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**Saginaw Bay**

Dow Corning PROPRIETARY

Effective Date: 5FEB10

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Filename: DOCUMENTUM SERVER\432 BOILER SOP  
Title: 432 Boiler

**STANDARD OPERATING PROCEDURES  
SITE: MIDLAND PLANT POWER & UTILITY**

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## 1. DESCRIPTION OF THE PROCESS OR OPERATION

- 1.1.1. The boiler system consists of three Johnston, three pass, natural gas fired, fire tube boilers with a capacity of 86,250 lbs/hr of steam per boiler.
  - 1.1.1.1. Process includes but is not limited to the following hardware:
- 1.1.2. Natural gas feed controls for each boiler and for each combustion air supply heater.
- 1.1.3. 25,000 cfm 2739 rpm combustion air blower with 150 hp 3575 rpm motor and controls for each boiler.
- 1.1.4. Four 238 gpm boiler feed water pumps with water cooling / flush systems, 3560 rpm 50 hp Variable Frequency Drive (VFD) motors, recycle line back to de-aeration (DA) tanks from economizers shared with steam boiler outlet drip trap condensate lines, and control valves to control boiler level.
- 1.1.5. Economizers heat boiler feed water with heat from flue gas. Flue gas inlet and outlet thermometers and outlet temperature transmitter. Temperature Transmitter on boiler feed water inlet and outlet of each economizer. Flue gas analyzer.
- 1.1.6. Boiler treatment chemical feed lines, adjustable stroke A & F model 1860 piston pumps, 200 gallon tank, and Aquatrac Multiflex controller.
- 1.1.7. 3 natural gas fueled Johnston 509 series Model Number PFTS2500-3G-225S horizontal fire tube boilers;
  - 1.1.7.1. 9618 gallon normal water level for each boiler;
  - 1.1.7.2. Heat transfer area = 10,000 SF per boiler;
  - 1.1.7.3. Btu's per hour = 83,688,000 per boiler;
  - 1.1.7.4. Design heat transfer rate = 8,370 Btu's per SF;
  - 1.1.7.5. Natural circulation water side.
  - 1.1.7.6. Two relief valves on each boiler set at 225 psig with relief valve stacks.
  - 1.1.7.7. Flame safety controls for each boiler.
  - 1.1.7.8. Boiler sight glass level gauge.
  - 1.1.7.9. Boiler Level Indicator and Recorder on control room panel.
  - 1.1.7.10. Boiler Low Level Switch.
  - 1.1.7.11. Boiler Steam Flow Indicator and Recorder on control room panel.

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- 1.1.7.12. Non-return valve and steam block valve on outlet of each boiler.
- 1.1.7.13. Pressure Indicator Controller Recorder on 432 building main steam header to control boiler output.
- 1.1.7.14. Flow Indicator Controller Recorder on 432 building main steam header to control chemical treatment feeds.
- 1.1.7.15. Pressure transmitters on boiler feed water pump discharge, inlet and outlet of each economizer, and on each boiler.
- 1.1.8. Continuous automatic boiler blow down line with control valve to Penberthy flash steam separator to separate flash steam to supply DA tanks and to partially heat makeup water in heat exchanger while cooling continuous boiler blow down before discharge to waste water sewer. Continuous blow down controlled by conductivity probe. Flow to sewer controlled by level control valve on Penberthy steam separator. Temperature indicators on heat exchanger makeup water inlet and outlet and cool blow down.
- 1.1.9. Manual batch mud drum blow down piping, flash steam separator to atmosphere, blow down cooling water and controls, waste water sewer.
- 1.1.10. Boiler sample coolers, sample lines, and cooling water lines.
- 1.1.11. Piping, valves, flanges, all components.

## 2. SAFETY KEYPOINTS

- 2.1.1. Read and understand General Safety Procedure SOP 2.001

### 2.2. MATERIAL SAFETY DATA SHEET

- 2.2.1. For material hazards and first aid instructions see the MSDS.
- 2.2.2. All Dow Corning and Vendor material safety data sheets (MSDS) can be accessed by the Dow Corning desktop. Logon to any Dow Corning network computer and double click on the MSDS-PSDS icon on the desktop. Enter the name of the product in the proper field and submit the search.  

<http://corpnt4c/sds/>
- 2.2.3. Steam, boiler feed water, boiler water, and condensate are high temperature (up to 400 degrees F at 225 psig relief setting on boiler) and high pressure (up to 300 psig differential pressure on discharge of boiler feed water pump) so they can cause severe thermal burns from leaks or contact with hot surfaces.
- 2.2.4. Condensate, boiler feed water, and boiler water contain parts per million of condensate treatment chemicals to prevent corrosion and scaling and may contain contamination from production processes.

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- 2.2.5. Flood affected area with cool water for 15 minutes and get medical attention in case of contact with skin or eyes. This will minimize damage from heat or chemicals.
- 2.2.6. Memorize location of eye wash / safety showers for emergency use.
- 2.2.7. Wear goggles for protection from concentrated boiler treatment chemical.
- 2.2.8. Wear any of the following gloves for protection from boiler treatment chemical per review with Jeff Frazier from Industrial Hygiene:

Nitrile > or = to 15 mil thick
Neoprene > or = to 18 mil thick
Butyl > or = to 20 mil thick
PVC > or = to 15 mil thick
Viton > or = to 30 mil thick

**NOTE: NEVER touch eyes with hands after handling chemicals.**

- 2.2.9. Wear leather gloves for protection from thermal burns and cuts when operating valve handles.
- 2.2.10. Valves should be steel OS&Y bolted bonnet design. Threaded bonnets can work loose and come off when valve handle is turned so watch closely for loose or rotating threaded bonnets.
- 2.2.11. Use valve wrench when needed to operate valve. Do not use pipe wrench since jaws of pipe wrench can create burrs on valve wheel handle.

**NOTE: NEVER close block valves on both ends of a liquid filled pipe or makeup water flow through heat exchanger or economizer without either locking out the heat source or draining some of the colder liquid since severe hydrostatic pressure increases can result. (There is no relief valve on water heater tubes to prevent 125 psig at 375 F tubes from hydrostatic expansion when water flow is interrupted).**

**NOTE: NEVER check for steam leaks with any part of your body. A broomstick with a rag attached will be used to check for steam leaks.**

- 2.2.12. Use sample cooler for routine boiler water sampling to prevent burns.
- 2.2.13. Pump deadhead pressure plus DA (Deaeration) tank pressure plus DA tank liquid head will exceed 300 psig rating of boiler feed water piping system (with no relief valve or high pressure switch.)
- 2.2.14. Partially close pump discharge valve before starting pump to prevent water hammer and improve pump reliability when large rapid flow change would result from starting pump with valve open.
- 2.2.15. Open discharge valve wide open as soon as pressure is established.
- 2.2.16. Partially close pump discharge valve before stopping pump to prevent water hammer and improve pump reliability when large rapid flow change would result from turning pump off with valve open.
- 2.2.17. Do not run boiler feed water pumps with valve closed or when there is no flow.

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- 2.2.18. Maintain boiler feed water supply to boilers at all times when boilers are operating.
- 2.2.19. 480 volt electrical supply for pump motors.
- 2.2.20. Written SOP's are not intended to be a substitute for other types of supervision, attention to the job or established safety standards and procedures and do not relieve the worker (tradesperson, engineer or other) from the responsibility of exercising good safety judgment in performing work.

### 3. ENVIRONMENTAL CONSIDERATIONS

#### 3.1. VENT PERMIT INFORMATION

- 3.1.1. Operating limit for 432 boilers is 0.041 lbs of NOX per millions btu's.
- 3.1.2. See section 8.1.9. for procedures for NOx emission issues.

#### 3.2. STORM/WASTE WATER

- 3.2.1. Not applicable to this SOP.

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## 4. EMERGENCY SHUTDOWN PROCEDURES

### 4.1. EMERGENCY SHUTDOWN CONDITIONS

4.1.1. Not applicable to this SOP.

### 4.2. STEPS TO TAKE IN CASE OF EMERGENCY SHUTDOWN

4.2.1. Shutdown boiler at local control panel.

4.2.2. Close natural gas supply block valves outside south wall of 432 building in case of fire in 432 building.

4.2.3. Turn off boiler feed water pump if not needed for other boilers.

4.2.3.1. Close boiler feed water valve upstream of economizer – leave economizer discharge valves open to recycle to DA to prevent hydrostatic pressure buildup and relief valve discharge / leak / repair.

4.2.3.2. Close boiler level control valve on manual.

4.2.3.4. Close continuous boiler blow down block valve.

4.2.4. Turn off boiler chemical feed pump and close one discharge block valve.

4.2.5. Turn off boiler sample flow before turning off sample cooling water flow.

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## 5. EMERGENCY OPERATIONS

5.1.1. Not applicable to this SOP.

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## 6. MATERIALS AND EQUIPMENT

### 6.1. EQUIPMENT COVERED UNDER THIS SOP

- 6.1.1. Not applicable to this SOP.

### 6.2. MATERIALS USED IN THE PROCESS

- 6.2.1. See General Safety Procedure SOP 2.001 for a list of hazardous materials used in the department.
- 6.2.2. Log into SAP on any DC computer. Type IL03 on the main command bar at the top of the screen and hit enter. This will bring up the Display Functional Location: Initial Screen, type 0052-432 in the FunctLocation box. Click on the button to the right of the FunctLocation box. This button has three small boxes in it. This should bring up another screen that lists all the processes for 432 bldg. Click on the small button to the left of the desired process. This will expand that process and show all the equipment associated with it. This can be repeated for further break down of the processes and equipment.

## 7. INITIAL START UP PROCEDURES

- 7.1.1. Visually inspect and verify that all maintenance and construction has been successfully completed and process is ready to start up.
- 7.1.2. All drain valves must be closed including mud drum and continuous blow down.
- 7.1.3. All bypass valves must be closed.
- 7.1.4. Two block valves must be closed in flash steam line from Penberthy steam separator to keep steam from pressure reducing stations from entering Penberthy steam separator and hydrostatically over pressurizing cold water in heat exchanger when there is no flow.
- 7.1.5. Check cooling water block valves to mud drum blow down cooling system to make sure that they are open.
- 7.1.6. Check mud drum blow down line valves to make sure that valves are open, except for the one that will be used to control blow down.
- 7.1.7. Open manual boiler top blow down/air vent valve and air vent valve on top of economizer to vent air as boiler and economizer are filled with boiler feed water. Air is expected to vent out of economizer much faster than boiler – attach hose to direct any overflow to safe location. Close valve when venting is complete.
- 7.1.8. Open boiler non-return valve and main steam header block valve.
- 7.1.9. Open boiler and economizer boiler feed water block valves and set boiler level control valve on manual to feed at pump minimum flow rate or more through economizer to boiler normal

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level without water hammer. 9,618 gallons or 80,214 pounds of water at normal working level.

- 7.1.10. Check boiler feed water pump strainer to be sure it is not restricted.
- 7.1.11. Check boiler feed water pump suction valve to be sure it is wide open.
- 7.1.12. Turn on boiler feed water cooling/flush system.
- 7.1.13. Partially open pump discharge valve to let water displace air in pump and piping.
- 7.1.14. DA system must be operating properly (See 432 DA Tank SOP), tank level must be at least 80 %, and boiler feed water pump recycle valve from economizer to DA tank must be open before turning one boiler feed water pump on.
- 7.1.15. Do not run boiler feed water pump with valve closed or when there is no flow. Pump deadhead pressure plus DA tank pressure plus DA tank liquid head will exceed 300 psig rating of boiler feed water piping system so partially close pump discharge valve before starting pump to prevent water hammer and improve pump reliability when large rapid flow change would result from starting pump with valve open.
- 7.1.16. See Installation, Operation, and Maintenance Manual for pumps. Bump boiler feed water pump to check for leaks, binding, vibration, etc. Start pump if OK. Fully open discharge valve as soon as pump pressure is established.
- 7.1.17. Close manual boiler top blow down/air vent valve when normal level is reached.
- 7.1.18. Turn boiler feed pump off, close boiler level control valve on manual, and close block valve until boiler is ready for more feed water.
- 7.1.19. Empty boiler will require about 0.8 gallons of Accuserse 3222 boiler treatment chemical to treat to target range so start boiler treatment feed pump as soon as boiler begins to fill.
- 7.1.20. Check pump relief valve discharge to be sure it is connected to safe location. Relief valves on boiler treatment chemical pumps are set at 400 psig.
- 7.1.21. Check pump strainer.
- 7.1.22. Lubricate pump head and bearing drive weekly.
- 7.1.23. See attached sheets for lubrication, breather plug for speed reducer, & lubricating pump head and bearing drive.
- 7.1.24. See Installation, Operation, and Maintenance Manual for pumps.
- 7.1.25. Verify that valves are open at pump and at boiler before starting pump.
- 7.1.26. Set piston pump at minimum stroke on adjustable knob on pump. Minimum setting is 0.5 gallon per hour or 12 gallons per day.

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- 7.1.27. Adjust Aquatrac Multiflex controller to feed for 96 minutes and start pump.
- 7.1.28. Check for leaks - piping, valves, flanges, threaded connections, packing, seals, pressure gauges.
- 7.1.29. Cooling water must be turned on to boiler sample cooler before sample flow is turned on.
- 7.1.30. Flush sample through line and sample cooler to get representative sample from boiler when boiler level is high enough to take sample.
- 7.1.31. Turn off boiler chemical feed pump once target time has been reached if there will be a delay in starting boiler.
- 7.1.32. If there will be no delay in starting boiler after initial treatment is completed then adjust Aquatrac Multiflex controller to feed every 10 minutes for 0.35 minutes or 21 seconds (3.5% feed time) for 42,000 pph of steam or to feed every 10 minutes for 0.7 minutes or 42 seconds (7% feed time) for 84,000 pph of steam. These rates are based on recent experience with the old boilers.
- 7.1.33. If the Aquatrac Multiflex controller is not capable of feeding as described above then adjust it to feed every 29 minutes for 1 minute (3.5% feed time) for 42,000 pph of steam or to feed every 14 minutes for 1 minute (7% feed time) for 84,000 pph of steam.
- 7.1.34. The initial startup rates above may be different than the rates provided by the chemical treatment service provider when those are communicated.
- 7.1.35. Start up boiler when normal boiler level is reached. See Installation, Operation, and Maintenance Manual for boiler startup.
- 7.1.36. Review Initial Startup e through i above when boiler is ready for more feed water to make sure that all valves are in proper position, to make sure boiler feed water pump is running properly, to make sure boiler level control valve is on automatic, to make sure chemical feed valves are all open, and that chemical feed pump is running at proper rate.
- 7.1.37. Manually blow down mud drum every 8 hours by opening and then closing block valve in one continuous motion with no delay when valve is wide open.
- 7.1.38. Steam will automatically flash off the blow down in the flash steam separator and the remaining hot liquid will be automatically cooled by mixing with cold water to protect waste water sewer from high temperature damage.
- 7.1.39. Check makeup water flow to heat exchanger in continuous blow down cooling system to make sure that there is flow and that no valves including automatic control valve to DA are closed.
- 7.1.40. Check continuous boiler blow down line valves to make sure that valves are open except for the control valve.
- 7.1.41. Open flash steam block valve to specific DA tank.

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- 7.1.42. Set automatic continuous boiler blow down conductivity control set point at 5000 mmhos to begin.
- 7.1.43. Expect boiler to run at about 50 cycles when dealkalinizer is running so expect continuous blow down to begin after about 4 million pounds of steam from boiler which would be about 48 hours at maximum steam design rate.
- 7.1.44. Steam will automatically flash off the continuous boiler blow down in the flash steam separator and the remaining hot liquid will be automatically cooled by the continuous makeup water flow to protect waste water sewer from high temperature damage.

## 8. NORMAL OPERATING PROCEDURES

### 8.1. OPERATING PARAMETERS

- 8.1.1. Boiler feed water is automatically pumped from DA tank to maintain boiler level with some recycle back to DA tank after economizer.
- 8.1.2. Flue gas heats boiler feed water in economizer.
- 8.1.3. Boiler natural gas and combustion air feed rates are controlled by pressure controller on 432 building main steam header to generate steam to match variable site demand.
- 8.1.4. Boiler treatment chemical is fed to boiler per chemical treatment supplier recommendations.
- 8.1.5. Continuous blow down rate is controlled by conductivity set point which is adjusted to maintain hardness, OH alkalinity, and conductivity based on sample results.
- 8.1.6. Continuous boiler blow down supplies flash steam for DA and is cooled by makeup water before discharge to waste water sewer.
- 8.1.7. Samples go to waste water sewer.
- 8.1.8. Manual mud drum blow down every 8 hours is cooled by flashing steam and cooling water.
- 8.1.9. NOx emissions operating limit is 0.041 lbs/MMbtu. If NOx emissions goes higher, operator pager will get an alarm. Operator should contact bldg engineers and troubleshoot cause of high NOx levels (see section 13.1.5.). If NOx is over limit by less than 10% above operating limit (0.045 lbs/MMbtu), the boiler should be shut down within ½ hour. If NOx is above 0.045 lbs/MMbtu, the offending boiler's load should be shifted to other 432 bldg boilers, MCV or backup boilers and shutdown immediately.

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DESCRIPTION	TYPE	TARGET (UNIT)	ALLOWED OP. LIMITS	IMPACT IF OUT OF OPERATING LIMITS	ACTIONS TO TAKE IF OUTSIDE THE ALLOWABLE LIMITS
NOx emissions		<0.041 lbs/MMbtu	0.041 lbs/MMbtu	DEQ Emissions Noncompliance	See section 13.1.5.

## 9. TEMPORARY OPERATIONS

- 9.1.1. Boiler feed water bypasses economizer.
- 9.1.2. Load shifting / sharing with backup boilers in 2701 or 403 for reliability demonstration tests or 432 building maintenance.
- 9.1.3. As needed to maintain supply.

## 10. NORMAL SHUTDOWN PROCEDURES

- 10.1.1. Slowly shift load on boiler to other boilers to prevent upset to site steam pressure or flow.
- 10.1.2. When load has been reduced to zero:
  - 10.1.2.1. Close continuous boiler blow down block valve.
- 10.1.3. Turn off boiler chemical feed pump and close one discharge block valve.
- 10.1.4. Turn off boiler sample flow before turning off sample cooling water flow.

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## 11. START-UP AFTER EMERGENCY SHUTDOWN

- 11.1.1. Once reason for shutdown has been corrected, and all faults and alarms have been cleared, open any hand valves that were closed during the shutdown and restart automatic control system.

## 12. DESCRIPTION OF SAFETY SYSTEMS AND THEIR FUNCTIONS

- 12.1.1. Relief valves on boiler set at 225 psig to protect class 150 flanges in site distribution system.
  - 12.1.1.1. Boiler high pressure switch shuts down boiler at 180 psig to protect class 150 flanges in site distribution system and to prevent boiler relief valve discharge / leak / repair.
- 12.1.2. Relief valves on boiler feed water economizers set at 400 psig.
- 12.1.3. Relief valve on Penberthy steam separator set at 125 psig.
- 12.1.4. Relief valve on heat exchanger set at 125 psig to prevent hydrostatic pressure.
- 12.1.5. Relief valves on boiler chemical feed pumps set at 300 psig.
- 12.1.6. Boiler feed water pumps will shut down to prevent damage to pumps or piping if minimum flow rate of 12,500 pounds per hour each is not maintained or if pressure exceeds 300 psig rating of piping.
- 12.1.7. Boiler Low Level shuts boiler down.
- 12.1.8. Flame safeguard shuts boiler down if no flame is detected.
- 12.1.9. Tank overflow directs hot boiler feed water to waste water sewer if level is high enough.
  - 12.1.9.1. High level alarm notifies operator.
- 12.1.10. Low and Low Low Level Alarms notify operator of potential loss of level control.
- 12.1.11. Low Level Switch protects boiler feed water pumps from running dry.
- 12.1.12. Safety Shower / Eyewash located near brine tank.
- 12.1.13. Pyrotronics alert system.
- 12.1.14. Fire protection sprinkler system.

## 13. TROUBLESHOOTING

### 13.1. QUALITY KEY POINTS:

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- 13.1.1. Test sulfite concentration, hardness, alkalinity, and conductivity per run sheet schedule and directions and record results.
- 13.1.2. Adjust conductivity set point as needed based on lab sample results to control boiler hardness, OH alkalinity, and conductivity within control ranges and note adjustments on run sheet.
  - 13.1.2.1. Increase blow down by reducing conductivity set point when high sample results.
  - 13.1.2.2. Decrease blow down by raising conductivity set point when low sample results.
- 13.1.3. Adjust sulfite feed rate to DA as needed to maintain levels in boiler in control range and note adjustments on run sheet.
  - 13.1.3.1. Increase sulfite feed rate when low sample results.
  - 13.1.3.2. Decrease sulfite feed rate when high sample results.
- 13.1.4. Feed boiler chemical per current recommendation of supplier and note adjustments on run sheet.
- 13.1.5. The following is a list of high NOx troubleshooting steps to perform upon pager alarm.
  - 13.1.5.1. Check boiler loads. NOx levels increase with high boiler load. Try switching some of affected boiler's load to other boilers by placing in manual and driving gas valve output down.
  - 13.1.5.2. Contact P&U Department Instrument Technician to check emissions monitoring equipment and calibration gases.
  - 13.1.5.3. Check / adjust damper operation for correct fuel to air ratio.
- 13.1.6. Troubleshooting the CEMS
  - 13.1.6.1. Perform gas calibration
  - 13.1.6.2. Check for malfunctioning equipment
- 13.1.7. List of spare CEMS equipment kept on hand:
  - 13.1.7.1. Vacuum pump
  - 13.1.7.2. Any other spare equipment can be ordered through Monitoring Solutions

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