempt to identify the compartment at fault by observing the broken bag detector indication trends on the DCS. If identification is possible, isolate that compartment and take corrective action, as warranted. If bag failure confirmed, inspect compartments at first opportunity and replace or refit bags as required.

Tube Sheet Damage

Check the tube sheet for holes, cracks, loose bolts, or loose bag cage assemblies and correct.

Insufficient Filter Cake

Allow more dust to build up on bags by cleaning less frequently.

Premature Bag Failure

Fabric Attack

Have bag samples analyzed. Evaluate for protection by residual cake, and effects of operating below the acid dew point.

Low Bag Cleaning Pressure

Clean Air Blower Problem

Check clean blower and repair as required.

Clean Air Header Problem

Check header relief and bypass valve. Check for piping leak.

Increasing Opacity

Bypass Damper Actuation

The bypass dampers are programmed to open upon detection of certain adverse conditions. If bypass dampers open for cause (e.g., High-High flue gas temperatures), then cause must be immediately addressed, or unit removed from service until issue has been addressed. Certain PJFF bypass alarms will initiate an automatic unit trip. If damper actuation is due to instrument or equipment malfunction, close dampers immediately and address control issue.

Bypass Damper Leakage

Check damper and actuator position. Check limit switches. Check seal air header. Inspect dampers at first opportunity, repair as required.

Incorrectly Installed or Broken Bag

Isolate compartment and address at next outage of opportunity.

Preventative and Predictive Maintenance

Responsible Person(s)

System Engineer:

The System Engineer has designated responsibilities for determining and establishing predefined Maintenance Plans.

Maintenance Lead:

The Maintenance Lead for the respective PJFF equipment will ensure that the activities defined in the Maintenance Plans are carried out and documented on the schedule identified or more frequently as needed.

Maintenance Plans

Maintenance plans will include vendor recommended periodic maintenance activities to be performed for each piece of equipment on an appropriate schedule or during system outages of adequate length. The inspection results and maintenance activities/corrective actions will be documented and maintained electronically. All appropriate information including vendor manuals shall be maintained for reference and training.

Outage Inspections

All visual inspections of the PJFF and associated ductwork will occur at least once every 36 months during either a periodic outage or an outage of adequate length. These visual inspection of the PJFF and associated ductwork are only required to be completed once in a 36-month period even if more than one outage of adequate length or periodic outage occurs in a 36-month period.

PJFF Maintenance Plans will include the following inspections, which will be conducted during scheduled periodic outages. The results and maintenance activities/corrective actions will be documented appropriately.

- Check for signs of corrosion, moisture, or in-leakage to the PJFF.
- Check man ways, doors, dampers and expansion joints for leaks.
- Inspect the condition of insulation and exterior of the unit.
- Check access door gaskets. Repair or replace hard or deteriorated gaskets.
- Check for ash build-up on the tube sheet. Remove any accumulations and investigate the source of the leak.
- Check operation and seating of bypass dampers. Check bolted parts and actuators.
- Check for bag failure. Record type and location of failures.
- Check filter bags for proper installation. Inspect from the hopper to see that bags are hanging properly and not touching the wall or each other.
- Visually inspect all critical instrument air piping.
- Check hoppers and manifolds to assure they are free of debris.

Byproduct

A large portion of PJFF flyash/byproduct is recycled back to the SDA via the SDA Recycle Ash System and the remainder is conveyed to the Unit 3 Dry Flyash Byproduct system (for resale or landfill). The SDA Byproduct system consists of the following major equipment: two transfer towers [[TT3A and TT3B], three vacuum exhausters [two in operation and one spare], and three disposal silos [Ash Silos A, B, C]. Each transfer tower includes two filter separators and transfer tanks. Each transfer tank and each disposal silo are equipped with a bin vent filter.

TT3A, TT3B and the three associated vacuum exhausters located at Boiler 3 are regulated under EUBYPRODUCT.

The vacuum conveyance system pulls ash from the PJFF hoppers and transports the ash in hard piping through a filter separator (F/S) and into a transfer tank where the conveyance air is then discharged through a vacuum exhauster (two F/S's per transfer tank. Transfer tank displacement air is released through a bin vent filter to atmosphere. Flyash and byproduct materials collected in the transfer tanks are periodically conveyed to disposal silos DSA and DSB where the material is loaded onto trucks for shipment as either byproduct or waste.

Byproduct Operation

Startup

The Byproduct system is started when the coal mill feed is initiated and therefore is operating when coal is fired into the boiler unit.

Operation

The Byproduct system is normally in continuous service and operated in accordance with the guidelines and instructions found in associated vendor manuals and plant operating procedures, unless otherwise deemed appropriate based on experience of system conditions.

Shutdown

Shutdown of the Byproduct system is operator initiated and integrated into the boiler shutdown procedures.

Monitoring Parameters

Byproduct Transfer Tanks

Bin Vent Filter Differential Pressure

Differential pressure (dP) transmitters are installed locally on the bin vent filters and will be monitored by operations. The system alarms at high dP.

Visible Emissions

Non-certified visible emission observations of bin vent filter exhaust will be performed daily when the ash system is in operation on all emission points to atmosphere. The observations will be recorded in the proper system log.

Malfunction Abatement

During otherwise normal operation, an operator may experience some abnormal conditions that will require immediate attention. Prompt response to alarms or abnormal conditions can save the system from equipment damage and non-compliance with environmental regulations. All control equipment will be restored to normal operation as quickly as possible in response to any noted abnormal condition, according to the vendor manuals and site-specific system operating procedures and alarm response procedures.

High Bin Vent or Filter/Separator Differential Pressure (dP)

Loss of Cleaning Function

Initiate a cleaning cycle. If the differential pressure drops, then check dP instrumentation and DCS for an explanation to the loss of auto cleaning. If the differential pressure drop does not drop, then check air supply and diaphragm valve operation/condition and repair as needed.

Instrument Malfunction

Check dP sensing lines for blockage and blow out as needed. Check and calibrate dP instrumentation.

Low Bin Vent or Filter Separator Differential Pressure (dP)

Bag Failure or Loss

Inspect bag filters at first opportunity; replace or re-fit bags as required.

Instrument Malfunction

Check dP sensing lines for blockage and blow out as needed. Check and calibrate dP instrumentation.

Bin Vent Filter Filter/Separator Visible Emissions

Incorrectly Installed Bag or Bag Failure

Swap to redundant equipment and remove from service until corrective action complete. Check bag life and inspect bag installation and filter housing integrity. Follow CAM Plan and report visible emissions observations in proper log.

Preventative and Predictive Maintenance

Responsible Person(s)

System Engineer:

The System Engineer has designated responsibilities for determining and establishing predefined Maintenance Plans.

Maintenance Lead:

The Maintenance Lead for the respective Byproduct equipment will ensure that the activities defined in the Maintenance Plans are carried out and documented on the scheduled identified or more frequently as needed.

Maintenance Plans and Inspections

Maintenance Plans will include vendor-recommended periodic maintenance (including preventative) activities to be performed for each piece of equipment on an appropriate schedule or during system outages of adequate length. All appropriate information including vendor manuals shall be maintained for reference and training. The inspection results and maintenance activities/corrective actions will be documented and maintained electronically.

Outage Inspections

The Byproduct system does not require a unit outage for maintenance and inspection.

Non-outage Inspections

The Byproduct system inspections include the following non-outage inspections and reviews.

- On a weekly basis, review differential pressure readings associated with each bag filter and determine when the bags need to be replaced.
- As needed, inspect bags to determine condition.
- Keep spare filter bags for all units in the stock system.
- After each year of operation, perform ultrasonic inspection of 50% of all elbows and ten (10) straight sections of pressure pipe.
    - Based on rate of wall loss, reinforce the elbows and pipe if wall loss is localized or replace when wall loss exceeds 70%.
    - If experience shows that wear is confined to less than one-half the circumference of the pipe, it may be rotated when wall loss exceeds 50%.

Spare Parts

The System Engineer along with the local supply chain lead is responsible for ensuring that the necessary critical spare parts are available for replacement as needed.

Record Keeping

Maintenance Activities

All maintenance activities (including preventative/predictive maintenance and maintenance related to malfunctions) related to the control equipment will be documented electronically and maintained for a period of not less than five years. If some activities occur at frequencies of greater than five-year intervals, the history will be extended for those activities such that as a minimum the last maintenance activity performed is retained.

Vendor Information

All appropriate vendor information, as well as operations and maintenance (O&M) manuals, shall be maintained for reference and training. These documents will also be referenced for supply parts and proper maintenance practices. This information shall be maintained for the life of the equipment.

Malfunction Documentation

Malfunctions of the Control Equipment that is used for Mercury and Air Toxics Standard (MATS) and/or Consent Decree compliance shall be documented in the appropriate log. Malfunctions that caused or could have caused an exceedance with a MATS emission limit, as well as their appropriate corrective action, shall be included in the semi-annual reports.

Visible Emission Documentation

Documentation of visible emission readings shall be kept on file for a period of not less than five years.

Records and Retention

The document owner must ensure compliance with all corporate records standards documented in the Company Information Governance Policy 0.8.1 and applicable records retention practices referenced in the Information Asset Manager Information SharePoint site.