Report

Startup, Shutdown, and Malfunction Plan
Malfunction Abatement Plan
For One (1) Natural Gas-Fired Auxiliary Boiler

Holland Energy Park
Holland Board of Public Works
Holland, Michigan

NTH Project No. 73-160038-01
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APPENDICES

1.0 INTRODUCTION

Holland Board of Public Works (BPW) received Permit to Install (PTI) No. 107-13E for the installation and operation of a natural gas-fired combined heat and power (CHP) plant, known as Holland Energy Park (HEP), located at East 5th Street and Fairbanks Avenue in Holland, Michigan. PTI No. 107-13E includes requirements to submit a Startup, Shutdown, and Malfunction (SSM) plan and a Malfunction Abatement Plan (MAP) under Special Conditions (SC) III.1 and III.2 for one (1) natural gas-fired auxiliary boiler (EUAUXBOILER) with dry low NO_x (DLN) burners and flue gas recirculation (FGR). EUAUXBOILER was manufactured by English Boiler and Tube, Inc.

1.1 Process Description

The auxiliary boiler is natural gas-fired 83.5 million BTU per hour (MMBtu/hr) unit that serves as backup for snowmelt and district heating when either unit in FGCTGHRSG is offline. It provides saturated steam for station steam or to heat exchangers in order to adequately heat the snowmelt and district heating working fluids. For control of nitrogen oxides (NO_x), the auxiliary boiler is equipped with DLN burners and FGR.

1.2 Purpose of the Plans

The SSM plan and MAP are used to detail procedures for operating and maintaining the auxiliary boiler during periods of SSM. The SSM plan and MAP also detail how to document preventative measures to guard against malfunctions and/or failures that result in excess emissions above permitted emission rates. Additionally, the SSM plan and MAP present procedures for detecting and correcting these incidents, should they occur.

Sections 2.0 of this report details the plan requirements. Sections 3.0 and 4.0 contain recordkeeping and reporting requirements. Sections 5.0 and 6.0 contain a list of plan revisions and referenced documents. Appendices A - D of this report include procedures for SSM events.

2.0 PLAN PROCDURES

During SSM events involving the auxiliary boiler, BPW will follow the procedures in this plan for proper operation so as to minimize excess emissions. The SSM plan and MAP are intended to provide a roadmap to plant operations and outlines procedures for operation of EUAUXBOILER during SSM events. This plan will help ensure that:

- During SSM events, BPW operates and maintains EUAUXBOILER in a manner consistent with good air pollution control practices;
- BPW is prepared to correct malfunctions as soon as it is safe and practicable to do so, in order to minimize excess emissions of air pollutants; and
- BPW meets the recordkeeping and reporting requirements associated with periods of SSM (including documenting corrective action taken to restore malfunctioning process and air pollution control equipment to its usual manner of operation).

2.1 Startup and Shutdown

This section provides details regarding operation of the auxiliary boiler during a startup and shutdown.

Definition of Startup

Startup of EUAUXBOILER is defined as the period of time from first ignition of fuel to when steam is available for use. A typical startup will last between 5 and 8 hours.

Procedures during Startup

Detailed procedures are available in Attachments A and B of this document, but the general procedures for startup are as follows:

1. Before starting the burner, the operator must ensure that all system checks have been completed. This includes ensuring complete system integrity to rectify that

there are no open pipes or connections, no cooling air available, no maintenance actions are occurring, and systems lockouts are inactive;

2. The boiler fan is turned on to purge the system. This prevents the explosion of fuel inside the boiler;
3. Fuel firing begins, and FGR system is engaged;
4. Boiler pressure and temperature is slowly brought up from the cold start conditions, at a maximum rate of 100 to 125 degrees F per hour until conditions for a warm start are reached;
5. Boiler is then brought to the design pressure and temperature, with the DLN burners allowed to operate above minimum fire only when steam flow is confirmed to be greater than 3,000 lb/hr;
6. Boiler load, design pressure, and temperature are maintained at steady-state conditions above the manufacturer's recommended minimum load;
7. Once the flow is confirmed to be above 3,000 lb/hr the burner can release to meet the steam demand; and
8. Startup is complete when steam is available for use.

Definition of Shutdown

Shutdown is defined as the period of time between lowering steam output with the intent to shut down the unit to when the fan has been turned off.

Procedures during Shutdown

Detailed procedures are available in Attachment B of this document, but the general procedures for shutdown are as follows:

1. Boiler load is reduced to below the manufacturer's recommended minimum load;

2. Fuel firing is stopped through the DLN burners, FGR stops, and load reaches zero;
3. Steam is no longer available for use;
4. The system has been purged and cooled;
5. Fans are shut off;
6. Additional checks are made to verify that valves, vents, and pumps are correctly positioned; and

Additional detail on startup and shutdown are provided in Appendices A-B of this document. Burner startup procedure excerpts from the manufacturer are provided in Appendix A. Boiler furnace operation and maintenance instructions and procedure excerpts are provided in Appendix B; procedures include initial startup, normal cold startup, warm condition startup, and normal and emergency shutdowns. Appendices A and B are obtained from the Zeeco Ultra-Low NO_x Free Jet Gas Burner O&M Manual and the auxiliary boiler Operation and Maintenance (O&M) Manual, as provided by English Boiler and Tube, Inc.

The full Zeeco burner manual includes a burner description, as well as information on burner components, commissioning, operation, maintenance, spare parts, drawings, and a glossary of terms. Appended to the manual are power burner data sheets, a physical air model report, flame scanner information, fuel curves, and valve train cut sheets.

The English Boiler and Tube, Inc. manual includes:

- Boiler and furnace operation and maintenance instructions;
- Boiler pre-start and start-up documents;
- Economizer, blowdown separator, burner, and deaerator information;

- Miscellaneous information including info on the demister pad, warranty, and spare parts list;
- Boiler valve and trim schedule information with manuals;
- Boiler instruments list; and
- English Boiler project drawings.

These O&M manuals are kept at HEP as noted in Section 6.0. Copies can be provided to Michigan Department of Environmental Quality (MDEQ) upon request.

2.2 Malfunctions

This section provides details regarding operation of the auxiliary boiler during malfunction events.

Definition of a Malfunction

For the purposes of this SSM plan, malfunction is defined as follows per Part 1 of the Michigan Air Pollution Control Rules:

> *Malfunction means any sudden, infrequent and not reasonably preventable failure of a source, process, process equipment, or air pollution control equipment to operate in a normal or usual manner. Failures that are caused in part by poor maintenance or careless operation are not malfunctions.*

Malfunction Abatement Plan

Pursuant to Michigan Rule 911, a MAP must specify the following:

- 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.

- 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.
- 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.

EUAUXBOILER and associated monitoring equipment must be operated by qualified individuals. The Maintenance Supervisor will be responsible for overseeing the inspection, maintenance, and repair of appropriate EUAUXBOILER components and DLN burners so as to minimize air emissions. The Maintenance Supervisor will be responsible of the on-going training of personnel in charge of operations and monitoring the equipment to ensure processes of the auxiliary boiler are functioning properly.

EUAUXBOILER spare parts for replacement are contained in the auxiliary boiler O&M manual. Records of items shall be updated and maintained as necessary. Note, however, BPW does not intend to keep any spare DLN burners in stock.

Verification that the auxiliary boiler is operating properly is important. If the boiler is found to be malfunctioning, shutdown of the unit is generally necessary; however, impacts of shutting the equipment down should generally be investigated to determine that the shutdown will not exacerbate the problem. In some cases, it may be necessary to continue operating the unit during a malfunction condition in order to minimize excess emissions and/or as a safety measure until such time that the unit can be safely shutdown. In these

instances a decision to continue operating after a malfunction will be carefully documented. If boiler shutdown is necessary, the procedures related to emergency shutdowns in the O&M manual will be followed. Should a malfunction or failure occur to any part of the boiler, the instructions and procedures discussed in the auxiliary boiler O&M Manual and the Zeeco Ultra-Low NO_x Free Jet Gas Burner O&M Manual will be followed. Records of maintenance events, and date and time of occurrence will be properly documented.

The auxiliary boiler contains a programmable logic controller (PLC) that monitors certain operating variables. Alarms will activate at certain set trip points that can be indicative of poor emissions:

- Low Oxygen Trip: Set point at < 3.7% O_2
- Low Combustion Air Flow: Set point at < 0.2" w.c.
- Flame Scanner Intensity Alarm: Set point at < 10%

Corrective actions taken to address the alarms and bring the operating variables back to normal ranges and EUAUXBOILER into proper operation are as follows:

- Inspect FD fan to ensure proper operation.
- Inspect flame scanner sight tube for proper alignment and that nothing is blocking the scanner line of sight.
- Inspect gas flow control valves and ensure they are operating properly.
- Inspect flame to verify proper flame distribution.

Additional detail of the burner and boiler inspections, operation, maintenance, monitoring and recommended operating variables, and corrective actions are addressed in the auxiliary boiler O&M Manual and the Zeeco Ultra-Low NOx Free Jet Gas Burner O&M

Manual. Appendix C contains excerpts from the O&M manuals that briefly summarizes portions of this information, including recommended inspection and cleaning schedule and methodology.

BPW will keep records of each SSM in accordance with Section 3.0 of this document. Such records will be reported to the MDEQ if they cause excess emissions, as specified in Section 4.0 of this document.

3.0 RECORDKEEPING REQUIREMENTS

This section covers various recordkeeping requirements related to SSM.

Pursuant to PTI No. 107-13E for EUAUXBOILER under SC III.1 and III.2, BPW shall submit a SSM plan to MDEQ prior to startup and a MAP within 180 days of initial startup. The SSM plan shall incorporate procedures recommended by the equipment manufacturer, as well as incorporating standard industry practices. The MAP shall address events that meet the characteristics of a malfunction and specify information contained in Michigan Rule 911. BPW will keep current copies of the SSM plan and MAP onsite, and will maintain SSM records in log books.

All SSM records shall be provided to the BPW's Environmental Regulatory Specialist, which will be responsible for maintaining the records in accordance with the BPW's records retention policy. Additionally, the following information will be kept:

- Records of startups and shutdowns of the equipment will be kept in the plant log books.
- During an abnormal startup or shutdown, records of the event shall be recorded including the time, date, probable cause(s), duration, affected equipment, emission estimates, and the corrective actions taken in response to the abnormal event.

4.0 REPORTING REQUIREMENTS

This section covers various reporting requirements related to the SSM plan and MAP.

4.1 Michigan Air Pollution Control Rule 912

Michigan Rule 912 requires that a facility operate its source, process, or process equipment, to the extent that is reasonably possible, in a manner consistent with good air pollution control practices for minimizing emissions during periods of abnormal conditions, startup, shutdown, and malfunctions. A source, process, or process equipment that complies with all applicable emission standards and limitations during periods of abnormal conditions, startup, shutdown, and malfunction shall be presumed to have been operated in a manner consistent with good air pollution control practices for minimizing emissions. However, there could be instances of equipment upset during a startup or shutdown, or an abnormal startup or shutdown not consistent with manufacture specifications, or malfunctions that could occur.

PTI No. 107-13E contains emission limits for EUAUXBOILER for oxides of nitrogen (NO_x), carbon monoxide (CO), particulate matter (PM, PM_{10}, $PM_{2.5}$), volatile organic compounds (VOC) and Greenhouse Gases (GHGs) (as carbon monoxide equivalent (CO_2e)), during normal operation. Pursuant to Rule 912, BPW shall provide notice of an abnormal condition, startup, shutdown, or a malfunction that results in excess emissions of these pollutants.

BPW shall provide notice and a written report of an abnormal condition, startup, shutdown, or a malfunction if it results in excess emissions above the emission limitations for EUAUXBOILER for more than two (2) hours. The requirements for notices and written reports are as follows:

- The notices required shall be provided to MDEQ as soon as reasonably possible, but not later than two (2) business days after the startup or shutdown or after discovery of the abnormal conditions or malfunction. Notice shall be by any reasonable means, including electronic, telephonic, or oral communication.
- Written reports, if required, must be submitted to MDEQ within 10 days after the startup or shutdown occurred, within 10 days after the abnormal conditions or malfunction has been corrected, or within 30 days of discovery of the abnormal condition or malfunction, whichever is first. The truth, accuracy, and completeness of the written reports shall be certified by a responsible official in a manner consistent with the Clean Air Act. The written reports shall include all of the required information:
  - The time and date, the probable causes or reasons for, and the duration of the abnormal conditions, start-up, shutdown, or malfunction.
  - An identification of the source, process, or process equipment that experienced abnormal conditions, was started up or shut down, or which malfunctioned and all other affected process or process equipment that have emissions in excess of an applicable requirement, including a description of the type and, where known or where it is reasonably possible to estimate, the quantity or magnitude of emissions in excess of applicable requirements.
  - Information describing the measures taken and air pollution control practices followed to minimize emissions.
  - For abnormal conditions and malfunctions, the report shall also include a summary of the actions taken to correct and to prevent the abnormal conditions or malfunction from reoccurring and the time taken to correct the malfunction.

5.0 PLAN REVISIONs

The SSM plan and MAP will be revised to address reasonable revision requests required by MDEQ. Revisions may be requested if it is determined that the plan:

- Does not address an SSM event that has occurred.
- Fails to provide operation of the auxiliary boiler in a manner consistent with the general duty to minimize emissions during SSM events.
- Inadequately addresses provisions for correcting malfunctioning process or emission control equipment.

Copies of the Written Plan

A current copy of the plan shall be sent to MDEQ. Another copy will kept on file by BPW (in paper or electronic form) for the life of the auxiliary boiler.

Table 5-1. Revision History

Date Issued	Revision #	Revised by	Summary of Changes
10/14/2016	0	Not Applicable	Original Version
4/12/17	1	NTH Consultants, Ltd.	Incorporation of MAP requirements

6.0 REFERENCED DOCUMENTS

Table 6-1 contains a listing of referenced documents in this SSM plan and MAP and their locations. Copies of the documents can be provided to MDEQ upon request.

Table 6-1. Referenced Documents

Referenced Document	Location
Boiler Operation and Maintenance Manual by English Boiler and Tube, Inc.	Control Room
Zeeco Ultra-Low NO_x Free Jet Gas Burner Operating and Maintenance Manual	Control Room
Operations Log	Share Point

APPENDIX A

BURNER O&M DOCUMENTATION

Chapter 4 – Operation

Burner Operation

Startup and Purge

If the boiler is not sufficiently purged prior to operation of the burners, an explosion may occur resulting in serious damage to equipment and the possible loss of life.

PURGING OF THE FURNACE OR BOILER IS EXTREMELY IMPORTANT.

If the burners are operated without a sufficient air supply, a build-up of gas may occur resulting in an explosion. Care should be taken to assure proper air for combustion is flowing through each burner at all times.

MAKE SURE THE BOILER STACK DAMPER IS WIDE OPEN AND THE COMBUSTION AIR FAN IS RUNNING PRIOR TO LIGHT OFF.

The following description is general in nature and may not be fully representative of this particular application; it is meant to show the basic operating philosophy of the burner system. For specific instruction or detail of the application please reference the original burner management system (BMS) and control system manufacturer specifications.

Before starting the burner, the operator must ensure that all system checks have been completed. This includes ensuring complete system integrity; no open pipes or connections, cooling air available, no maintenance actions or systems lockouts are active.

Only when the systems are properly aligned and the pre-startup checks are completed should the burner system be started.

For details on the burner management logic and operation see the appropriate operations and maintenance manual.

The first step is to start the Forced Draft Fan. All system dampers should be properly aligned to the startup position. The damper position switches must be calibrated and made for the purge sequence to be activated. For example, the fan dampers are typically

closed while starting the fans to prevent overloading the motors. However, this position may not be correct for lighting the burners and adjustment may be required.

The operator then prepares the BMS to initiate the purge sequence. This is one of the most important sequences and should never be bypassed. The purge sequence removes all combustible gases and prevents furnace or boiler convective pass explosions.

The purge is a timed sequence which starts only when an exact set of pre-configured or pre-programmed conditions are met. For these conditions to be met, all or some of the fans may need to be ramped to higher flow rates and dampers re-positioned. When the purge timer is finished, the fans and dampers are re-positioned to the minimum or start-up positions or settings.

Lighting Igniters

Do not operate igniters without first familiarizing yourself with these operating instructions! Improper operation of the equipment will result in injury to persons or loss of life and damage to equipment.

Do not operate equipment unless guides, shields or covers are in place for moving components, rotating equipment, mechanically automated devices and electrically and pneumatically operated control components.

Do not bypass burner management system sequencing and safety interlocks!

The igniter will go through a trial for ignition period and establish a pilot flame. This flame will have sufficient heat energy to ignite the oil or gas. Fuel oil or gas may then be admitted to the burner per the plant standard operating procedures.

1) Visibly check to ensure the igniters are not lighting. Often times a flame scanner/flame rod error can cause an igniter trip when the igniters are in fact lit. If igniters are lighting but BMS trips with no igniter flame:
    i) Check to ensure flame scanner is sighted properly.
    ii) Some flame scanners can distinguish between igniter flame, main flame and background flame. Check to ensure that the scanner is set to see igniter flame.
2) Slightly adjust the gas and/or air pressures up and down within ±2 psig.
3) Check to ensure the orifices are the correct size and are free of any debris/build up and are on the correct lines (air and gas have different sized orifices).
4) Check to ensure there is a spark from the HEI rod.
5) Remove the igniter to ensure the tip and igniter are clear of debris and are undamaged.

Lighting Main Flame

Depending on the NFPA class, the igniter may need to remain lit during burner operation. Check the igniter class to ensure whether the igniter is intermittent or continuous firing.

Combustion air passing through the swirler assures that a stable flame is maintained throughout the burner operating range and that a relatively low temperature fuel lean flame zone is established in front of the swirler to anchor the flame.

Once all burners are in operation on fuel oil / gas, the burners will be tuned to optimize NOx and CO from 25% to 100% boiler load. This is achieved by modulating the total air to the burner and adjusting the percent fuel split to the various burner components.

If the main flame will not light:

1) Ensure that the main burner fuel valve is opening as well as the subsequent valves to verify that the burner is receiving fuel.
2) Ensure that the air fuel ratio is in the correct range. This can be ascertained from the air curves and pressure curves in the Appendix.
    a. Ensure that each of the individual components is receiving the correct amount of fuel pressure. The CFG gun, inner Free Jet ring and outer Free Jet ring, usually require different amounts of fuel and are usually designed to operate at different pressures. See capacity curves for light-off and operating pressures.
3) Ensure that the fuel tips are not plugged.
    a. This can be observed by a higher fuel pressure than expected at a given load or visibly buy an asymmetric flame pattern.
    b. Even if the fuel pressure seems in the correct range and flame appears symmetric, the tips should be removed to ensure they are clean and free of debris/deposits.

If the main flame is lighting but not remaining lit:

4) In some cases, ZEECO burners are designed with a continuous igniter to provide a constant ignition source and anchor the flame. If this is case, ensure that the igniter flame remains lit throughout operation.
5) Ensure that the air fuel ratio is in the correct range. See fuel/air curves in the appendix and check the air side pressure drop across the burner if able.
    a. A long, wavy flame *may* be a sign of insufficient air supply.
    b. A short, very hot/blue flame *may* be a sign of too much air supplied.
6) If problems persist, check the location of the swirler relative to the center fired gas (CFG) assembly and the tile – see Chapter 3 and referenced drawings.
7) Ensure the windbox and air ducting baffles are in the correct location.
    a. Greater than ¼ inch error in the baffle location can cause a non-unified air distribution to the burner which can cause flame out.

APPENDIX B

BOILER O&M DOCUMENTATION

II. NORMAL COLD START-UP

When the boiler is to be started-up from the cold condition after the initial boil-out as described in Section I, the following procedure is recommended:

When the boiler is to be started from a "Cold Start – Cold Iron"; the control system will automatically close the main steam non return valve and open the automatic steam vent located on the superheater outlet header.; open the saturated steam drum vent, and establish the water level slightly below normal.

Light the burner and fire at the minimum firing rate. The safe firing rate will be determined by superheater thermocouples and minimum steam flow meter in the saturated steam line to the superheater inlet header. Once the firing rates are established to protect the superheater, the firing rate can be programmed into the burner management and combustion controls for future start-ups, the same fuel and air setting can be used. **See the burner and control operating instructions for a list of specific steps to take in placing the burner and controls in operation.**

When the minimum steam flow is established through the superheater, the automatic vent valve on the superheater outlet header will close and the non return valve located downstream of the superheater outlet header will automatically open. Close the saturated steam vent, and allow the boiler pressure to increase. At no time during Cold Startup, should the firing rate must be controlled such that the water temperature within the saturated steam drum does not increase more than 100 to 125 deg F per hour. This is best controlled be the operating pressure of the boiler. Refer to the ASME Saturated Steam Tables should there be a question as to the pressure to maintain during Cold Startup.

At this point the operator should follow the WARM CONDITONS START-UP detailed in this manual.

III WARM CONDITION START-UP

Verify that the boiler drum pressure is a minimum of 150 PSIG (366 def F). If this pressure is not met, a cold start procedure will have to be followed PER Operator supervised manual procedure.

- Open drain valves for moisture in SH piping for condensate and close prior to starting Feedwater pumps

- Once the boiler water pressure is verified with pressure transmitter, turn on the DA pump. This will depend on which pump is left in "Auto mode" at the local panel; the site will determine this schedule. If the pump fails, display a message for the operator to check operation of the pump, at this time they may have to switch other pump to auto.

  Verify the pressure on the pump. If the pressure is not adequate, do not proceed and display a message for operator to check operation of the pump.

- Once it is proven that the feedwater pump is running, energize the continuous blowdown valve.

- Open motorized super heater vent valve

- Confirm the SH vent valve is open with a limit switch; if the valve does not open do not proceed and display a message for the operator to check the operation of the valve. Close valve & turn off pump

- Confirm NRV is closed; if valve is not closed close it. If the valve is not proven to be closed, do not proceed. The NRV should have closed at shut down.

- Start burner sequence,

- The burner must stay at low fire until 3,000 lb/hr is achieved through the super heater at 320 PSIG (boiler operating pressure.

- NOTE: Auxiliary steam connections may need to be closed during Warm Start to achieve minimum steam flow and pressure. Auxiliary connections can be reopened slowly after requirements have been met. This will be determined during the initial startup process.

- Once this flow is reached and verified by a flow meter, the SH vent valve can close. A time limit to meet the flow rate will need to be determined during startup. If the rate is not met, the unit should shut down and alarm the operator to diagnose the problem.

- Prove that the SH vent valve is closed with a limit switch; if this is not proven, then hold the firing rate and display message on screen for the operator to check the operation of the valve. Please note that item 7.3 and 7.4 should work concurrently.

- Once the SH vent valve is proven to be closed by the limit switch, open the non return valve. Please note that item 7.3 and 7.4 should work concurrently.

- Prove that the non return valve is open. If the NRV does not prove open, hold the firing rate and display a message on the screen for the operator to check the operation of the valve. Reopen the SH vent if NRV does not open.

- Once the NRV is proven to be open, verify that the boiler drum 320 PSI (operating pressure).

- If the temperature and pressure is not met continue firing at low fire.

- Once the temperature and pressure conditions are met, you can release the burner to ramp up to meet the steam demand.

- The steam flow through the super heater must always be greater than 3,000 lb/hr; if this flow decreases the burner must return to minimum fire. Once the flow is confirmed to be above 3,000 lb/hr the burner can release to meet the steam demand.

- Time delays:
  30 second delay for proving all motorized valves.
  We feel the pumps would be instantaneous so no delay should be necessary.

A. NORMAL SHUTDOWN

Note: Shutdown procedure to follow the burner manufacturer's recommendations (operator initiated shutdown) in sequence with boiler recommendations

When load demand is such that it requires a firing rate below minimum stop

- The system pressure may increase to the point that the automatic steam Hi Pressure limit switch opens and the burner will automatically shut down.

- A restart of the burner cannot be accomplished from a remote location should the burner shutdown be caused by a limit on the boiler causing the shutdown.

- For burner and combustion control systems designed for shutdowns and automatic restarts, the startup procedures will be governed by either the Cold or Warm startup procedures previously detailed.

- When the burner and combustion fan are out of service, stack damper should be closed

- The non-return steam valve will close automatically and the boiler no longer requires water.

- Should more than one boiler is be served by the feedwater pumps, the feedwater regulator isolation valve should be closed as the control valve is not a shut-off valve.

  The pressure should be allowed to drop naturally with all blowdown and vent valves closed.

  When the steam pressure has dropped to 25 psi, the steam drum vent valve should be opened to prevent the formation of a vacuum, and superheater drains when furnished, should be opened to drain moisture formed from condensation of steam.

  <u>THE BOILER SHOULD NOT BE EMPTIED UNTIL THE FURNACE HAS COOLED TO A TEMPERATURE AT WHICH ONE CAN ENTER AND REMAIN IN THE FURNACE.</u>

- Once it is verified that the burner is shut down, the fan is off, and the stack damper is close, NRV should be shut automatically. Close manually and verify that the Non Return valve limit switch is closed.

- After NRV is proved closed, wait 60 second and then shut down the feedwater pumps.

B. EMERGENCY SHUT-DOWNS

1. Low Water

IF WATER GOES OUT OF THE BOTTOM OF THE GAUGE GLASS, FOR ANY REASON, ALL FUEL SHOULD BE SHUT-OFF. ANY DECISION TO KEEP THE BOILER IN OPERATION, EVEN FOR A BRIEF PERIOD, SHOULD BE MADE BY THE PERSON WHO IS IN RESPONSIBLE CHARGE AND WHO SHOULD BE FULLY AWARE OF THE CONDITIONS EXISTING AT THE TIME. IF WATER REMAINS OUT

OF SIGHT IN THE GAUGE GLASS AFTER TRIPPING THE FIRE, WATER SHOULD NOT BE ADDED UNTIL THE BOILER HAS COOLED WITHIN 100° F OF INLET WATER TEMPERATURE.

2. Boiler Tube Failures

If a tube rupture occurs, and low water follows, the procedure in paragraph 1 should be followed. If loss of burner ignition occurs, fuel flow must be stopped immediately. Cooling should then follow the procedure give in Section V. A. Where tube failure does not cause flame failure and it is possible to maintain water level, operation may be continued and normal procedures followed until a more convenient shut-down time. It should be recognized that the presence of moisture from leaks, plus a high sulfur fuel, can cause external corrosion of tubes and drums.

APPENDIX C

BURNER MAINTENANCE

Appendix C
Burner and Boiler Preventative Maintenance

Boiler - External Inspections and Cleaning

- Fuel burning equipment, especially those parts that are not accessible when the unit is in service, should be checked annually, and repairs or replacement should be made to ensure the proper functioning of the equipment as well as to reduce the possibility of interruptions during subsequent operation. Refer to instructions pertaining to the type of equipment furnished for details.
- Fan blades and dampers should be cleaned as required and as part of the annual boiler inspection, since dirty inlet vanes affect minimum air flow setting.

6888A O_2 Combustion Flue Gas Transmitter

- Conduct a calibration check on a quarterly basis (every 3 months) by flowing bottled gas to the probe.
- Conduct calibrations of the 4 and 20 milliamp (mA) settings, sensor trim, and analog output trim every 2 years.

Proflame Integrated Flame Scanner

- Clean the sight tube glass on a quarterly basis.

Burner Maintenance

- The swirler should be observed through the site port on a weekly basis. There should be no signs of overheating or severe distortion in the blades or shroud. A distorted swirler should be replaced, as it will affect its ability to maintain a stable flame at the burner front and reduce NO_x and CO performance.
- The register should be examined from the windbox on an annual basis. There should be no signs of distortion. The register should be kept clean from dust, dirt, fuel oil, carbon and other deposits. Any deposits should be wiped clean with a soft brush or rag.
- The refractory throats should be examined on an annual basis to ensure that the refractory is complete and in place. The throat geometry is an integral part of the burner design and any deviations will result in degraded performance with regards to NO_x and CO reduction.