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Title:	**Operation of Pulverized Fuel Firing Equipment**		
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1 INTRODUCTION/PURPOSE

This APS Procedure defines the Code of Practice for Pulverized Fuel (PF) safety in the ACME power plant, strict compliance with this, procedure will establish and maintain the necessary safety standards for operation and maintenance of PF systems and associated plant.

2 SCOPE

The Code of Practice for PF Safety (Handbook) recognises and includes the general principles and standards identified in NFPA 85F - Installation and Operation of Pulverized Fuel Systems, NFPA 850 - Fire Protection for Generating Plants and NFPA 8503 Pulverized Fuel Systems.

It defines the hazards and dangers of PF, the training requirements for staff, the operational normal and abnormal conditions, procedures for dealing with fires, inerting system and maintenance procedures.

3 DEFINITION

PF System Applies to all pulverized fuel systems within the following boundaries:

- The pulveriser plant system: - The plant bounded by the entry to the coal silo feeding that pulverizer, the nozzles of PF burner fed from that pulveriser and the points at which hot air and cold air ducts are isolated from their respective main supply duct.
- The furnace: - The combustion chamber and ash hopper
- The dust disposal system: - The dust hoppers arid dry transportation systems.

4 RESPONSIBILITIES

It is the duty of all persons from the Operation and Engineering departments who have a responsibility for operation and maintenance on PF systems to be thoroughly familiar with those aspects of the Code of Practice for PF Safety (Handbook) appropriate to their particular activity,

5 PROCEDURE

The procedure is defined in Appendix 1: Code of Practice for the Operation of Pulverized Fuel Firing Equipment (Handbook).

6 TRAINING

The training and assessment requirements for this procedure are defined in Section 2 of Appendix 1 - Code of Practice for the Operation of Pulverized Fuel Firing Equipment (Handbook).

Record of training will be submitted to HR. Copies of training records shall also be kept in the APS filing system.

7 CONTROL OF RECORDS

The control of records associated with this procedure, "Code of Practice for the Operation of Pulverized Fuel Firing Equipment (Handbook)" will be secured and maintained in the APS Filing System managed by Document Control.

8 REVIEW AND AUDIT

This APS Procedure will be subject to review every two years unless the need arises before the planned review date. Additionally, this procedure will be subject to audit in accordance with APS/P/SHE/03/003 - "Safety, Health and Environment Audit and Review"

Any inaccuracies or omissions in this procedure should be notified to the procedure owner immediately,

ACME Power Services Ltd
P.F. Code of Practice

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INTRODUCTION

The following notes and instructions are the Code of Practice for the Operation of Pulverized Fuel Firing Plant as installed at the ACME Power Plant.

These instructions represent local compliance with the National Fire Prevention Association (NFPA) Standards.

This procedure applies to any person having an involvement with any aspect of the operation and maintenance of the Pulverized Fuel plant. Such persons shall at all times ensure compliance with the following instructions in the interest of safety of personnel, avoidance of plant damage, and the effective minimisation of fire or explosion hazards.

1 EXPLOSIONS OF FLAMMABLE DUST

1.1 Discussion and Background Information

The ignition of finely divided combustible material in suspension can lead to a significant explosion and the emission of flame. All such dust, whether hot or cold, should be considered dangerous.

This combustible material can be present throughout the boiler, from the pulverizer plant to the precipitator hoppers.

It is essential, therefore that staff:

(i) Be aware of the dangers of explosions from pulverized fuel

(ii) Be provided with the necessary understanding as to how they can arise

(iii) Be trained in the best manner of avoiding them

1.2 Potential Pulverized Fuel Explosions Sites

These fall into two categories:

1.2.1

Those explosions initiated in suspensions of PF in air in equipment essential to the generation process, inside the pulverized fuel systems and inside the boiler furnace.

1.2.2

Explosions initiated by other means, which are:

(i) Leakage of PF from the plant

(ii) Careless cleaning up of deposits of PF outside the plant

(iii) The disturbance of deposits of PF outside the plant by other circumstances

(iv) The release to atmosphere of hot pulverized fuel ash (PFA) containing a high concentration of unburned carbon as can occur at precipitator hoppers and economiser dust hoppers.

1.3 Factors which may cause an Explosion

The factors, brought together, which may cause a pulverized fuel explosion, are:

(i) A concentration of pulverized fuel in suspension in air falling within the explosive limits (i.e. explosive mixture).

(ii) An interruption in coal feed to an operating pulverizer.

(iii) A trip of a pulverizer containing coal.

(iv) A hot off-line pulverizer containing coal.

(v) A source of ignition with adequate energy

1.4 Development of Explosive Mixtures

Note: A Pulverizer system is defined as "The plant bounded by the mouth of the coal silo feeding that Pulverizer, the mouths of the PF burners fed from that Pulverizer and the points at which the hot air and cold air ducts are isolated from their respective main supply duct".

1.4.1

The formation of an explosive mixture in a pulverizer system is an unavoidable routine event and is normally a transient occurrence. Every time a pulverizer is put into, or taken out of service, the air:fuel mixture passes through the explosive range.

The mixture must change from very weak to very rich and vice versa. It can be explosive at different points at different times.

The air:fuel ratio of the mixture has an explosive range, between 4:1 (4 parts air: 1 part coal) and 50:1 (expressed by weight). It is however, most reactive within the range 6:1 and 12:1. During normal operation, the air:fuel ratio within the pulverizer system should not exceed 3.5:1

Explosive mixtures may also be caused by:

(i) Temporary loss of coal feed

(ii) Faulty control or indication systems or excessive bias for regulation purposes resulting in weak mixtures

1.4.2

Explosive mixtures in a boiler furnace are an abnormal event. It follows the failure to ignite an accumulating cloud of fuel or the loss of ignition during operation.

1.4.3

Explosive mixture outside of the boiler can arise in those situations covered in section 1.2.2.

1.5 Sources of Ignition

1.5.1

Below are three of the sources of ignition that could occur in a pulverizer system

1.5.1.1 Fire due to spontaneous combustion

If any deposits of coal or PF are allowed to stand in a pulverizer system, they are likely to catch fire eventually, even when in air at ambient temperatures. This is due to the spontaneous combustion, which progresses with increasing temperatures of the fuel and the surrounding air.

1.5.1.2 Flashback of flame from furnace

This can occur if the velocity of flame propagation in the PF piping exceeds the air/fuel forward velocity of the air/fuel stream.

Provided that the forward velocity is above 23 metres/sec. flashback will normally not occur.

Flashback into a running, or shutting down pulverizer, where the forward velocity is normally adequate, can be caused by:

(a) A pressure disturbance in the furnace that reduces the forward flow of the air/fuel mixture such that a flame may be propagated or carried from the furnace into the pipework, and possibly as far back as the pulverizer itself.

(b) Low primary flow air to the pulverizer.

(c) Failure to ensure that the primary air supply to running pulverizers is not disturbed by the incoming service of subsequent pulverizers.

1.5.1.3
Combustible material such as foreign elements in the pulverizer such as wood or rag.

1.5.2

Sources of ignition within the furnace, other than the normal flame are:

(i) The fuel oil burners

(ii) Hot refractory

(iii) Slag deposits

1.5.3

Examples of sources of ignition for explosive mixtures outside the boiler are:

(i) Welding and cutting operations

(ii) From the hot external components of the boiler

Such sources are dangerous in the vicinity of pulverized fuel leaks or if cleaning operations involve the risk of creating clouds of dust containing significant combustible content in their vicinity. They should be eliminated as far as is reasonably practicable, whilst the risks exists.

1.6 Summary

The foregoing indicates some of the situations where explosive mixtures can occur, together with some sources of ignition. It is clear that in a pulverizer system a fuel rich mixture of air to fuel will reduce the risk of explosion, even if that mixture comes into contact with a source of ignition. Keeping the forward velocity of the pulverized air/fuel mixture above the normal minimum will reduce the risk of flashback explosions.

2 TRAINING

2.1 Operations Staff

Each person concerned with the operations of PF plant will receive suitable on-site formal training on PF safety and the Code of Practice for operation of pulverized fuel firing equipment. The Operations Director will verify their knowledge and competence in pulverized fuel plant operation, before they are allowed to take up their position on shift. Thereafter, the competence and reassessment of individuals shall be confirmed every three years and the results recorded in their personal training file.

No person shall undertake upgrading duties where they will be directly concerned with the operation of pulverized fuel plant unless they have received training for the post and are deemed competent. Their competence to upgrade shall be recorded in their personal training file.

2.2 Engineering Staff

All maintenance and contractor staff who work on PF plant must be aware of the correct maintenance procedures before working on that equipment.

Engineering personnel who carry out maintenance activities should receive training on their responsibilities under this procedure. Refresher courses and any special training required for plant maintenance will be specified by the Engineering Director.

Engineering Director shall ensure that all such staff are also aware of the dangers of improper maintenance and are conversant with the relevant sections of this Code of Practice.

2.3 Record Keeping

Training records will be kept and maintained at the Power Plant by the Commercial Department Training Section. Shift Managers (Operations) and Section Managers (Engineering) are responsible for the training and sending them the results for filing purposes.

3 GENERAL PRECAUTIONS

Coal Firing System
A full description of the Pulverized Fuel Plant and its associated auxiliary equipment can be found in the Original Equipment Manufacturers Design and O&M manuals. Diagrams of PF plant are contained in this handbook.

3.1 Plant Cleanliness

The pulverized fuel plant and associated equipment shall be maintained clean at all times.

The detailed instruction and check sheets are presented in a specific document APS/I/OPS/01/018 – Plant Cleaning

In general external surfaces of coal feeders, pulverizers and PF burner distribution piping shall be regularly cleaned and kept free of accumulations of coal dust and/or oil films. The flat tops of ducts, light fittings, structural steelwork, control panels, walkways, etc., shall be kept free of pulverized fuel deposits; likewise all accumulations at floor level shall be removed promptly. During cleaning, care must be taken to avoid creating clouds of pulverized fuel.

Any leakage of PF from a pulveriser or feeder casings, distribution piping, expansion joints or burner boxes must be reported immediately to the Control Room. The Duty Shift Manager will then arrange that the plant be taken out of service as soon as reasonably practicable to carry out repairs.

The same diligence will apply to any oil leaks occurring on or about the pulverizers, oil leaks must be dealt with promptly. Oil drums or cans containing new or residual oil shall not be stored in the vicinity of pulverizing plant, and old oil removed from auxiliaries should be taken outside the building to a designated dirty oil store without delay.

3.2 Damper Operation, Safety Devices and Tests

All dampers and associated control equipment serving the boiler and pulverizer systems, shall be maintained in a clean and workable condition. Security of attachments to spindles or pivots shall be regularly checked and local or remote position devices proved for accuracy of indication by the Plant Area Operators.

Damper and safety devices shall be periodically tested and the results recorded in accordance with the following section.

3.2.1 Damper Position Inspection

At the start of each shift, all boiler and pulverizer dampers shall be checked to be in the correct operating position on the DCS and by local routine observation in conformance with detailed instructions and logsheets.

Any faults or discrepancies in the indication shall be verified by local observation and proven defects recorded for priority maintenance attention.

3.2.2 Safety Devices and Alarms

The following devices shall be checked according to the appropriate test schedule.

(i) Motorized coal bunker shutoff gates
This alarm/permissive and its associated trip should be tested once every three months by manually shutting each gate.

(ii) Pulverizer outlet gates
This alarm/permissive and its associated trip should be tested once every three months by manually shutting each gate.

(iii) Pulverizer instrumentation and interlocks
Instrumentation calibration checks and interlock signals/permissive shall be conducted by the engineering department as part of their routine test schedule.

(iv) Inerting steam and "pulverizer clearing" system

3.2.3 Overall Damper and Device Tests

Following a prolonged unit shutdown or maintenance outage, all boiler and pulverizer system isolating and regulating dampers shall be operated over full travel and all associated indications and/or alarms checked for correct function and defected as necessary. Damper operation should be observed periodically during normal operations and any defects recorded.

3.3 Drag Chain Conveyor and Dust Hoppers

All personnel engaged in the operation of pulverized fuel plant must be made aware of the hazards and dangers associated with ash and dust removal.

3.3.1 Drag chain conveyor and dust hoppers

Drag chain conveyor operation, raw water supply, re-circulation system and effectiveness of chain links should be maintained while the boiler is hot and ash is present in the system.

Particularly following a master fuel trip (MFT), ashing and dusting should be carried out under normal sealed conditions; ash and dust likely to contain unburned fuel must not be exposed to the atmosphere until thoroughly wetted.

3.3.2 Dust Hoppers

Dust hopper levels must not be allowed to rise above the prescribed hopper capacity. This may be ascertained by a combination of high level alarms, precipitator performance, fly ash silo and time intervals between dusting.

When operating conditions are likely to lead to incomplete combustion of fuel (including fuel oil), for example low excess O_2 and high CO level, the dust collecting hoppers should be emptied immediately. Under such conditions, it is possible that the unburnt fuel will continue to burn in the hopper due to its initial temperature in the hoppers and the hopper mouth. This can lead to very high temperatures in the hoppers and the formation of large incandescent clinkers. Worse, if the dust in this condition is spilled from the hopper into the open air, a major fire or explosion can result.

Dust hopper steam heater should be checked daily for normal operation.

The indiscriminate removal of dust and the use of air lances on dust hoppers in this condition are **Prohibited**.

There is a considerably higher risk of accumulation of combustible material in all boiler and precipitator hoppers during lighting–up operations from cold than under normal operating conditions.

If, for any reason the emptying of these hoppers is delayed, the Shift Manager must be informed because this creates a fire risk. Dry dust may only be emptied out of a boiler or precipitator hopper into the open air after a Shift Manager, or a person nominated by him, has confirmed and recorded that there is negligible risk of a fire or explosion resulting.

3.4 Fuel Oil Burners and Tests

3.4.1 Precautions

Fuel oil must not be allowed to accumulate on or about oil burners or windbox surfaces. Oil leaks must be reported to the Unit Operator for immediate attention. Drip trays must be regularly emptied and cleaned.

3.4.2 Oil Burner Testing with Unit on Load

Each elevation of oil burners will be fired once a week, to prove their availability and the function of safety devices. As no direct observation of burners is possible on mixed firing, the expected load pick-up and DCS indication must be recorded, as an indication of satisfactory performance in the Unit Operators Log Book.

3.5 PF Burner Conditions

Burner tilt mechanism controls shall be selected to automatic for normal operation, except during start-up and shut down. The exercising of the burner tilt mechanism shall be carried out in manual control on a suitable routine basis. All burner assemblies should operate within +/- 5 degrees of each other over full travel. All faults shall be recorded and defected as high priority.

During the stroking procedure, the Plant Area Operator shall visually observe the tilt action at each corner to note any erratic motion, unusual noise, or shear pin breakage. In the event of shear pin failure, maintenance personnel should install a replacement pin and stroke the tilts again.

3.6 Coal / Oil Flame Monitoring

A visual display is indicated on the DCS screens and back panel displays associated with fuel firing. Training will be given to ensure that the Unit Operator is fully conversant with the system.

3.7 Fire Protection Equipment and Precautions

3.7.1 Equipment

Fire protection equipment and appliances will at all times be maintained in a serviceable and readily available condition and selected to automatic control where applicable.

The shift fire personnel are trained to know the location of the fire protection equipment.

The shift fire personnel are trained to know the type of protective clothing and procedures necessary for dealing with fires and explosions.

3.7.2 Fire Protection

Refer to Section 6 Procedure for Dealing with Plant Fires.

3.8 Reporting and Attention to Defects

Defects or malfunctions appertaining to PF pulveriser system equipment, dampers, DCS indication, alarm, interlocking or inter-tripping devices, the existence of which can be construed to compromise the safe operation or condition of the plant must be properly recorded at the time of their occurrence or detection, and entered into the plant Computerised Maintenance Management System (CMMS) for priority maintenance attention. If an imminent hazard is perceived it should be raised directly by telephone with the Engineering Section responsible.

Pulverizer fuel equipment should not be put into service with known defects that could affect its safe operation.

The Shift Manager will ensure that, when a safety defect occurs, immediate action is taken to either shut down the equipment or to operate safely, using alternative indications and alarms pending rectification being carried out on an emergency basis.

The Shift Manager is ultimately responsible for deciding whether a reported safety defect is of sufficient magnitude to cause an unacceptable risk to personnel and plant. Continued running of plant with a safety defect should be regularly reviewed by the Shift Manager.

4 OPERATIONAL PROCEDURES – NORMAL CONDITIONS

4.1 Factors Affecting Stability of Combustion

The following notes are a guide to the maintenance of safe and stable combustion conditions.

4.1.1

Oil burner groups to ensure stable ignition, must be proven before an attempt is made to start the feeder (This is ensured by achieving pulverizer permissives to start the feeder).

4.1.2

Oil burners must be kept in service during starting and low-load operating of the furnace and also whenever flame pulsation or instability of firing develops from any cause.

4.1.3

The minimum stable load without oil support is 2 adjacent mills in service with at least 50% coal feed rate on each.

4.1.4

To achieve early and efficient combustion when starting PF firing, the following conditions should be observed:

(i) Provide a correct and consistent mixture of air and fuel by ensuring that the pulverizer PA bias is always be set to 1 during start-up and shutdown.

(ii) The grinding capability of the pulverizers is maintained within specification and checked monthly by the efficiency department.

(iii) A clear furnace atmosphere i.e. absence of unburned coal or oil vapour

(iv) Routine inspections should be made once per shift to check that the ignition point is maintained ≈ 1.5 meters from the burner tip.

4.1.5

Once established, stable combustion will be maintained if:

(i) Pulverizer operating conditions as detailed in Section 4.7 are observed.

(ii) The DCS maintains the required excess O_2 levels. Failures of the system to maintain excess O_2 can result in the fire being extinguished.

(iii) Auxiliary air dampers on burners in service are free to move and respond to the DCS.

4.2 Boiler firing Preparations and Precautions

Existing operating instructions prescribe the comprehensive pre-start checking of the boiler unit. Such instructions apply to boiler pressure parts and gas passes, serviceability of auxiliaries, lubrication, dampers, control, alarm, interlocking and inter-tripping devices. Special attention should be given to the following for the establishment and continuity of safe plant operation.

(i) Boiler access and inspection doors to be checked shut and should be kept closed and sealed except during actual observations. DCC water hopper seal should be filled to the required level.

(ii) Ash and Dust hoppers should be completely cleared of ash, dust or any unburnt fuel.

(iii) Adequate coal stocks to be available in the coal bunker.

(iv) Pulverizer tables and spillage hoppers to be cleared of coal.

(v) Pulverizer, feeder, PF pipework, doors, aperture covers and plugs to be replaced and leak free.

(vi) Boiler fire protection and detection systems available.

(vii) Coal bunker heat detection systems are available.

4.3 Pre-start Furnace Purging

Before the first oil burner elevation is initiated, the automatic purge sequence as detailed in APS/I/OPS/03-001 – Purge Requirements, with an air flow of $> 30\%$ MCR for 300 seconds, must be carried out and all DCS group controllers and sub-loop controllers set to automatic.

4.4 Establishing Oil Burners

The normal establishment of oil burners will be carried out but the plant automation system, the Automatic Plant Sequence (APS) together with the Mill Burner Control (MBC) will select and start oil burners from starting the 1/2 elevation, see APS/I/OPS/03/005 – start-up, normal operation and shutdown of fuel oil burners for specific information.

Boiler air dampers are controlled by Automatic Plant Control (APC) system, check that they are modulating.

When the first elevation of oil burners is established and no ignition instability is apparent, then a visual inspection of the oil burner flame and furnace should be carried out to check for:

(i) Bright and stable flames on selected burners with a uniformly shaped flame of a bright yellow-white colour and medium length should be present. It should not be too small or impinging on the burner quarl; variation of the windbox pressure can significantly affect this.

(ii) Furnace atmosphere free from smoke

(iii) No other oil burner tips leaking

(iv) Oil and PF burners are free of slag.

NOTE: When making boiler inspections the procedures described in APS/I/OPS/03/013 - Furnace Viewing must be strictly followed before any boiler inspection ports are opened.

4.4.1 Hazards which exist when carrying out furnace inspections

The principal hazard which exists when carrying out a furnace inspection under the conditions described above is that of hot gas being expelled from the inspection opening, plus the additional hazard of hot ash and dust being expelled from openings in the ash hopper area.

The precautions outlined in this instruction are intended to prevent, as far as possible, the expulsion of hot ash and gases from the furnace, and to protect the person carrying out the inspection from the effects in the event of such an occurrence.

4.4.2 Lighting additional elevations

Additional elevations are started by the Fuel Burner Load Program as increased steam demand and temperatures dictate but on each occasion the burner firing pattern is changed the furnace must be inspected as described above for flame stability and furnace atmosphere.

(i) As steam flow rate rises and boiler pressure achieves $\approx$ 130 bar, commence start up sequence the first pulveriser group, and following unit synchronisation start the first pulveriser feeder. Ensure that a minimum of 2 out of 4 oil burners from opposing burner assemblies are proven at the required elevations. With further load increases, start additional pulverizer groups and reduce the oil burners in service until eventually with stable furnace combustion all oil burners are taken out of service.

(ii) If there is any doubt about furnace stability, inform the Control Room immediately. As per APS/I/OPS/03/013 all viewing must stop immediately. Oil burners must be fired immediately to regain stability. Only then can further viewing inspections take place.

(iii) If serious instability occurs and the fire is extinguished, then do not attempt to fire oil burners until the furnace has been thoroughly purged and the permissives for firing are re-established. Under these circumstances the Shift Manager must be consulted for permission to re-fire the boiler.

4.5 Pulverizer Group Start-up (First Pulverizer)

(i) Plant Area Operator to report to the Unit Operator that all pre-start checks have been completed and that the pulverizer is available for service.

(ii) Ensure a minimum of 2 out of 4 oil burners from opposing burner assemblies are in service and stable at the relevant elevation for the pulverizer going in service.

(iii) The boiler is at least 10% BMCR

(iv) Start the pulverizer group on Group Level or Sub Group Level when all permissive are available.

(v) Before the coal feeder is started the pulverizer is warmed to achieve a target pulveriser outlet temperature of between 70 – 80°C with a primary air flow of 71.4 t/h. Normally "pulverizer warming" takes 5 – 10 minutes, heated at a rate of $\approx$ 9°C /min.

(vi) As a function of the pulverizer start, the APC system controls the "Initial Coal Feed Operation" which is designed to shorten the pulverizer start-up time and stabilise the pulverizer system.

This is achieved by setting the coal feeder initial coal feed rate to 32%, then upon detection of the start of coal pulverization indicated by an increase of pulverizer motor amperes, the coal flow rate is reduced to 26% until the pulverizer outlet temperature recovers and the coal flow can be increased in-line with the coal master demand.

(vii) While loading up the pulverizer, observe furnace suction pressure, pulverizer table differential pressure, pulverizer/furnace differential pressure, pulverizer temperature outlet and pulverizer motor current readings for any abnormalities.

WARNING: Furnace inspection doors must not be opened whilst pulverizers are put into or taken out of service; ensure PF ignition is well established and stable before commencing furnace inspection.

4.6 Pulverizer Group Start-up (Subsequent Pulverizer)

The same general provisions of section 4.5 apply equally to all subsequent pulverizer groups commissioning, with particular emphasis on the following points:

(i) Subsequent pulverizers are started by the MBC on receipt from the Megawatt Demand signal under the following parameters;

- 25% - 35% MW ECR $\longrightarrow$ 2 Pulverizers
- 35% - 50% MW ECR $\longrightarrow$ 3 Pulverizers
- 50% - 70% MW ECR $\longrightarrow$ 4 Pulverizers
- 70% - 100% MW ECR $\longrightarrow$ 5 Pulverizers

(ii) The correct firing conditions must be established to satisfy the pulverizer group starting permissive i.e. ignition energy available requirement, which requires either of the following;

- Adjacent oil burner is ignited
- Adjacent coal burner is ignited

(iii) Burner tilts should be set as near the horizontal position as practical before starting the coal feeder.

(iv) Pulverizer outlet valves should be checked to be open.

WARNING: On no account should a coal feeder be started if it suspected that any of the pulverizer outlet valves are suspected of not being fully open.

4.7 Conditions to be Maintained on Running Pulverizer

(i) A consistent supply of coal to the pulverizer must be maintained and any imminent stoppages reported without delay to the Unit Operator.

(ii) Pulveriser rejects must be inspected at least once per shift as specified in Section 4.1.3.

(iii) The minimum temperature at which a pulverizer should be operated is 65°C. Below this the dew point can be reached with resultant condensation. This can give rise to pulverized fuel congealing both within the mill and the coal pipes which becomes a fire risk. This can also lead to blocked instrument lines. This problem is encountered particularly when the coal is wet.

If the temperature on an operating pulveriser falls to below 65°C, then increase the PA bias and reduce the coal feed rate in order to increase the temperature to the set point. Determine the cause for the deviation.

If it is suspected that the fall in pulverizer outlet temperature is due to wet coal then the Unit Operator should consider using oil burner support for flame stability.

(iv) The pulverizer outlet temperature set-point should be limited to 85°C at high coal feed rates.

4.8 Shutting Down a Pulverizer

Establish stable conditions for the pulverizer by firing adjacent oil guns if necessary.

(i) Start the automatic mill shut down sequence. This will reduce the coal feed at a defined rate and automatically stop the feeder when the permissive for temperature and hot air gate closed are achieved.

Automatic shutdown must be used unless there is a specific reason for shutting down manually.

(ii) If it is necessary to shut a pulverizer down manually firstly reset the outlet temperature set point to 65°C and ensure that the PA bias is set to unity (1). Decrease the coal feed to minimum via the feeder bias control, maintaining pulverizer outlet temperatures within the acceptable range of 60 - 65°C. The load on other pulverizer groups will increase to compensate.

(iii) Once the coal flow is < 20 T/H and the pulverizer outlet temperature is < 65°C, the coal feeder can be stopped. The cold air damper must be maintained at 30% open for ≈ 5 minutes to spin off the coal and clear the pulverizer.

(iv) If the spinning off sequence has not been completed, inert the pulverizer and carry out pulverizer clearing as soon as possible. If inerting and/or pulverizer clearing cannot be carried out, it must be logged and reported to the Shift Manager immediately. Pay full attention to the pulverizer outlet temperature as an increase could be an indication of a pulverizer fire. If fire is suspected it should first be extinguished using the procedures as laid down in Section 6.4.

(v) Shutdown any oil burners utilised, unless required for stabilising the fire.

(vi) After shutdown, the pulverizer group should be checked to ensure that all dampers are in the correct position.

(vii) Inspect and clean the pulverizer spillage system, ready for return to service.

(viii) When changing pulverizers over, the firing support permissives must be available. Conditions of steam pressure and temperature, metal temperature, furnace and windbox conditions must be maintained as near normal as possible by trimming back temporarily on other pulveriser groups.

4.9 Conditions to be Maintained on a Standby Pulverizer

(i) Pulverizer spillage hoppers must be emptied

(ii) Hot air dampers and gates must be shut, cold air damper should be regulating at around 5% open to provide a cooling airflow of about 10 kg/sec. with pulverizer outlet valves open for PF pipework cooling.

(iii) Pulverizer standing temperature should not exceed 50°C. The temperature of the pulverizer should be kept as low as is practical and preferably below 50°C, to prevent any risk of spontaneous combustion of trapped coal dust.

4.10 Furnace Purging – Controlled shutdown

On completion of firing, the furnace and boiler gas passes will be purged at $> 30\%$ airflow for 300 seconds.

4.11 Sootblowing Precautions

(i) If, during a sootblowing sequence, any instability of combustion is encountered, oil firing must be established to stabilise the fire.

(ii) Furnace suction set point to be set to –2.5 mbar during sootblowing.

4.12 Isolation of a Pulverizer Group Prior to the Issue of a Permit for Work

On taking a pulverizer out of service for issue of a PFW on internal parts, the pulverizer should be empty. The pulverizer will be purged with air for ≈ 10 minutes.

The isolation must be carried out in accordance with the Senior Authorised Person's instructions.

CAUTION: A pulverizer system should not be opened up without first checking for the presence of fire by the pulverizer outlet temperature, and by local visual inspection. If fire is suspected it should first be extinguished using the procedures as laid down in Section 6.4.

4.13 Inspection of Pulverizer Spillage System

Pulverizer spillage must be inspected at least once per shift, using the inspection window. Any sign of spillage rejects being on fire, excessive in quantity or none at all, unusual objects retrieved should be reported to the Unit Operator, for possible further investigation. Following a MFT all vessels will require inspection and cleaning before returning pulverizer groups back to service.

5 ABNORMAL CONDITIONS AND EMERGENCY PROCEDURES

As unpredictable factors may arise at the instant of fault or abnormality the following procedures should not be read as rigid instructions in every detail. They must be treated as strongly recommended procedures designed to ensure the safety of personnel and be consistent with minimum interruption of boiler service or unit generation. In particular they are procedures most likely to prevent a PF explosion on the pulveriser systems.

The boiler Master Fuel Trip Emergency push button is clearly accessible to operational personnel in case of emergency.

Plant should not be run with interlocks and automatic control systems defeated or DCS simulations applied, unless authorised by the Shift Manager.

Unstable firing
If combustion instability is expected then oil burners should be put into service immediately.

Instability will cause the furnace draught to fluctuate violently and this can be observed by 'boiler pulsing' on the plant, or variation of draught plant indications on the DCS.

Wet coal may produce combustion instability or varying pulverizer output if pulverizer outlet temperatures fall too low. To provide an adequate supply of hot air for drying, if possible very wet coal should not be fed to the coal bunker's, especially prior to a unit cold start when achieving an adequate hot air temperature is more difficult. If this situation should arise the Shift Manager must be informed by the Coal & Ash Plant Supervisor prior to the coal bunker being filled.

5.1 Loss or Interruption of Coal Supply – High Air/Fuel Temperature

The maintenance of a steady supply of coal to the pulverizer is an essential factor for the continuity of stable combustion. Coal supply interruptions must be anticipated by routine filling of coal bunkers and every effort made to maintain the free flow of coal to the pulverizer. If coal supply to the pulverizer is actually interrupted the protection will immediately trip the coal feeder for "NO COAL ON BELT".

Pulverizer outlet temperature is measured by fast response temperature elements. There are two stages of high temperature protection:

(i) When the outlet temperature $> 85°C$, the pulverizer outlet temperature "HI" alarm is received. The Operator should closely monitor the pulverizer operating conditions and possibly bias the pulverizer to increase the coal feed rate by $\approx 15\%$.

(ii) If the outlet temperature reaches 100°C the pulverizer outlet temperature "HI HI" alarm is received which will trip the pulverizer and coal feeder. A pulverizer fire should be suspected and inerting steam will automatically be injected into the pulverizer to reduce the oxygen level and extinguish the fire.

5.1.1 Action

In the event of coal flow failure occurring, the pulverizer has been designed to trip and steam inert.

(i) Commission oil burners, if considered necessary, to maintain furnace stability.

(ii) If coal feed is readily restored after finding the problem, carry out "Coal Clearing" first before returning to service.

5.2 Pulverizer Trip

The effect of a pulverizer tripping will vary depending on the unit load at the time.

(i) When a pulverizer trips, the hot and cold air flow automatically cut out and inerting steam is applied for 5 minutes, after this time period the inerting steam is shut off and the pulverizer outlet gates will close, the Unit Operator MUST NOT foreshorten this process. If the "Pulverizer Clearing" operation cannot be carried out the pulverizer should be refilled with inerting steam every 30 minutes.

(ii) The coal and partly pulverized fuel remaining in the pulverizer constitutes a potential danger, these deposits should be removed from the pulverizer through the spillage hopper using the "Pulverizer Clearing" operation as described in Section 7.4.

(iii) Following the "Pulverizer Clearing" operation, the Shift Manager should make the decision to carry out an internal inspection on the pulveriser or return it to operational state.

(iv) If inerting steam is not available or "Pulverizer Clearing" can not be carried out it must be logged and reported to the Shift Manager immediately. Close attention should be given to the pulverizer outlet temperature as an increase could be an indication of a pulverizer fire. If fire is suspected it should first be extinguished using the procedures as laid down in Section 6.4.

5.3 Clearing Pulverizers Manually

The pulverizer will require manual clearing if its residual contents cannot be removed by the "Pulverizer Clearing" operation. The following conditions will require that manual clearing be used:

1. Pulverizer tripped with no restart possible.
2. Failure of inerting steam system.
3. "Pulverizer Clearing" operation cannot be completed.

The manual clearing procedure is as follows:

(i) Cool pulverizer and its contents to ambient temperature.

(ii) Obtain all safety clearances to enter the pulverizer as required by APS Safety Rules and associated procedures and instructions.

(iii) Ensure that all inert gases have been removed before anyone enters the pulverizer. Purge by opening all access doors and using air movers to change the air.

(iv) Remove the contents of the pulverizer to a suitable storage area (use shovels, electrostatic protected vacuum cleaners, etc.). Personnel Protective Equipment and safety devices, as identified in APS/I/SHE/01/004 – Use of Personal Protective equipment, shall be used during this operation.

5.4 Procedure for Dealing with a Choked Pulverizer

If the table (bowl) differential pressure of a pulverizer begins to increase this is an indication that the pulverizer is filling up or choking. If the table (bowl) differential pressure increases to > 45 mbar the "HI" alarm will annunciate. On receipt of this alarm the operator should bias the coal feeder flow rate down to normalise the condition. If there is no indication that the pulverized is returning to normal then TRIP the feeder, then after inerting and "pulverizer clearing", check with the Shift Manager to ensure it is safe to return it back into service, close attention should be given to its performance.

5.4.1 Conditions Tending to Choke

A Pulverizer will tend to choke if the primary air flow to the pulverizer is insufficient for the desired coal flow, the air temperature is too low or wet coal.

A Pulverizer that is beginning to choke will give the following indications:

(i) High pulverizer table (bowl) differential, "HI" alarm initiates

(ii) Falling pulverizer outlet temperature.

(iii) High pulverizer motor amps.

(iv) High level of rejects in spillage system.

5.4.2 Action on Tendency to Choke

If the above conditions are observed before the pulverizer trips, the following procedure may restore the pulverizer to a safe condition:

(i) Insert appropriate oil burners, if considered necessary to stabilise combustion.

(ii) Increase primary airflow bias, if this fails to regain stability.

(iii) Initiate a sequence to stop feeder, or, if the blockage is severe, a sequence to trip the pulverizer.

(iv) If the pulverizer table (bowl) differential falls, restore Primary Air bias to 1.0. When the pulverizer table differential pressure reaches ≈ 5 mbar, start the coal feeder on minimum speed.

(v) If there is no further tendency to choke, put the pulverizer and feeder controls back on 'Auto' and remove from service any oil burners not required.

(vi) Carry out visual (local) inspection of the pulverizer for signs of fires.

5.5 Loss of Fans

This section is designed to provide guidance on the loss of the following auxiliaries:

One Induced Draft Fan
One Forced Draft Fan
One Primary Air Fan

All the above abnormalities cause similar disturbances in firing conditions and can be treated in broadly similar manners. Trip alarms will be displayed on the DCS followed by a runback signal being initiated to put the unit in a safe condition as far as is practical. The Unit Operator must monitor all conditions and act accordingly.

The main effect of the loss of any of the above is the deliberate and automatic reduction in the number of pulverizers in service to three.

The total capable load in the event of the loss of an ID or FD fan is 60% and for a PA 50%

5.6 Loss of Ignition (MFT)

A Master Fuel Trip or MFT may be initiated by several protective devices both on the Boiler, Feedwater or Turbine plant. The effect is to shut off all fuel to the boiler by tripping all pulverizers and oil guns in service.

Following loss of ignition, the furnace atmosphere contains pulverized fuel. This is a potentially hazardous situation, the DCS will initiate a boiler furnace purge to prevent the accumulation of gas that is generated from residual coal remaining in the system in order to make the boiler safe.

5.6.1 Causes

Loss of ignition may be caused by any one of a number of factors, the main possibilities being the following:

(i) ID or FD Fan runback.

(ii) Reduced combustion air supplies caused by PA fan runback.

(iii) Loss of one or more pulverizers, particularly at low loads or where the remaining pulverizers are widely separated on the burner box.

(iv) Excessive or unstable furnace pressure control.

(v) Loss of fuel oil pumps, etc.

(vi) Loss of electrical supplies to pulveriser or loss of communications to DCS

(vii) Severe tube leak.

5.6.2 Actions on Total Loss of Ignition

Once total ignition loss is confirmed, the following actions must be carried out as quickly as possible.

(i) Make no attempt to light-off oil burners.

(ii) Ensure all tripped pulverizers are inerting.

(iii) As soon as permissives are available initiate a furnace purge as outlined in Section 5.7.

(iv) Ensure that all gas side dampers are open.

(v) Ensure the cause of loss of ignition is established and if no damage has been observed. If the Shift Manager has given his consent, the Unit Operator can prepare the boiler for light-up.

(vi) When the furnace purge sequence has been completed, preparations for re-firing can commence and combustion re-established as outlined in Section 4.4.

5.7 Furnace Purging following a Master fuel Trip (MFT)

Following a MFT trip and when a pulverizer has been in service, the furnace shall be purged using the boiler purge sequence ensuring at $>$ 30% MCR air flow for 300 seconds.

5.8 Procedure following a Full Load Trip (Firing on PF)

If such a trip occurs, the Shift Manager must be informed immediately, so that appropriate measures can be taken to avoid potential fires.

Following a full load trip (MFT) with consequent loss of ignition, consideration must be given to the increased level of unburnt carbon which will be present in the precipitator dust hoppers.

In any event when emergency dusting of precipitator dust hoppers is required (consequent upon blockage or other malfunction of fixed dust transport system), the Shift Manager must decide the method of work. The consideration will include recent operational history having regard to the potential for high carbon content of the dust.

CAUTION: The Coal & Ash Plant Supervisor should be informed by the Unit Operator of the likelihood of unburnt carbon being present in the dust hopper systems. These should be emptied as soon as possible after steady state boiler conditions are established. Ash and dust likely to contain unburnt fuel should not be exposed to the atmosphere until thoroughly wetted.

6 PROCEDURE FOR DEALING WITH PLANT FIRES

6.1 General

The following general instructions are given a guide for dealing with combustion equipment fires.

The Control Room shall be informed promptly of all fires.

Portable extinguishers can be used on isolated small fires of PF or waste materials ignited by welding sparks or similar sources. Care must be taken not to disturb piles of PF when using portable extinguishers.

For larger fires in the region of the windboxes, fuel oil system, etc, the first action will be to inform the Control Room. The Shift Manager will decide on the extent of assistance required or any plant isolation that may be necessary to contain the incident.

If the isolation valves for the affected zones are themselves threatened or hazardous, then the isolation shall take place further back where safe access is available.

Pulverizer lower housing fires are more common than other fires and can be dealt with in accordance with the procedure outlined in Section 6.4.

(i) Always pay first attention to personnel safety

(ii) Ring the emergency/fire phone no. (Insert emergency phone number here) and give relevant information regarding the fire.

(iii) Tackle small fires with extinguisher if possible, providing you are trained.

(iv) Control room should activate the fire alarm

(v) The Shift Fire Team personnel should be alerted and proceed to a location (sufficiently near to the pulveriser area) to be able to provide assistance if needed, but should not be in the restricted area.

(vi) The area should be cleared of unnecessary personnel.

(vii) The Shift Manager must assume overall charge of the situation and all staff report to their respective positions as laid down in the APS/P/OPS/01/015 – Emergency Response Plan.

6.2 Fire Detection System

NOTE: The boiler is protected by an automatic water spray system and heat detection system, which will operate over, selected areas. Staff should familiarise themselves with the isolation points on this system.

6.2.1 Boiler Burner Fire Detection

The boiler fire detection system must be tested routinely as defined in APS Instruction APS/I/OPS/05/004

Boiler burner fire heat detection system is installed at 3 elevations.

An audible and visual alarm is given in the control room main fire alarm control panel when initiated.

A routine system operation check should be carried out once a shift.

On an extended outage when boiler cooling and depressurising is completed, the operation of the boiler fire valves should be proved. Any faults should be reported to the Control Room Engineer for priority maintenance and the valve operation confirmed to be satisfactory before lighting the boiler.

6.2.2 Pulverizer Fire Detection System

There is no installed fire detection system associated with the pulverizer, however if a "HI HI" temperature alarm is received on the pulverizer outlet temperature thermocouple then a fire may be assumed. This is only an assumption as a high temperature also occurs when there is no coal feed and when steam inerting is in progress.

Fires in feeders, pulverizers and fuel piping are categorised by where they occur in the fuel preparation system and thus are broken down into four types:

6.2.2.1 Feeder Fires

Fires may occur in the coal feeder, these are normally as a result of burning or smouldering coal flowing from the coal bunker into the coal feeder and coming into an air rich environment.

There are no coal feeder temperature sensor devices installed, however there are temperature sensors installed on the coal bunker so, if the operator identifies a rise in coal bunker temperatures he should increase the number of regular visual inspections at the coal feeder and where practical to do so, increase the coal flow by biasing the coal feeder.

If a fire is identified, the operator should connect the fire hose onto the installed fire fighting spray connection and extinguish the fire.

6.2.2.2 Above/Under Table Fires

Above table fires occur in the area above the table within the pulverizer.

Under table fires occur in the lower housing area under the table within the pulveriser or inside the primary air duct to the pulverizer. There is no temperature measurement in this region so the pulverizer outlet temperature is the reference.

Fires in these areas may also be recognised during routine shift operations inspection by paint peeling from the pulverizer air inlet housing, sparks discharging from the spillage hopper.

6.2.2.4 Fuel Piping

Fires in fuel pipes are a result of pulverized fuel accumulating in the section of inherent low velocities.

This may be due to:

(i) A pulverizer group being tripped whilst in service.

(ii) Slagged pulverized fuel burner nozzles.

Fires in this area may be identified during routine shift operation inspection by paint peeling from the fuel piping.

6.3 Pulverizer Fires

6.3.1 Introduction

If handled properly, pulverizer fires are not overly dangerous from a personnel safety standpoint. If, however, the fire is not brought under control in an effective and expedient manner, an explosive condition could occur. Pulverizer fires are typically deep-rooted fires surrounded by a large mass of hot metal. Because of this, extinguishing agents that chemically interrupt the fire or remove oxygen from the fire are relatively ineffective.

6.3.2 Causes of Pulveriser Fires

1. Excessive pulveriser temperatures - the pulverizer outlet temperature should not be allowed to exceed 85°C.
2. Foreign material in the pulverizer - Materials such as paper, rags, straw, wood, etc., can collect in the pulverizer. These materials do not pulverize readily and, therefore, must be kept out of the raw fuel supply. When entering the system, this material is a potential cause of ignition. During pulverizer inspection, any such debris must be removed.
3. Excessive spillage - Spillage can accumulate in the lower housing area or in the primary air inlet duct to the pulverizer. Accumulations of debris in the primary air inlet duct must be removed when the pulverizer is opened for internal inspection.
4. Improper pulverizer operation - If the pulverizer is rejecting large quantities of coal to the lower housing area, it is a sign of improper pulverizer operation. The reason for the heavy spillage should be determined and corrected. The fire extinguishing system described in Section 6.3.3 is not intended to be a system to safeguard against improper pulverizer operation.

6.3.3 Fire Extinguishing (Water Injection) System

To assist in fighting fires and cooling pulverizers a free passage water injection nozzle is installed in the coal feeder.

1. When fire is suspected in the pulverizer as indicated by elevated pulverizer outlet temperatures and/or by physical indications of smoke and blistering paintwork, fire water can be sprinkled into the pulveriser via the installed fire fighting nozzle installed in the coal feeder. The water injection nozzle is supplied via an isolating valve and a manual fire fighting hose connection.
2. Depending on the severity of the fire, the preferred method of fighting the fire is using the inerting steam that is automatically initiated on a pulverizer trip as described in the inerting procedure (Refer to section 7 .
3. If it is considered necessary to inject water into the above and under table areas of the pulverizer, this must be initiated manually.
4. After any pulverizer water sprinkling event, the pulverizer must be manually cleaned. (Refer to Section 5.3 - Clearing Pulveriser Manually.

6.4 Pulverizer Fire Extinguishing Procedure

The fire extinguishing procedures are as follows:

6.4.1 Upon Detection of a Coal Feeder Fire

1. Trip feeder which initiates inerting etc.
2. Close coal bunker outlet slide gate
3. Make fire hose connection on coal feeder
4. Open fire fighting water valve.
5. Continue water injection until evidence of fire has disappeared and pulverizer has been cooled. The pulverizer should be kept under observation for physical indication of a fire and the pulverizer outlet temperature monitored.

6.4.2 Upon any indication of a possible pulverizer fire

1. On receiving a pulverizer outlet temperature "HI" alarm, the Unit Operator should increase coal feeder speed and ensure the pulverizer outlet temperature set point to 65°C.
2. If the temperature rises to 100°C the pulverizer outlet temperature "HI HI" alarm trips the pulverizer. The hot and cold primary air dampers will close automatically and inerting steam is supplied to the pulverizer for 5 minutes.
3. If the pulverizer outlet temperature continues to rise it must be assumed that the fire has not been extinguished. Fire water should be injected to the inside of the pulverizer through the hose connection on the coal feeder.
   Note: Water to fight pulveriser fires should only be introduced as a last resort.
4. Isolate, clean out, and repair pulveriser as required. (Refer to Section 5.3 - Cleaning Pulverizer Manually).

6.4.3 Fire detected in a pulverizer following a controlled shutdown

If a fire is detected in a pulverizer following a controlled shutdown, the Unit Operator should trip the pulverizer and inerting steam will automatically injected into the pulverizer.

6.5 Fire in a Secondary Air Windbox

There are four basic causes, which lead to fire and must be reported immediately to Control Room.

(i) Holed or cracked PF nozzles or pipework resulting in PF Fire in Windbox.

(ii) Oil leak from burner inside windbox resulting in an oil fire in the windbox. Immediate actions – ensure affected oil burner(s), have been scavenged and isolate supply valves, disconnect and withdraw from windbox.

(iii) Extended operational running periods with low windbox differential pressure i.e. short ignition point.

(iv) Leaks from pulverized fuel and oil pipework close to the windbox resulting in external fires.

The boiler firing galleries are protected by an automatic spray water fixed fire fighting system. The spray water system is pressurised and has quartzoid bulbs installed around the burner area. When subjected to high temperatures the quartzoid bulb will shatter releasing the system pressure which activates the water spray deluge valve. There are four separate systems, one for each burner assemblies, which detect and activates at three different elevations.

If an oil fire is noted on the boiler the Control Room should be informed via the emergency phone no. (Insert emergency phone number here) and the oil trip valve must be operated from the Control Room. If it is safe to do so then local oil valves on the burner concerned should be shut.

If a severe fire develops in the windbox and spreads to the outside, or a major external fire occurs, then the automatic water spray system should operate. The pulverizers and oil burners in the fire zone must be tripped immediately. Isolate oil supplies in the affected area, if necessary isolating the supply mains to the boiler.

Fire fighting should be commenced as per APS/P/SHE/04/001 – Actions in Event of a Fire and/or Explosion and additional equipment brought to the area to cover any oil, which escapes the water spray zone.

The Shift Manager must quickly ascertain the severity of the fire and if necessary take the Unit off load.

Whatever action is taken by the operator, first safety of personnel and then plant is the overriding consideration.

6.6 Air Heater Fires

6.6.1

Although during unit start-up the air heater is by-passed, when there are prolonged periods of oil firing there is a danger of an air heater fire. This danger is greatest after a major overhaul and with an air heater with new elements, particularly during extended periods of firing on oil for unit start-up and safety valve floating etc.

To minimise the risk of air heater fires there is a need to maintain the cleanliness of the air heater heat exchange surface by:

(i) On-load sootblowing at regular intervals

(ii) Paying particular attention to the cleaning, maintenance and testing of oil burners.

6.6.2

If an air heater fire is discovered the following actions may be taken;

(i) External casing hot spots may be sprayed with water at the Shift Managers discretion.

(ii) Shutdown the fan groups and box the boiler.

(iii) Ensure that the hopper drain valves are open and the pipe work is clear; large quantities of water are heavy and must be drained.

(iv) Admit water in sufficient quantities through the fire fighting manifolds, ensuring that the telltale valve next to the FD fans is shut.

(v) If possible, identify by viewing through the sight glass.

(vi) If the source of the fire is widespread, keep the rotor turning so that complete water coverage of the elements is possible.

6.7 Fire in a Coal Bunker

6.7.1

Coal bunker fires are dangerous due to the release of toxic gases (carbon monoxide) into the tripper floor. They can create severe operational problems if evacuation requirements, due to carbon monoxide, prevent coaling. Because of this it is essential that suspect coal bunkers fires are reported immediately, bunker house ventilation fans are kept in sound working order and breathing apparatus sets are available at the location.

Fires in a coal bunker are normally caused by hot air entering a bunker from a standing pulveriser or spontaneous ignition of standing coal.

If it is suspected that the coal in a bunker is smouldering, the atmosphere around the coal bunker must be checked immediately.

Close monitoring of the coal bunker temperature sensors is essential to gauge the rate of rise in bunker temperatures giving an indication of the severity of the fire.

Maintain communication with the Coal and Ash Plant Operators.

Ensure that the associated bunker coal feeder seal air supply valve is shut.

Resume filling of the coal bunker as soon as practicable, to attempt to smother the burning coal. Continually monitor the area for hot spots and CO levels. Resume normal pulverizer group operation as soon as practicable. Until such a time there are no hot spots, the area around the coal bunker shall be retested on a regular basis until it is decided that it is safe to resume access.

Should a bunker contain coal that is on fire, as indicated by elevated bunker sensor temperatures and extensive smoking from the top of the bunker into the tripper floor area, the pulveriser should be tripped, steam inerted and "Pulverizer Clearing" operation completed.

The Shift Manager should assess the severity of the fire and take action to suppress and extinguish the fire, initial action would be to blanket the coal in the bunker with a class A foam according to NFPA 850-2, Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations, 2000 edition.

This may involve special fire fighting techniques (Breathing Apparatus to be worn) due to the expected high levels of CO in the tripper floor area.

Note: Water is not recommended as an extinguishing agent because there is a danger of explosion if water hits an advanced hot spot. It should be noted that in some cases water was

successfully used for extinguishing bunker fires.

If for any reason it is not practicable to take the pulverizer out of service, then the coal must be passed through the pulverizer. During this operation only the minimum number of personnel necessary should be allowed in the hazard zone wearing appropriate protective clothing. They must be instructed to retire immediately if coal flow is lost or if the pulverizer is to be shut down. Communication with the Unit Operator therefore must be maintained at all times.

Bunker levels should be monitored and recorded in the Unit Operators log at the end of each shift. Additionally, if the level falls to below $100m^3$ or is suspected of funneling, this must be reported to the Shift Manager who will decide upon the appropriate action to be taken.

6.7.2

Spontaneous Ignition of standing coal in a coal bunker.

In order to prevent this it is necessary that:

(i) Coal & Ash staff identify coal stock spontaneous ignition areas and prevent delivery of hot (steaming) coal to the coal bunker.

(ii) The coal bunker is whenever practical, emptied of coal on long pulverizer and unit outages.

7 PULVERIZER INERTING SYSTEM

7.1 Introduction

The pulverizers have an inerting steam system.

The fire fighting system is not part of the inerting system. The inerting system is a fire prevention system.

The main purposes of the pulverizer inerting and fire fighting systems are to:

(a) Dilute the oxygen content of a pulverizer when there is risk of a pulveriser explosion.

(b) Extinguish fires in the pulverized fuel system.

A primary concern is ensuring the safety of plant personnel during a potentially hazardous situation. The systems provide methods to safely control a fire and thereby reduce the risk of explosions in the pulverized fuel system.

When there is risk of a pulverizer fire, the pulverizer inerting system dilutes the oxygen content of the pulverizer.

7.2 Pulverizer Inerting System Description

The inerting medium is steam. Steam is usually available in sufficient quantity to provide a flow through the pulverizing system for purging of volatile gases. If used as recommended, it does not damage the pulverizer or associated equipment and thus permits safe, fast equipment restart.

The activation of the inerting steam flow is automatic. The oxygen content in the pulveriser is reduced and the pulverizer atmosphere rendered inert. When the BMC control system determines a pending hazardous pulverizer condition (that is, any pulverizer trip under load or an interruption in raw fuel feed), inerting steam flow is automatically activated. Inerting is activated for any pulverizer trip.

Inerting steam flows are not monitored during operation. Steam flows are based on pressure and steam piping size.

7.2.1 Steam Inerting System

Steam, from the boiler side auxiliary steam header is extracted and piped to nozzles in the primary air inlet duct on the pulverizer. Individual lines, with isolating and control valves, connect the auxiliary steam header to each pulverizer. Drains, located at the low points of the system, continuously extract condensate so that the piping system is kept warm and maintained free of water.

7.3 Steam Inerting System Operation

7.3.1

Following a pulverizer trip the steam inerting system is automatically initiated.

(i) The control valves are programmed to open automatically when then pulverizer trips and close after a 5 minute period of inerting steam injection.

(ii) If for any reason the "Pulverizer Clearing" operation cannot be carried out immediately following the steam inerting period, the pulveriser should be manually steam inerted every 30 minutes.

7.4 Pulverizer "Clearing" Procedure

The pulverizing "clearing" process removes the residual coal in the pulverizer following a pulverizer trip through the spillage hopper transporting it into the DCC hopper for disposal.

After the pulverizer has been steam inerted for 5 minutes the operator can remove the residual coal from the tripped pulverizer by manually initiating the "Pulverizer Clearing" operation. This requires the transferring from the normal spillage hopper emptying operation to the "pulverizer clearing" operation.

The "Pulverizer Clearing" operation is carried out with the primary air dampers and the pulverizer outlet valves closed and the pulverizer motor running in an inerted atmosphere. During this operation the primary air fan must be running to supply sealing air to the pulverizer.

8 MAINTENANCE PROCEDURES

8.1 Safety - related maintenance

In order to reduce risk of pulverizer internal fires, any ledges or pockets where accumulations of PF can lead to a combustion hazard, must be eliminated.

In addition to routine inspection for integrity, other critical areas for inspection, in relation to PF safety are:

- Pulverized fuel piping monthly inspection
- Pulverizer annual internal inspection
- Air heater annual internal inspection
- Electrostatic Precipitator (EP) annual internal inspection

8.2 Care and Maintenance of PF Pipework

8.2.1

PF pipework must be subject to regular inspection and replacement to ensure integrity. The condition of couplings should also be checked.

Inspections shall be programmed as part of the boiler statutory survey overhaul work.

8.2.2 Work must include:

- assessment of thickness of pipework and bends (with renewals where necessary)
- checks for alignment of pipework and continuing integrity of pipework supports and hangers
- re-assembly of joints between sections of pipework to manufacturer's standards, with new joints and correct grade fasteners of full integrity, where these have been disturbed.

8.2.3 Quality control

Full quality control must be applied to such works with a schedule of all work undertaken being completed and retained in maintenance records.

All existing pf plant components which are removed must be re-installed in accordance with the correct procedures to ensure that the containment requirements are fully accommodated.

When new pf plant components are required, these must be procured to the required design specification and installed in accordance with the correct procedures to ensure that the design containment standards are met.

8.3 Control and Instrumentation

All protection and control instrumentation, including alarms related to the pulveriser plant shall be subject to scheduled maintenance and checked at regular intervals.

A schedule of preventive maintenance together with the associated records of testing/calibration shall be maintained in the company Computerised Maintenance Management System (CMMS).

8.4 Cleaning Procedure

Cleanliness of PF Plant and associated equipment should be maintained to the highest standard. Cleaning operations must be carried out in accordance with the General Precautions stated in Section 1.

9 REPORTING OF INCIDENTS ASSOCIATED WITH P.F. PLANT

The Shift Manager should report any accident, explosion of fire associated with pulverized fuel plant whether or not causing damage or injuries, in writing, to the Operations Director.

Significant pulverized fuel incidents must be investigated and remedial measures applied where appropriate.

The information from significant pulverized fuel incidents received into the company from which future failure or integrity risks associated to the installed ACME plant can be assessed may require procedural changes.

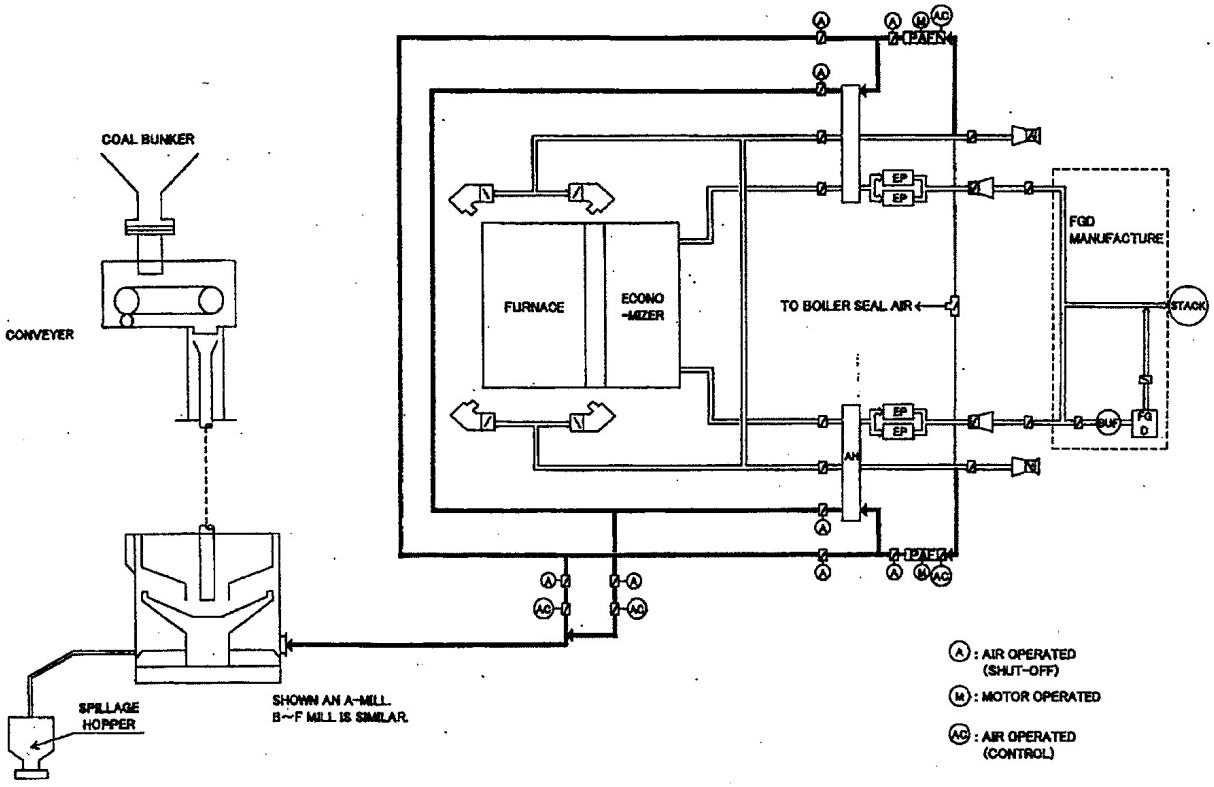

Figure 1: Primary Air Flow Diagram

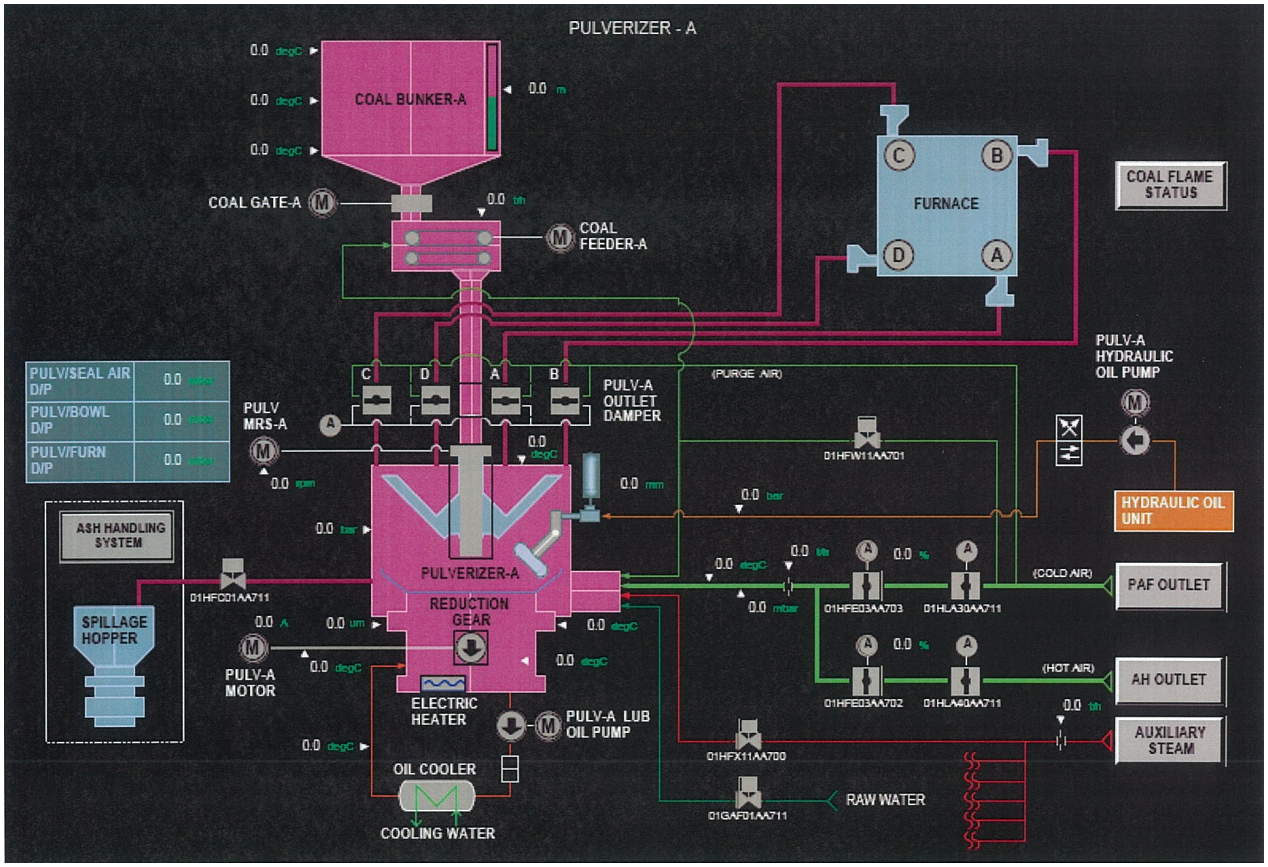

Figure 2: Pulverizer DCS screen Layout Diagram

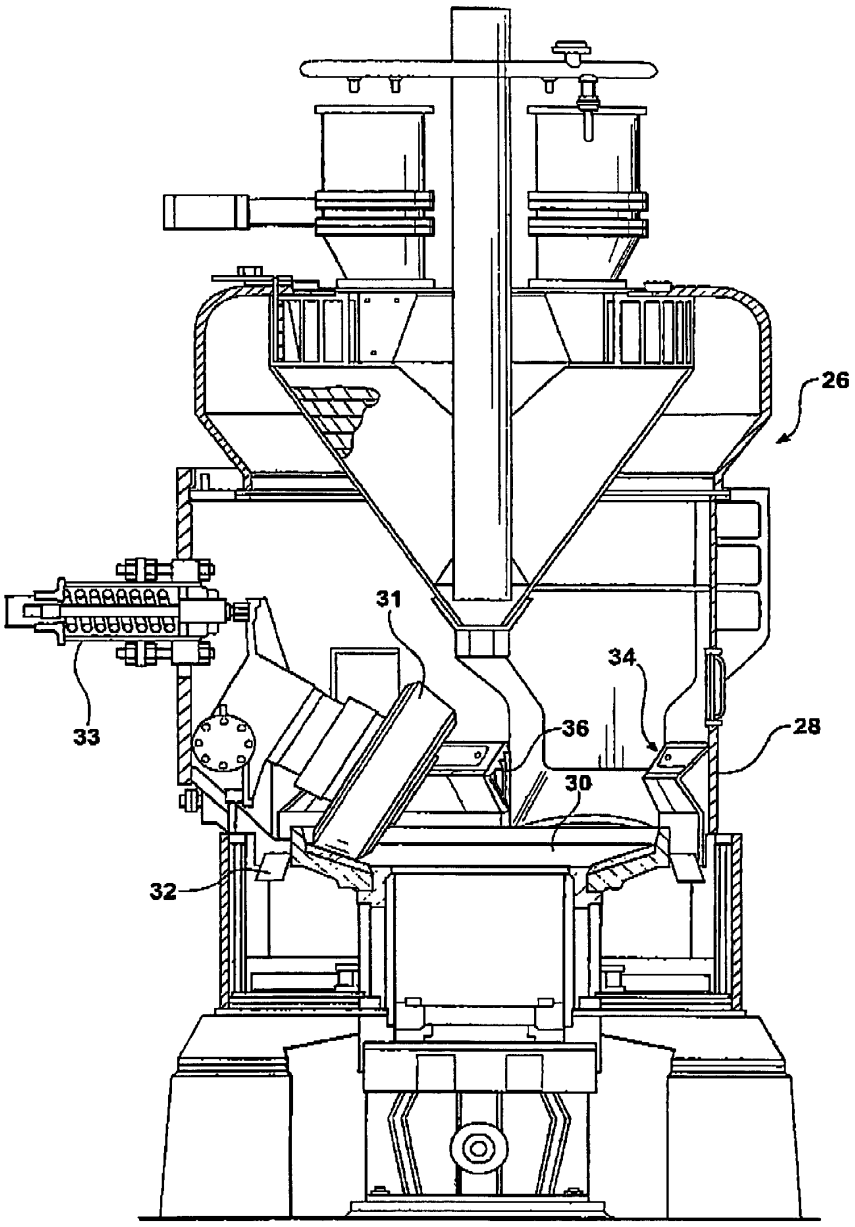

Figure 3: Vertical Pulveriser

Coal flow (t/h)	Normal/High Coal - Air Demand (t/h)	A/F Ratio
0	71.4	
25	71.4	2.856
58	90.4	1.559
76	106.1	1.396
100	127.0	1.270

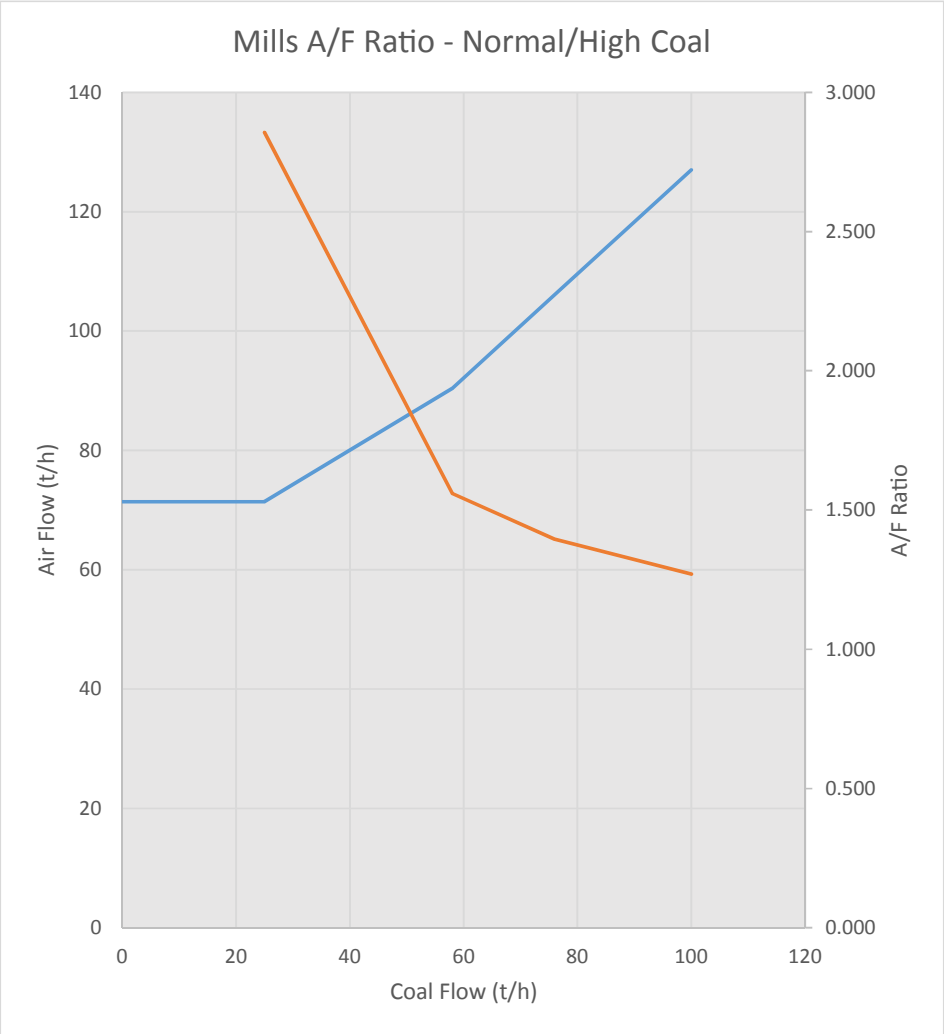

Figure 4: Primary Air/Coal Flow Curve for Normal/High Coal

Coal flow (t/h)	High Moisture Coal 1 - Air Demand (t/h)	A/F Ratio 1	High Moisture Coal 2 - Air Demand (t/h)	A/F Ratio 2
0	78.8		92.8	
22.7	78.8	3.471	92.8	4.088
60	106.0	1.767	113.0	1.883
100	127.0	1.270	127.0	1.270

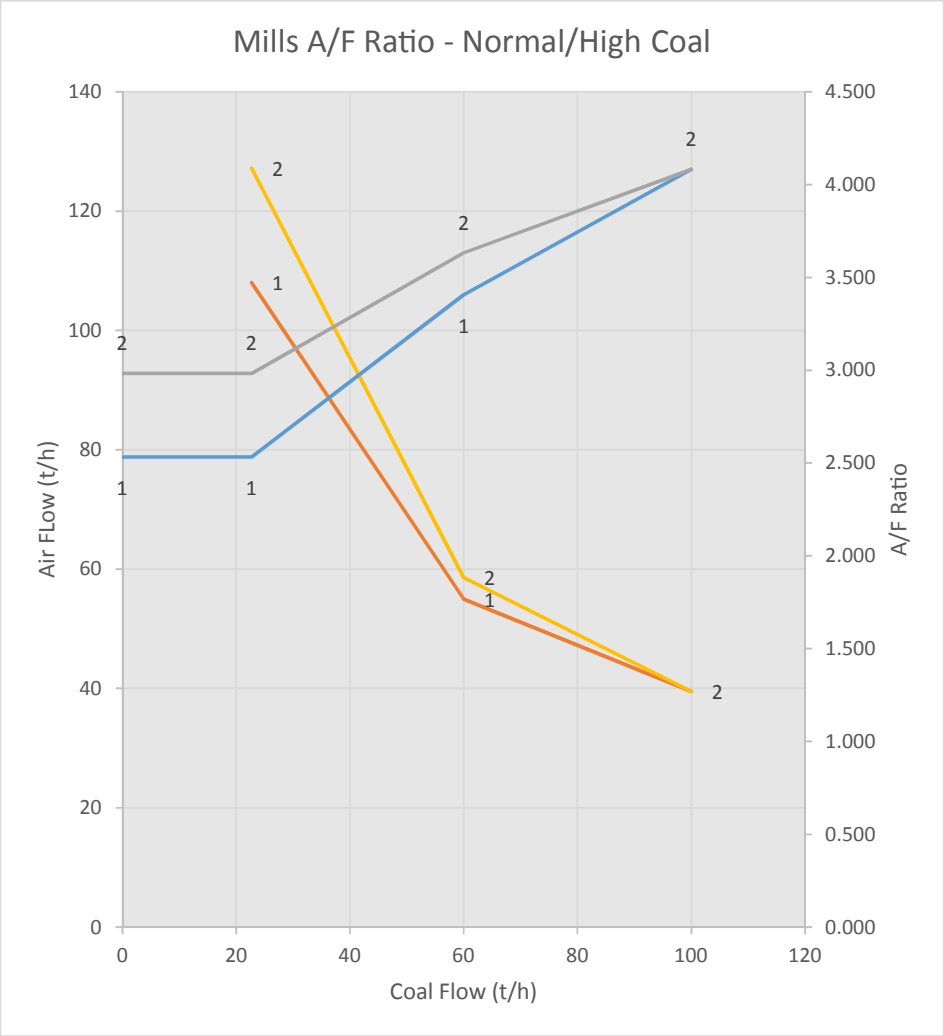

Figure 5: Primary Air/Coal Flow Curve for High Moisture Coal

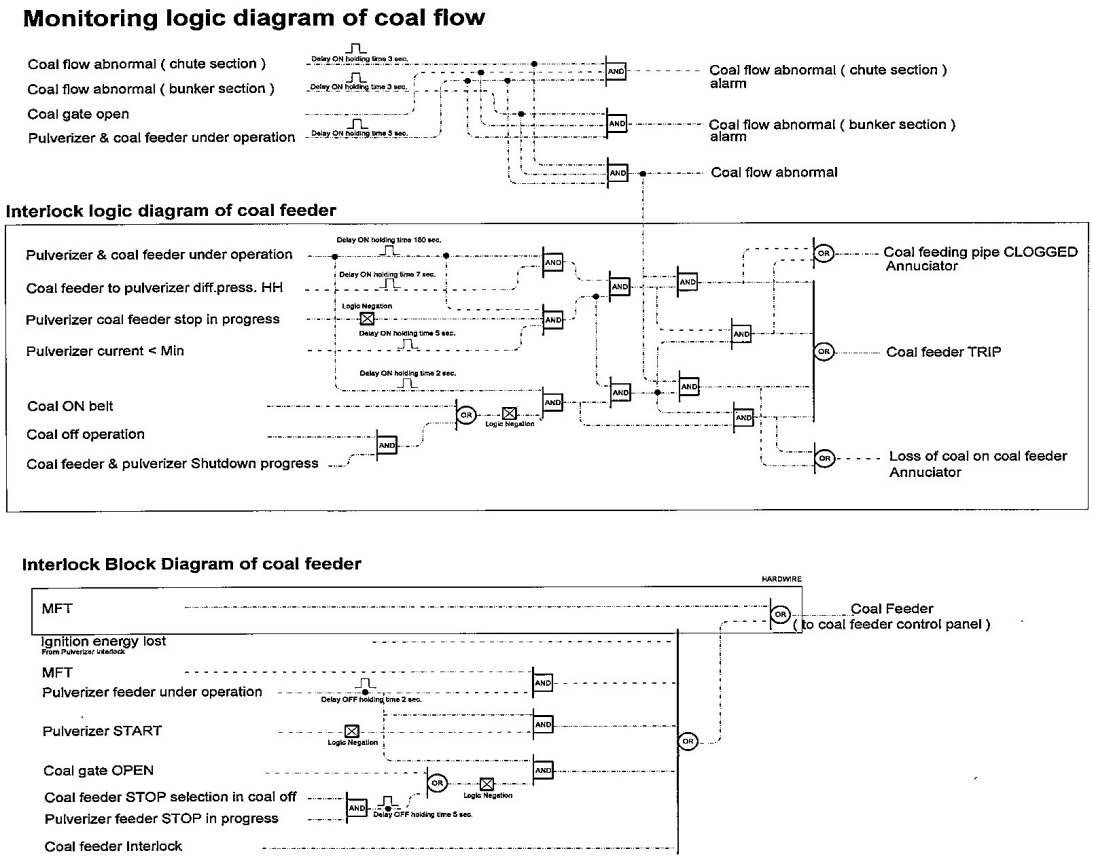

Figure 6: Monitoring Logic for Coal Flow and Interlock Logic ans Block Logic for Coal Feeder

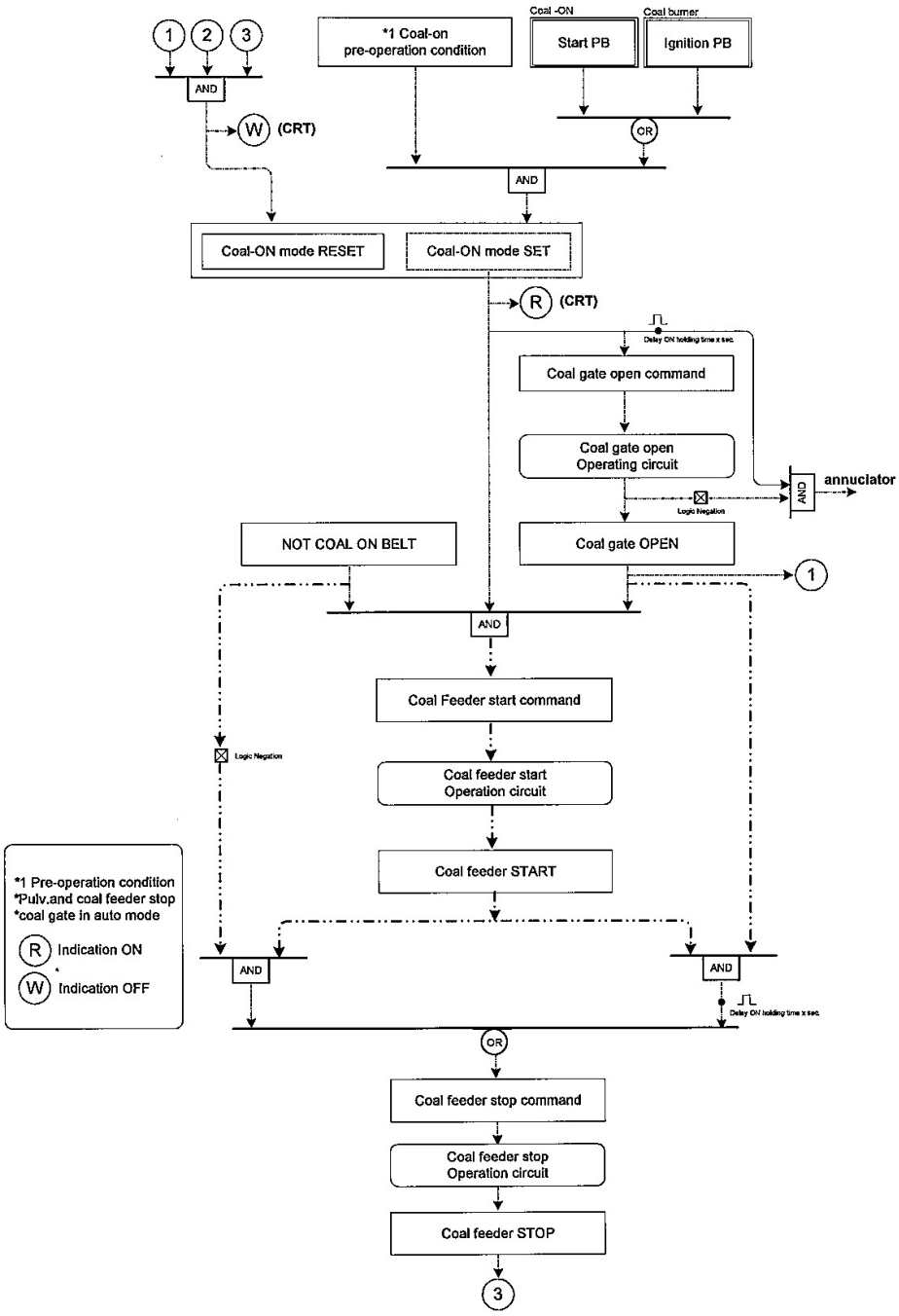

Figure 7: Coal Feeder "Start" Logic Diagram

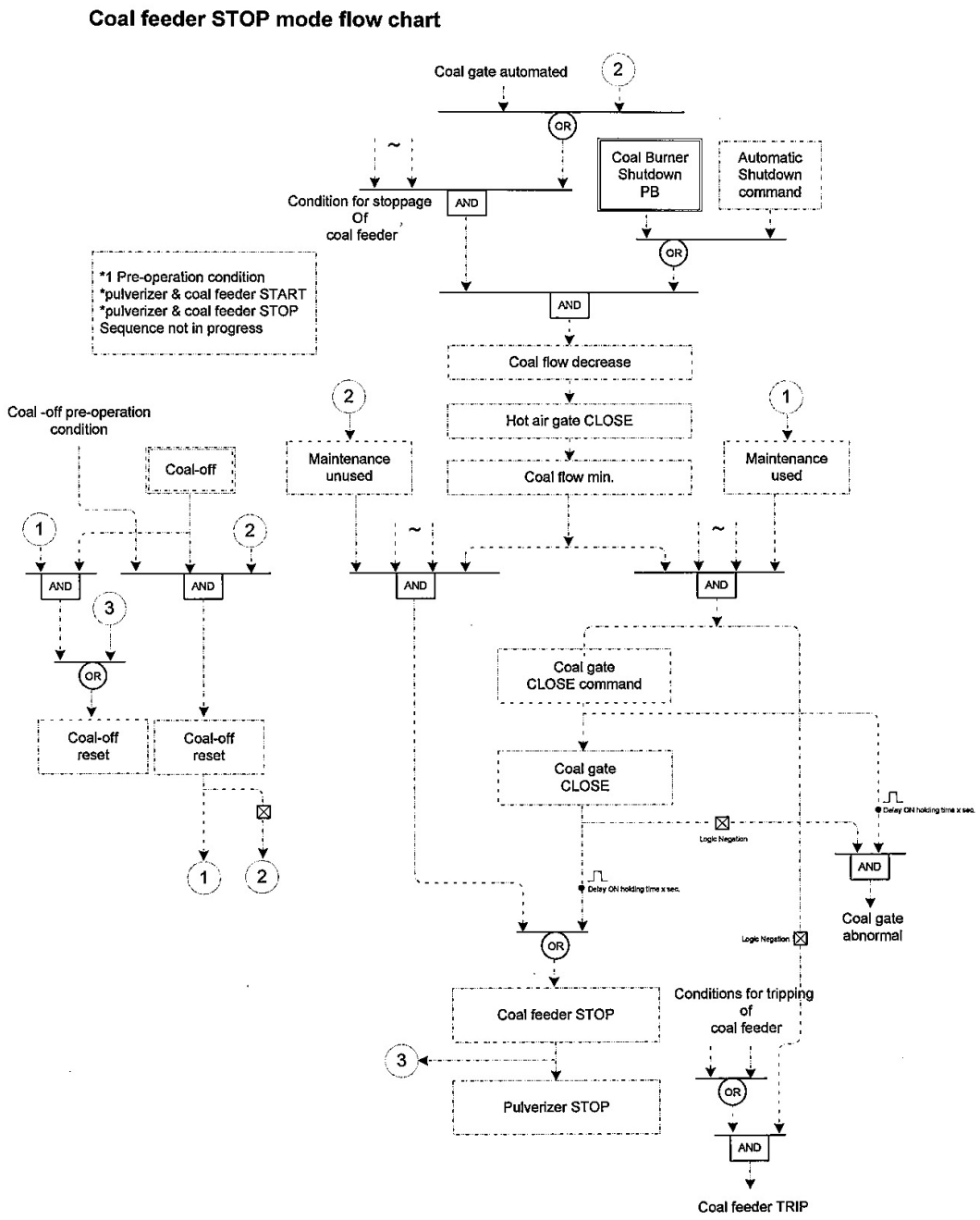

Figure 8: Coal Feeder "Stop" Logic Diagram

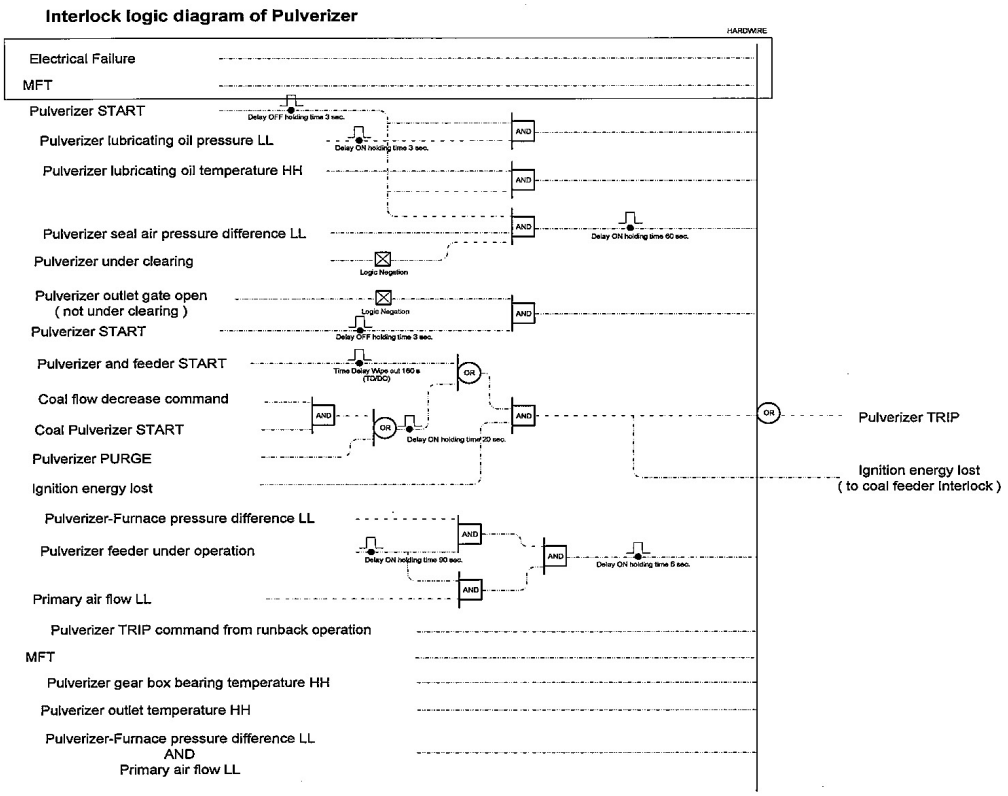

Figure 9: Interlock Logic Diagram for Pulveriser

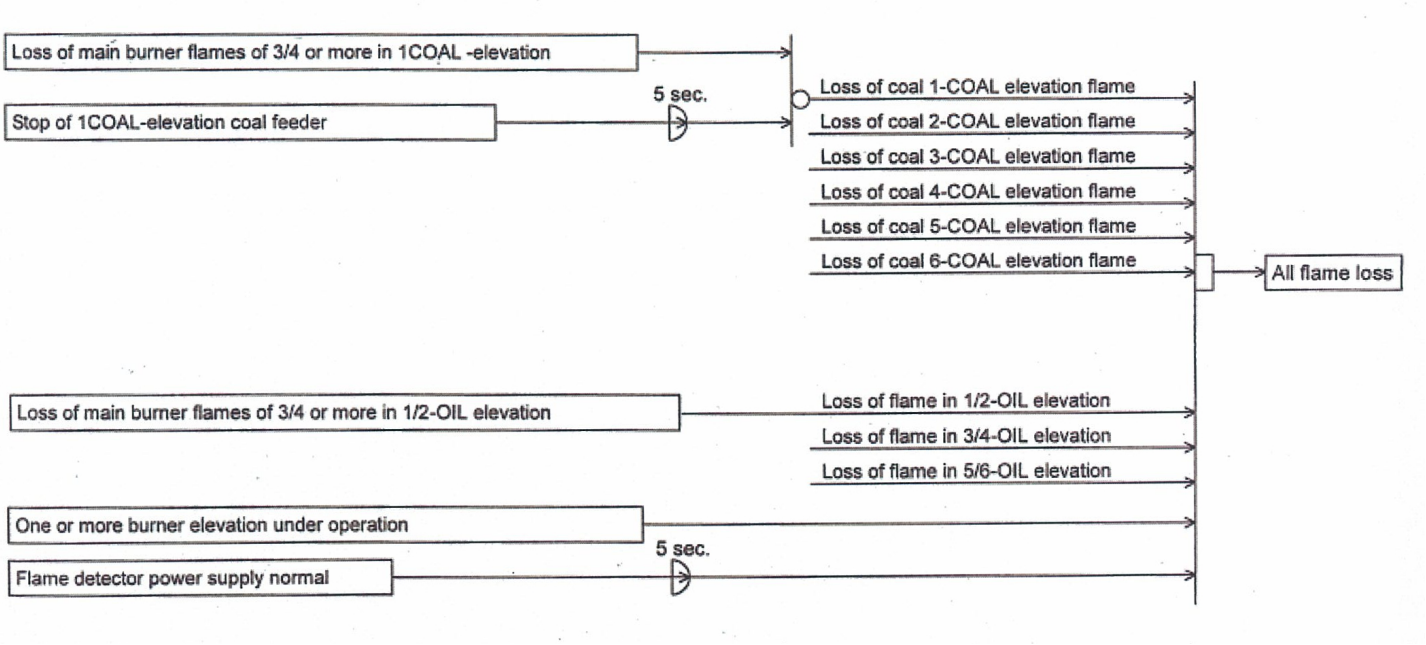

Figure 10: Flame Detection Logic Diagram