ORIGINAL
N.H.P.U.C. Case No. DE 09-091
Exhibit No. #3
Witness Panel #1
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Docket No. DE 09-
Exhibit No. 3

STATE OF NEW HAMPSHIRE
BEFORE THE
NEW HAMPSHIRE PUBLIC UTILITIES COMMISSION
DIRECT TESTIMONY OF
WILLIAM H. SMAGULA

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
RECONCILIATION OF ENERGY SERVICE AND STRANDED COSTS FOR
CALENDAR YEAR 2008

## I. Introduction

Q. Please state your name, position, employer and address.

A. My name is William H. Smagula. I am Director of Generation for Public Service Company of New Hampshire, (PSNH), a subsidiary of Northeast Utilities (NU). My business address is 780 North Commercial Street, P.O. Box 330, Manchester, New Hampshire 03105.

Q. Please provide a brief summary of your background.

A. I received a Bachelor of Science in Mechanical Engineering from the University of New Hampshire and a Master of Science in Mechanical Engineering from Northeastern University. I have worked for Public Service Company of New Hampshire and then Northeast Utilities since 1978. I am a Registered Professional Engineer in the states of New Hampshire, Connecticut and Massachusetts. My duties have included Manager of Generation Training for the PSNH system, Station Manager - Merrimack Station, Steam Production Manager - PSNH, Director Fossil Generation - The Connecticut Light and Power Company, and Director, Manage and Operate Services - Northeast Generation Services Company. In June 2001, I assumed the responsibilities of Director - PSNH Generation in New Hampshire.

Q. Have you ever testified before this Commission?

A. I have provided similar testimony in many previous Commission proceedings regarding the operation of PSNH's fossil-fired and hydroelectric generating plants.

Q. Please describe your responsibilities as Director - PSNH Generation.

A. In my present position, as Director - PSNH Generation, I am responsible for the operation and maintenance of PSNH's generating stations. I have responsibility for three fossil-fired, steam electric generating stations, nine hydroelectric generating stations, two remote combustion turbine/diesel generator sites and most recently a new biomass unit. PSNH Generation maintains a diversified fuel portfolio including fossil, hydro and renewable biomass with a total generation capacity of approximately 1150 MW.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony is to provide information on all outages that took place at PSNH's fossil-fired, hydroelectric and biomass units and at NextEra Energy Resources, LLC's (formerly FPL Energy) Wyman Station, Unit No. 4 in which PSNH is a small minority owner. This information will be for the period January 1, 2008 through December 31, 2008. I shall also provide information on unit equivalent availability achieved by PSNH's fossil units, consistent with reporting provided in previous years. Unit availability including planned outages will be calculated consistent with past submittals, as well as similar calculations without the influence of planned outages.

## II. Generating Unit Operation

Q. Please provide an overview of the performance of PSNH's generating units in 2008.

A. PSNH's generating units provided total generation in 2008 equal to 4,362,673 MWh. The fleet's availability during the 30 highest priced days when customers' exposure to high market prices was the greatest was 98%.

Merrimack Station's Unit 1 and Unit 2 each completed major turbine overhauls which are conducted every 5 to 6 years. These outages were completed safely, accident free and ahead of schedule. Schiller Station generated 991,240 MWh, the highest annual generation in its 50-year history. Schiller Unit 5, the new biomass unit, increased its generation 6% over its prior year's operation and contributed 319,846 MWh to the fleet's renewable energy production. PSNH's hydroelectric facilities generated 422,023 MWh, 25% more generation than in 2007, with a weighted average equivalent availability of 97.7%. Newington Station completed the year with an 88.9% equivalent availability.

In 2008, PSNH Generation continued to focus on plant operations and long-term planning to provide benefit to customers through reliable, compliant, and cost-effective operations and management.

Q. Please provide a summary of why PSNH's generating units have continued to operate exceptionally well, with high reliability and high availability.

A. PSNH Generation continues to focus on four key items important to long-term operational success: the day-in and day-out operation and maintenance of the units; the preventative maintenance and maintenance conducted during forced outages; pre-planning and execution of planned maintenance outages; and the use of a long-term (5-and 10-year) maintenance outage and capital expenditure planning process. The long-term maintenance plans prioritize reliable plant operations and are founded on equipment history and on-going condition assessment. The generating stations maintain a long-standing preventative maintenance program which allows for continuous improvement and a proactive management of plant equipment problems to best execute quality maintenance and the operations of the units. PSNH Generation relies on an experienced management team and a skilled work force utilizing best practices derived from experience within our facilities as well as working with suppliers, contractors, experts and other generating plant peers in the industry. PSNH Generation's budget requests continue to emphasize a proper

balance between spending what is necessary in the most critical areas, while being sensitive to the overall cost of production to our customers taking Energy Service, both long term and short term. PSNH Generation works hard to determine how larger maintenance projects can be most effectively executed and how capital investments can be best applied to achieve a high level of plant performance.

PSNH Generation continues to integrate into the above management focus consideration of recent recommendations by Liberty Consulting including:

- Optimizing availability with:
  - on-line maintenance,
  - redundant equipment to shorten forced outage time,
  - appropriate replacement parts and spare parts inventory,
  - assessment of inspection scopes and schedules for the equipment at the facilities,
  - locating or relocating equipment with high risk of outages for better operation and maintenance,
  - review of switching locations at the generating stations where there are two systems with different configurations;
- During planned and forced outages maintaining, as examples:
  - effective efforts to ensure that practices, procedures and safety requirements are being followed,
  - contractor value through effective contractor control,
  - a rigorous foreign matter exclusion procedure;
- And finally, working with others who will:
  - review lightning protection practices
  - assess the distribution system protective settings in the future such that local generation is not impacted, while still providing system protection.

## III. Unit Outages and Availabilities

Q. Please provide a list of all unplanned outages that took place during the period January 1, 2008 through December 31, 2008 for PSNH's fossil and hydro units and for NextEra's Wyman Station Unit No. 4.

A. Attachment WHS-1 lists these outages. This listing is similar to the information submitted in the past, as a reporting requirement for the fossil hydro "outage information" resulting from discussion with the Staff in Docket No. DR 91-011.

Q. Is there any additional reporting with respect to outages?

A. Yes. PSNH provides outage reports for all unscheduled outages in excess of two days at either Newington Station or at the two units at Merrimack Station; and in excess of four days at the three units at Schiller Station and Wyman. These Outage Reports are included as Attachment WHS-2.

Q. Please provide a chronological listing of the outages for which Outage Reports are provided in the testimony.

A. The table below provides the chronological listing along with the times and dates the units were removed and returned to service, as well as the durations of the outage and the cause of the outage.

| Report No. | | Outage Start Date | Outage Start Time | Outage End Date | Outage End Time | Duration Days | Reason |
|---|---|---|---|---|---|---|---|
| OR-1 | SR5 | 1/3 | 1901 | 1/10 | 1335 | 6.8 | Furnace Bed |
| OR-2 | MK1 | 1/7 | 1741 | 1/10 | 1602 | 2.9 | Planned Maintenance (AH) |
| OR-3 | MK2 | 1/30 | 0126 | 2/4 | 0829 | 5.3 | Superheater Tube Leaks |
| OR-4 | WY | 2/11 | 1215 | 2/17 | 1210 | 6.0 | Starting transformer fault |
| OR-5 | SR5 | 2/22 | 1050 | 3/8 | 0930 | 14.9 | Boiler, Miscellaneous |
| OR-6 | MK2 | 3/2 | 1825 | 3/7 | 0516 | 4.5 | Superheater Tube Leaks |
| OR-7 | NT1 | 3/14 | 0800 | 4/9 | 1316 | 26.2 | Exciter Repair |
| OR-8 | MK1 | 4/25 | 1620 | 4/29 | 0721 | 3.6 | Planned Maintenance (AH) |
| OR-9 | SR4 | 5/18 | 1145 | 5/23 | 0428 | 4.7 | Generating Tubes |
| OR-10 | MK1 | 6/6 | 1524 | 6/9 | 1645 | 3.1 | Reheater Tube Leaks |
| OR-11 | MK2 | 6/20 | 1515 | 7/14 | 1346 | 23.9 | HP/IP Turbine Inspection |
| OR-12 | MK1 | 8/20 | 2324 | 8/23 | 0113 | 2.1 | Screen Tube Leak |
| OR-13 | MK2 | 9/19 | 1620 | 9/23 | 2134 | 4.2 | Furnace Tube Leak |
| OR-14 | MK1 | 10/31 | 1435 | 11/2 | 1732 | 2.1 | Electrical Failure/ Tube Leak |
| OR-15 | MK2 | 11/3 | 1700 | 11/7 | 0625 | 3.6 | Economizer Tube Leak |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| OR-16 | MK1 | 11/25 | 0058 | 11/29 | 0135 | 4.0 | Screen Tube Leak |
| OR-17 | SR5 | 12/7 | 1855 | 12/12 | 1110 | 4.7 | Furnace Bed |

Q. Please provide a brief summary of each of the Outage Reports discussed above.

A. A summary of the Outage Reports follows:

OR-2008-01

This Schiller Unit 5 outage was 6.8 days long and began on January 3. The unit was taken off-line due to combustion air flow and boiler bed fluidization problems. The unit had been operating at low loads to allow bag house bag replacements and condenser cleaning. Maintaining adequate bed material temperatures and pressure differentials at low loads can be challenging. With the unit at about 30MW, the bed temperature on the west side of the furnace began dropping rapidly and the bed material began crusting over. After attempts to break up the crust were unsuccessful, station management decided to take the unit off line to avoid potential damage to the unit and complete the bag replacement and condenser cleaning. Other corrective and preventive work activities were completed and the unit was returned to service.

OR-2008-02

Merrimack Unit 1 was removed from service on January 7 to conduct preventative maintenance after a 105-day run. The need for an air heater wash typically occurs every 3 to 4 months. ISO was contacted and contractors were notified to expedite the length of the outage. This 105-day run was the 10$^{th}$ longest in Unit 1's history. Water washing of 1A and 1B air heater baskets was completed. As necessary, the air heater top and bottom circumferential seals were replaced. A sizable number of maintenance items that had accumulated in the outage back log list were completed. This maintenance outage enabled the unit to run successfully to the next air heater wash outage which was taken the end of April.

OR-2008-03

This Merrimack Unit 2 outage was 5.3 days long and started on January 30. The unit was removed from service after a 117 consecutive day run, 5th longest in the unit's history, due to a secondary superheater tube leak. The leak was found in the 11th pendant (north to south) in the secondary superheater inlet pendant. The failed tube damaged two adjacent tubes in the pendant. All three tubes were repaired. The repairs required the erection of staging and scaffolding for safe access. A total of 124 feet of tube including two new lower bends was installed. The cause of the initial tube failure was coal ash corrosion.

The replacement of the secondary superheater inlet bank section of the boiler was scheduled for replacement and completed during the Spring 2008 planned overhaul.

OR-2008-04

This Wyman Unit 4 outage was 6.0 days long and began on February 11 while the unit was off-line in reserve shutdown. The unit was placed in unavailable status when the station service start-up transformer experienced a fault. An inspection of the transformer suggested that a section of the low side of the transformer experienced a fault, while the differential relay confirmed the fault occurred from B phase to C phase.

The emergency generator was started and a back feed from the 345kV switchyard was initiated. The damaged section of the transformer was repaired and installed. The system was tested and once the readings were acceptable and the system normalized, the unit was returned to service.

OR-2008-05

This Schiller Unit 5 outage was 14.9 days long and began on February 22 when the unit was removed from service with low furnace bed temperature readings.

Removing the unit from service before bed temperatures remain low for an extended period of time limits the amount of bed agglomeration that occurs.

The bed was cleaned, additional leveling of the bed material was completed by hand, and the unit was turned over to operations for start-up. During start-up the forced draft fan experienced a fault resulting in damage to the motor. It was determined that the motor would likely require an extended repair time; therefore, to optimize total unit outage time, the upcoming planned outage work was initiated to coordinate with the motor repair timeframe.

OR-2008-06

This Merrimack Unit 2 outage was 4.45 days long and started on March 2. The unit was removed from service due to a secondary superheater tube leak found on pendant 5 (north to south) in the inlet pendant. The failure was a full tube circumferential break which according to the boiler manufacturer likely occurred due to stress corrosion. This type of failure results in a whipping of the tube and caused significant damage to tubes in the area. The type of failure also shakes the entire inlet area and results in breakage of the alignment brackets and misalignment of the pendants. The secondary superheater inlet area was inspected and 7 different tubes sections were replaced or repaired.

The replacement of the secondary superheater inlet bank section of the boiler was scheduled for replacement and completed during the Spring 2008 Planned overhaul.

OR-2008-07

On March 14 Newington Station was shut down for a forced outage that lasted 26.2 days. The unit had just completed a two week annual inspection and was performing start up testing and tuning. The exciter was never electrically energized on the day of the incident; however, the forced outage occurred when the main generator's exciter was subjected to a thermal excursion which resulted in

damage to the AC generator rotor windings fiberglass banding. The overheating of the exciter was caused by a lack of closed-cooling water to the two coolers mounted inside the exciter enclosure. A failed three way solenoid valve prevented the exciter's cooling water from flowing through the coolers. Due to the absence of cooling water to the exciter, the temperature inside the exciter increased as a result of the heat generated by the exciter rotor turning within its enclosure.

PSNH was able to procure and install a rebuilt exciter rotor, without the normal lead time delay associated with this type of replacement equipment or a repair of the failed exciter which would have taken up to 6 months, as part of an exchange program established by the original equipment manufacture, Siemens, which refurbishes and inventories rotors. The unit was returned to service in about 3.5 weeks.

OR-2008-08

Merrimack Unit 1 was shut down on April 25 for preventative maintenance after 105.97 days of continuous operation beginning when the unit returned to service on January 10. This 105.97 day run became the 10th longest in Unit 1's history (surpassing the 105-day run discussed earlier in OR-2008-02). Working with ISO-New England and bidding and planning personnel, the unit was removed from service late Friday afternoon.

During the outage, numerous preventative and corrective maintenance items were completed including water washing of the 1A and 1B air heaters which is required every 3 to 4 months of operation. To avoid a lengthy washing process, the cold end baskets were swapped out for clean baskets and the circumferential seals were replaced, as necessary.

OR-2008-09

This Schiller Unit 4 outage was 4.69 days long and began on May 18. The unit was taken off line with excessive water usage due to tube leaks in the area of the

steam cooled spacer tube. The inspection identified that the refractory around the spacer tube had separated away allowing the hot boiler gases to erode a number of tubes on the boiler walls.

The boiler underwent a number of fill and drain cycles to identify the boiler tube leaks. The boiler tube repairs in the area of the screen tube consisted of 4 dutchmen and 15 padweld repair areas. The screen tube was pad-welded in multiple areas, as necessary. Additional boiler leaks identified during the boiler hydros were also repaired. A final boiler hydro was completed and refractory work completed, and the unit was turned over for start-up and brought back on line.

OR-2008-10

This Merrimack Unit 1 outage was 3.1 days long and began on June 6. The outage was required to repair boiler tube leaks in the vertical reheater. A boiler inspection identified a single primary leak which caused secondary leaks in 3 additional tubes. All 4 tube leaks, 4 tubes in 2 pendants, were repaired with the installation of 2-foot dutchmen. This area of the boiler had been inspected during past overhauls for indications of tube wear. While these past inspections have not indicated any specific wear or aging issues, these boiler tubes have been in service for 12 years. And while there has been no history of failures in this section; during the fall outage a thorough non-destructive examination will be completed.

The air heater was washed during the boiler repairs to improve efficiency and extend the time necessary before the next cleaning. Also, a small number of backlog items were completed.

OR-2008-11

Merrimack Unit 2 was removed from service on June 20, 2008 and was off for 23.98 days to open and inspect the new HP/IP turbine that was installed during the annual outage. Anticipating the possible need for an outage, Merrimack Station worked with Bidding and Scheduling personnel and ISO-New England to schedule

this maintenance outage. When the unit had been returned to service after the planned overhaul the turbine was not producing the expected incremental megawatt output. Siemens (the turbine manufacturer) conducted on-site external inspections and performance tests to determine the cause of the limited output of the full turbine (HP/IP and low pressure turbines). The extensive investigation also included a technical assessment of the design analysis, manufacturing review, and performance tests. As part of this investigation, Siemens reviewed the bladepath design, manufacturing quality control records, and checked for any reports regarding manufacturing conformance issues and their associated resolution. The review also included a review of the installation quality control records, plant data, and a review of plant chemistry records made available by plant personnel.

With these multiple efforts Siemens was unable to determine the root cause of the turbine output shortfall. Based on its risk analysis, Siemens recommended that PSNH remove the unit from service to open the HP/IP turbine for internal inspection. The inspection would satisfy multiple objectives: first, safety - to insure that no risk existed for employees or equipment with continued operation of the turbine; second, to help determine the cause for low output; and third, to determine if continued operation would have any adverse effect on the turbine.

The turbine inspection found deposits of foreign material under all HP and IP rotating blade shrouds. There was significant solid particle damage and roughness of the vanes observed on every stage of the HP/IP turbine. The damage was judged to have occurred during the first 10-12 hours of start-up. Boroscope inspection of related components, valves, and piping systems was also conducted to investigate the possibilities of any foreign material, deposits and erosion.

All of the deposits were removed, and the turbine blades and rotor were inspected, cleaned and repaired to the extent possible. Samples of the material were collected from the turbine and taken to a local laboratory. The foreign material was present

in the HP section, IP section and the first few blade rows of the two LP sections of the turbine. The HP/IP rotating blades and stationary blade path looked to be in poor condition relative to the short period of time during which the unit had operated.

With respect to the balance of plant, a thorough systematic inspection of the boiler, valves, pumps, heaters and tubes was conducted to locate any additional foreign material and to remove it as necessary. This effort was also completed to provide additional information to assist in determining the possible source of the foreign material. The condenser hotwell was inspected and a sample of a similar contaminant was collected. Varying amounts of material were found in the hotwell, main boiler feed pump, condensate pumps, and deaerator.

The collected foreign material was round magnetic balls. Subsequent laboratory analysis results proved the materials to be identical; specifically similar in size and metallurgy. It was determined that the contaminant was a steel shot material, as is often used for shot-blasting purposes. It was later confirmed that there is no knowledge of steel shot blast material ever having been used at Merrimack Station. This would indicate that the material was probably contained in the piping or tubes from one of the three major replacement projects during the outage.

With the initial inspections areas completed, additional areas of inspection were identified in other parts of the turbine, as well as the condenser, boiler and balance of plant. A scope of cleaning and repair efforts was established. This work would determine any damage that had occurred, identify areas that needed to be cleaned of the shot blast material, and help determine a root cause.

A number of vendors and consultants were used in the inspection, cleaning and repair process. Chemistry and metallurgy analysis was provided both on-site and off-site with a number of companies.

A multi-company team conducted an Apollo Root Cause analysis process on-site on July 11 prior to the end of the outage. The process came to no definitive conclusions as to where the foreign shot blast material entered the system. Once the unit had been sufficiently inspected, cleaned and repaired, the unit was returned to service.

To date, the original source of the shot blast material has not been determined but appears to be from a single event that occurred during the May 22-23 start-up of the unit at the end of the planned annual overhaul.

OR-2008-12

This Merrimack Unit 1 outage was 2.1 days long and began on August 20. The outage was required to repair a screen tube leak in the furnace. A boiler inspection noted that a large ash clinker hanging from the secondary superheater inlet tubes had fallen from the upper furnace area. The clinker landed on the 4th upper screen tube tearing the clip and tube that connect the screen tube to the rear wall. The clip is intended to fail preventing large catastrophic failures to occur. Most of the clip did fail, but when it failed it also made a small crack that propagated into the tube itself causing the leak. The screen tube was repaired with welding. A portion of the screen tubes including this tube are scheduled for replacement during the upcoming overhaul.

With the unit's planned overhaul scheduled to begin on September 9 (less than 3 weeks later), and only a small boiler leak in 'C' cyclone found during the boiler inspection, the critical path was the repair of the tube leaks.

OR-2008-13

This Merrimack Unit 2 outage was 4.2 days long and began on September 19. The unit was removed from service due to high boiler water usage. A boiler inspection was completed and a number of boiler tube leaks were found. A leak in the horizontal reheat caused damage to other tubes in the area. This area is difficult to

access. Lagging and insulation was removed, as well as membrane and wall tubes in order to make the necessary repairs. The tube repairs included both the installation of dutchmen and the padweld repairs. The wall tube failure also required nine tubes on the superheater floor to be padwelded. This repair required the installation of a sky climber. Cyclone tube leaks found during the boiler inspection were also repaired.

In addition, boiler areas were vacuumed and the air heater washed; as well as jobs in the maintenance priority backlog were completed. Also, other corrective and preventive maintenance work activities were performed.

OR-2008-14

This Merrimack Unit 1 outage was 2.1 day long. The unit tripped off line on October 31, two days after returning to service from the planned overhaul. The reason for the trip was that equipment installed during the overhaul, the 1HB switchgear, specifically the P-12 breaker over-current relay, operated when the main fire pump motor was started. When the over-current relay operated it tripped the P-12 breaker which feeds the unit's circulating water pump motors. With the loss of the circulating water pumps, the operator tripped the unit.
The station electricians began troubleshooting the problem and utilized the knowledge of the vendor that installed the new 1HA & 1HB 5KV switchgear. The vendor inspected the switchgear and found that the P-12 breaker over-current relay setting for the screen house feed had been set too low by the vendor. The vendor made the necessary correction to P-12 relay settings and re-verified the settings were correct with the rest of the newly installed 1HA &1HB 5 KV switchgear.

Prior to the unit coming off line, it was apparent that a boiler leak existed. Not wanting to return the unit to service with a leak which would only put the unit at risk for a forced outage, the decision was made to repair the boiler tube leak. Dutchmen were installed to repair leaks in the secondary superheater section of the

boiler. This effort was the majority of the critical path of the outage requiring over 1 ½ days to repair the tube leaks.

During start-up the 1-A condensate pump's mechanical seal failed. This two piece seal was replaced and the unit returned to service.

OR-2008-15

This Merrimack Unit 2 outage was 3.6 days long and began on November 3. The unit was removed from service due to high boiler water usage. A boiler inspection was completed and the initial tube leak was located in a jumper tube in the horizontal reheat superheater section. This initial leak was caused over time due to the jumper tube and an economizer riser tube rubbing against each other. Both of these tubes were repaired with padwelds. Other wall tubes were damaged as a result of the initial tube leak and were also repaired with padwelds, bringing the tubes back to the original wall thickness. This area of the boiler had not previously experienced tube leaks and is routinely inspected; however, this area is particularly hard to inspect given the horizontal configuration and the close proximity of the tubes. In the future the inspection effort will be expanded. Cyclone tube leaks found during the boiler inspection were also repaired.

This outage was extended when the Operations Department noticed during start up that water was entering the screen house through electrical conduits. These electrical conduits run parallel to the main circulating water and recirculation water lines. Inspection efforts determined that the leak was somewhere in the recirculation line but without access, a specific location was not able to be pinpointed. The system start-up was modified to keep this line under vacuum in order to start and operate the unit. Further inspections were conducted to find and repair the leak.

OR-2008-16

This Merrimack Unit 1 outage was 4.0 days long and began on November 25. The outage was required to repair a screen tube leak near the furnace floor. The pin stud leak occurred on tube # 36 and was below the cut point for the screen tube replacement completed during the overhaul. The leak was just above where the tube bends back and it meets the floor. The pin stud was beneath the refractory in this area, and as such was not able to be inspected during the overhaul. This leak was in the center of fire box on the rear wall and as a result spraying over the boiler floor slag tap causing slag clinkers to develop in the slag tank. This screen tube was repaired by welding.

Though the air heater baskets showed no significant pluggage when inspected, the air heater was washed in an effort to extend the time the unit could operate after returning to service. Both the circumferential and radial air heater seals were also inspected after the wash.

OR-2008-17

This Schiller Unit 5 outage was 4.67 days long and began on December 7. Operators were attempting to control temperatures in the boiler bed to avoid agglomeration. Increasing the load of the unit to increase the bed temperature was limited by the unit's fan amperage due to air heater leakage. The unit was also experiencing NOx control problems. Efforts to simultaneously correct these issues proved to be unsolvable with the unit on line, so the unit was removed from service.

The boiler was cooled and then the bed material removed and replaced. A number of the SNCR ammonia system valves were inspected, repaired or replaced as necessary. During start-up the forced-draft fan motor bearings overheated. The bearings were replaced with in-stock inventory. The unit was then turned over to operations to re-initiate start up activities.

Q. Were Planned Maintenance Outages performed at any of PSNH's fossil and hydro units during the period January 1, 2008 through December 31, 2008?

A. Yes. Attachment WHS-1 contains of a list of outages including planned maintenance outages for each of PSNH's fossil, hydro, and combustion turbine units, as well as the Wyman 4 unit. WHS-3 also summarizes in a table the planned maintenance periods for the fossil units.

Q. Please provide a list of planned maintenance outages at the PSNH fossil units during January 1, 2008 through December 31, 2008.

A. The planned maintenance outages are listed below.

| Unit | Planned Maintenance |
|---|---|
| Merrimack Unit 1 | 9/9 – 10/29 |
| Merrimack Unit 2 | 4/1 – 5/22 |
| Newington Unit 1 | 3/1 – 3/13 |
| Schiller Unit 4 | 3/25 – 4/10 |
| Schiller Unit 5 | 10/17 – 10/27 |
| Schiller Unit 6 | 4/11 – 4/26 |

Q. Are these planned outages reviewed as part of the Reconciliation of Energy Service and Stranded Costs docket?

A. Yes. A review of the planned outages is completed by the PUC Staff utilizing Liberty Auditing. Liberty Auditing completes an on-site interview and review process of the planned outages.

Q. Does this conclude your testimony?

A. Yes, it does.

# ATTACHMENT WHS-1

# LIST OF UNIT OUTAGES
# AND
# SCHEDULED OUTAGE PERIODS

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
MERRIMACK 1 - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| OUTAGE DATE | START TIME | OUTAGE DATE | STOP TIME | DAYS | REASON |
|---|---|---|---|---|---|
| 1/7 | 1741 | 1/10 | 1602 | 2.9 | Planned Preventative Maintenance |
| 4/25 | 1620 | 4/29 | 0721 | 3.6 | Planned Preventative Maintenance |
| 6/6 | 1524 | 6/9 | 1645 | 3.1 | Reheater Tube Leaks |
| 8/20 | 2324 | 8/23 | 0113 | 2.1 | Screen Tube Leak |
| 9/9 | 1525 | 10/29 | 0655 | 49.6 | Major Overhaul |
| 10/31 | 1435 | 11/2 | 1732 | 2.1 | Electrical Failure/ Boiler leak |
| 11/25 | 0058 | 11/29 | 0135 | 4.0 | Screen Tube Leak |
| 12/5 | 0937 | 12/6 | 0246 | 0.7 | 1B Air Heater Drive |
| 12/15 | 1755 | 12/16 | 0055 | 0.3 | Cyclone Blast Gate |
| | | TOTAL OUTAGE DOWN TIME | | 68.5 | |

000079

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
MERRIMACK 2 - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| OUTAGE DATE | START TIME | OUTAGE DATE | STOP TIME | DAYS | REASON |
|---|---|---|---|---|---|
| 1/30 | 0126 | 2/4 | 0829 | 5.3 | Superheater Leaks |
| 3/2 | 1825 | 3/7 | 0516 | 4.5 | Superheater Leaks |
| 4/1 | 1346 | 5/22 | 0804 | 50.8 | Major Overhaul |
| 5/22 | 1057 | 5/23 | 0635 | 0.8 | G 201 Disconnect Switch |
| 6/20 | 1515 | 7/14 | 1346 | 23.9 | HP/IP Turbine Inspection |
| 9/19 | 1620 | 9/24 | 0540 | 4.6 | Furnace tube leaks, includes 6 hours reserve shutdown |
| 9/24 | 0541 | 9/24 | 1426 | 0.4 | Turbine pressure sensing line |
| 9/24 | 1427 | 9/25 | 0608 | 0.7 | Turbine pressure sensing line, includes 2 hours reserve shutdown |
| 11/3 | 1700 | 11/7 | 0625 | 3.6 | Economizer Tube Leak |
| | | TOTAL OUTAGE DOWN TIME | | 94.4 | |

000030

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
MERRIMACK CT1 - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| OUTAGE DATE | START TIME | OUTAGE DATE | STOP TIME | DAYS | REASON |
|---|---|---|---|---|---|
| 4/21 | 0530 | 4/25 | 1239 | 4.3 | Gas Turbine Major Overhaul |
| 5/7 | 0700 | 5/7 | 1158 | 0.2 | Other Fuel System Problems |
| 5/10 | 0830 | 5/10 | 1429 | 0.2 | Lube Oil System - General |
| 7/21 | 1600 | 7/22 | 1510 | 1.0 | Generator bearings and lube |
| 10/6 | 0800 | 10/10 | 1024 | 4.1 | Gas Turbine Major Overhaul |
| 10/26 | 0650 | 10/26 | 1004 | 0.1 | Switchyard Circuit Breakers |
| | | TOTAL OUTAGE DOWN TIME | | 10.0 | |

000081

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
MERRIMACK CT2 - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| OUTAGE DATE | START TIME | OUTAGE DATE | STOP TIME | DAYS | REASON |
|---|---|---|---|---|---|
| 4/21 | 0530 | 4/24 | 1600 | 3.4 | Gas Turbine Major Overhaul |
| 5/7 | 0700 | 5/7 | 1149 | 0.2 | Other Fuel System Problems |
| 10/20 | 1841 | 10/21 | 1736 | 1.0 | Miscellaneous Electrical Failures |
| 10/26 | 0650 | 10/26 | 1004 | 0.1 | Switchyard Circuit Breakers |
| | | TOTAL OUTAGE DOWN TIME | | 4.7 | |

000082

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
NEWINGTON - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| OUTAGE DATE | START TIME | OUTAGE DATE | STOP TIME | DAYS | REASON |
|---|---|---|---|---|---|
| 1/21 | 0458 | 1/21 | 1144 | 0.3 | Superheater Drain Leak |
| 3/1 | 0000 | 3/13 | 0136 | 12.1 | Major Overhaul |
| 3/14 | 0800 | 4/9 | 1316 | 26.2 | Exciter Repair |
| 4/10 | 1300 | 4/11 | 0517 | 0.7 | Exciter Balancing |
| 7/21 | 0800 | 7/21 | 0954 | 0.1 | LP trip valve |
| 7/22 | 0800 | 7/22 | 0930 | 0.1 | Induced Draft Fan Problems |
| 7/24 | 0830 | 7/25 | 0105 | 0.7 | Boiler Tube Leak |
| 12/9 | 1201 | 12/9 | 1525 | 0.1 | Induced Draft Fan Problems |
| | | TOTAL OUTAGE DOWN TIME | | 40.2 | |

000083

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
SCHILLER 4 - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| OUTAGE DATE | START TIME | OUTAGE DATE | STOP TIME | DAYS | REASON |
|---|---|---|---|---|---|
| 3/25 | 2146 | 4/10 | 1136 | 15.6 | Boiler Annual Inspection |
| 5/18 | 1145 | 5/23 | 0428 | 4.7 | Generating Tubes |
| 10/5 | 2157 | 10/7 | 1555 | 1.7 | Generating Tubes |
| | | TOTAL OUTAGE DOWN TIME | | 22.0 | |

000084

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
SCHILLER 5 - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| OUTAGE DATE | START TIME | OUTAGE DATE | STOP TIME | DAYS | REASON |
|---|---|---|---|---|---|
| 1/3 | 1901 | 1/10 | 1335 | 6.8 | Loss of Temperature control of bed material |
| 1/11 | 1727 | 1/14 | 0328 | 2.4 | Economizer Tube Leak |
| 2/22 | 1050 | 3/8 | 0930 | 14.9 | Furnace Bed Material |
| 6/2 | 1615 | 6/2 | 1850 | 0.1 | Forced Draft Fans |
| 6/13 | 0332 | 6/13 | 0540 | 0.1 | Forced Draft Fans |
| 10/6 | 1015 | 10/6 | 1539 | 0.2 | ID Fan Trip |
| 10/17 | 1902 | 10/27 | 1040 | 9.7 | Annual Overhaul |
| 12/7 | 1855 | 12/12 | 1110 | 4.7 | Furnace Bed Material |
| | | TOTAL OUTAGE DOWN TIME | | 38.9 | |

000085

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
SCHILLER 6 - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| OUTAGE DATE | START TIME | OUTAGE DATE | STOP TIME | DAYS | REASON |
|---|---|---|---|---|---|
| 2/14 | 0145 | 2/14 | 0316 | 0.1 | Wet Coal |
| 2/15 | 1435 | 2/18 | 0555 | 2.6 | Generating Tube Leak |
| 3/24 | 1350 | 3/25 | 0835 | 0.8 | Chemical Injection Line Leak |
| 4/11 | 2145 | 4/26 | 0943 | 14.5 | Annual Overhaul |
| 6/18 | 0002 | 6/19 | 1317 | 1.6 | Generating Tube Leak |
| 7/1 | 1450 | 7/3 | 2300 | 2.3 | Primary Superheater Tube Leak |
| 10/4 | 0255 | 10/6 | 2040 | 2.7 | Primary Superheater Tube Leak |
| 11/24 | 0020 | 11/25 | 0205 | 1.1 | Deaerator Flange Leak |
| | | TOTAL OUTAGE DOWN TIME | | 25.7 | |

000086

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
SCHILLER CT1 - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| OUTAGE DATE | START TIME | OUTAGE DATE | STOP TIME | DAYS | REASON |
|---|---|---|---|---|---|
| 1/17 | 0830 | 1/17 | 1505 | 0.3 | Other Jet Engine Problems |
| 3/3 | 1547 | 3/4 | 1029 | 0.8 | Other Jet Engine Problems |
| 3/10 | 0000 | 3/14 | 1100 | 4.5 | General Unit Inspection |
| 6/5 | 0710 | 6/5 | 1000 | 0.1 | Other Jet Engine Problems |
| 6/20 | 0658 | 6/20 | 0750 | 0.0 | Protection Devices |
| 9/28 | 0945 | 9/28 | 1137 | 0.1 | Miscellaneous Electrical Failures |
| 10/20 | 1855 | 10/20 | 2214 | 0.1 | Engine Vibration |
| 10/28 | 1300 | 10/28 | 1325 | 0.0 | Controls and Instrumentation |
| | | TOTAL OUTAGE DOWN TIME | | 5.9 | |

000087

WYMAN IV - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| OUTAGE DATE | START TIME | OUTAGE DATE | STOP TIME | DAYS | REASON |
|---|---|---|---|---|---|
| 1/22 | 1522 | 1/22 | 1700 | 0.1 | Human Error - Proper Steps to enable Variable Pressure not in SUSD |
| 2/4 | 0548 | 2/4 | 0818 | 0.1 | Boiler MFT due to trip on Furnace Pressure Hi/Lo as attempts made to fire a set of burners |
| 2/11 | 1215 | 2/17 | 1210 | 6.0 | Fault in 6.9 KV Bus from Starting Transformer to switchgear (not dispatched at the time of the fault) |
| 5/7 | 1021 | 5/7 | 1139 | 0.1 | Faulty Low Pressure switch tripped Fuel Oil Pump causing MFT |
| 5/11 | 1200 | 5/17 | 1622 | 6.2 | Planned maintenance outage |
| 6/9 | 1532 | 6/9 | 1645 | 0.1 | Human Error - ID fan tripped due to high inlet gas temperature, operator missed high temperature alarm |
| 6/20 | 0001 | 6/21 | 1140 | 1.5 | Planned maintenance outage |
| 7/18 | 0906 | 7/18 | 1001 | 0.0 | Boiler MFT due to trip on Furnace Pressure Hi/Lo as fourth burner pair placed in service |
| 9/13 | 0001 | 11/10 | 1605 | 58.7 | Planned overhaul -generator stator rewind and GSU replacement |
| 11/10 | 0439 | 11/12 | 0816 | 2.2 | Post outage testing |
| 11/12 | 2115 | 11/13 | 0724 | 0.4 | Post outage testing |
| 11/13 | 1108 | 11/15 | 1521 | 2.2 | Post outage testing |
| 11/15 | 2339 | 11/16 | 0653 | 0.3 | Post outage testing |
| | | TOTAL OUTAGE DOWN TIME | | 77.7 | |

000088

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
AMOSKEAG - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| Site | Unit Number | Date & Time OFF line | Date & Time ON line | Outage Duration - Hours | Outage Duration, Days | Water Available for unit? (Y or N) | Forced (F) or Scheduled (S)? | Cause of Outage | Comment |
|---|---|---|---|---|---|---|---|---|---|
| Amoskeag | 1 | 4/11/08 6:00 | 4/11/08 6:33 | **0.55** | **0.02** | Y | F | Line Fault | Unit tripped to a system outage that operated the 357 line switch |
| Amoskeag | 1 | 4/15/08 10:13 | 4/15/08 11:17 | **1.07** | **0.04** | Y | F | Line Fault | Unit tripped due to the TB-26 potential transformer failure |
| Amoskeag | 1 | 12/5/08 8:10 | 12/5/08 9:00 | **0.83** | **0.03** | Y | S | Black Start Test | Took unit offline to perform BS Testing |
| Amoskeag | 2 | 4/11/08 6:00 | 4/11/08 6:33 | **0.55** | **0.02** | Y | F | Line Fault | Unit tripped due to a system outage that operated the 357 line switch |
| Amoskeag | 2 | 4/15/08 10:13 | 4/15/08 11:19 | **1.10** | **0.05** | Y | F | Line Fault | Unit tripped due to the TB-26 potential transformer failure |
| Amoskeag | 2 | 6/8/08 17:28 | 6/8/08 19:00 | **1.53** | **0.06** | N | F | Unit tripped | High thrust bearing temperature |
| Amoskeag | 2 | 12/5/08 8:10 | 12/5/08 9:00 | **0.83** | **0.03** | Y | S | Black Start Test | Took unit offline to perform BS Testing |
| Amoskeag | 3 | 4/11/08 6:00 | 4/11/08 6:33 | **0.55** | **0.02** | Y | F | Line Fault | Unit tripped due to a system outage that operated the 357 line switch |
| Amoskeag | 3 | 4/15/08 10:13 | 4/15/08 16:10 | **5.95** | **0.25** | Y | F | Line Fault | Unit tripped due to the TB-26 potential transformer failure ( had to replace defective relay ) |
| Amoskeag | 3 | 5/28/08 16:10 | 5/28/08 16:40 | **0.50** | **0.02** | N | F | Sag in River Flows | Pond control took unit off due to sag in riverflows caused by closing wastegate at Hooksett |
| Amoskeag | 3 | 12/5/08 8:10 | 12/5/08 9:00 | **0.83** | **0.03** | Y | S | Black Start Test | Took unit offline to perform BS Testing |

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
AYERS - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| Site | Unit Number | Date & Time OFF line | Date & Time ON line | Outage Duration - Hours | Outage Duration, Days | Water Available for unit? (Y or N) | Forced (F) or Scheduled (S)? | Cause of Outage | Comment |
|---|---|---|---|---|---|---|---|---|---|
| Ayers | 1 | 3/6/08 6:14 | 3/6/08 8:10 | **1.93** | **0.08** | **N** | F | Unit tripped | Unit failed to pick up load after phasing. Tripped on reverse power |
| Ayers | 1 | 7/14/08 7:00 | 7/18/08 10:09 | **99.15** | **4.13** | **N** | S | Annual Inspection | Annual Inspection |
| Ayers | 1 | 7/21/08 5:48 | 7/21/08 7:30 | **1.70** | **0.07** | Y | F | Unit Tripped | Unit tripped on overspeed. |
| Ayers | 1 | 7/21/08 9:30 | 7/21/08 11:00 | **1.50** | **0.06** | Y | F | Unit tripped | Unit tripped on overspeed ( faulty overspeedspeed switch ) |
| Ayers | 1 | 10/8/08 1:29 | 10/8/08 8:35 | **7.10** | **0.30** | Y | F | Unit Tripped on Startup | Dispatchers could not pick up load after phasing |
| Ayers | 2 | 2/11/08 7:00 | 2/13/08 17:43 | **58.72** | **2.45** | **N** | S | Annual Inspection | Annual Inspection |
| Ayers | 2 | 7/19/08 14:30 | 7/19/08 15:05 | **0.58** | **0.02** | **N** | F | Line Fault | 3149 line fault ( lightning in the area ) |
| Ayers | 2 | 7/28/08 13:54 | 7/28/08 14:02 | **0.13** | **0.01** | Y | F | Unit tripped | Unit tripped on high bearing temp. |
| Ayers | 2 | 10/3/08 13:15 | 10/3/08 13:32 | **0.28** | **0.01** | Y | F | Unit Taken Offline | Observed shiny spot on Exciter |
| Ayers | 3 | 10/20/08 7:00 | 10/24/08 15:00 | **104.00** | **4.33** | **N** | S | Annual Inspection | Annual Inspection |

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
CANAAN - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| Site | Unit Number | Date & Time OFF line | Date & Time ON line | Outage Duration - Hours | Outage Duration, Days | Water Available for unit? (Y or N) | Forced (F) or Scheduled (S)? | Cause of Outage | Comment |
|---|---|---|---|---|---|---|---|---|---|
| Canaan | 1 | 3/6/08 12:47 | 3/6/08 14:31 | **1.73** | **0.07** | Y | F | Line Fault | Line J-510 opened causing fault |
| Canaan | 1 | 3/6/08 16:53 | 3/6/08 17:02 | **0.15** | **0.01** | Y | F | Line Fault | Line J-510 switched back into service causing fault |
| Canaan | 1 | 4/23/08 23:05 | 4/24/08 1:20 | **2.25** | **0.09** | Y | F | Line Fault | Lightning strike on the 355 line caused unit to trip offline. |
| Canaan | 1 | 5/15/08 14:20 | 5/15/08 15:40 | **1.33** | **0.06** | Y | F | Line Fault | Lineman dropped something on the line causing an operation on the line while doing substation work in Groveton. |
| Canaan | 1 | 5/23/08 16:26 | 5/23/08 18:34 | **2.13** | **0.09** | Y | F | Line Fault | A tree fell on the 355 causing an outage on the 355 line. |
| Canaan | 1 | 5/31/08 12:41 | 5/31/08 16:08 | **3.45** | **0.14** | Y | F | Line Fault | A broken conductor on cross arm between J9 and J95 caused the 355 line to trip. |
| Canaan | 1 | 6/10/08 16:02 | 6/10/08 18:29 | **2.45** | **0.10** | Y | F | Line Fault | An electrical storm caused problems in Whitefield which tripped the 355 line. |
| Canaan | 1 | 6/10/08 21:08 | 6/10/08 23:18 | **2.17** | **0.09** | Y | F | Line Fault | Heavy lightning and thunderstorms in the region caused an operation on the 355 line. |
| Canaan | 1 | 8/13/08 11:19 | 8/13/08 11:36 | **0.28** | **0.01** | Y | F | Line Fault | There was a problem in the North Stratford substation causing the unit to trip offline. |
| Canaan | 1 | 8/17/08 7:00 | 8/21/08 17:05 | **106.08** | **4.42** | Y | S | Annual Inspection | Annual Inspection |
| Canaan | 1 | 8/26/08 13:19 | 8/26/08 14:33 | **1.23** | **0.05** | Y | F | Line Fault | unit tripped when the J-510 was closed in West Stewartstown |
| Canaan | 1 | 9/13/08 2:19 | 9/13/08 6:18 | **3.98** | **0.17** | Y | F | Line Fault | Tree on the 355 line caused line fault |
| Canaan | 1 | 10/9/08 19:14 | 10/9/08 21:08 | **1.90** | **0.08** | Y | F | Line Fault | Line operation caused by bear on top of pole. |
| Canaan | 1 | 11/24/08 7:55 | 11/25/08 9:06 | **25.18** | **1.05** | Y | S | Penstock Inspection | Took unit OOS to have Canbar inspect the inside of the penstock. |
| Canaan | 1 | 12/25/08 2:52 | 12/25/08 6:06 | **3.23** | **0.13** | Y | F | Line Fault | Unit tripped caused by a bump on the 355 line. |

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
EASTMAN - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| Site | Unit Number | Date & Time OFF line | Date & Time ON line | Outage Duration - Hours | Outage Duration, Days | Water Available for unit? (Y or N) | Forced (F) or Scheduled (S)? | Cause of Outage | Comment |
|---|---|---|---|---|---|---|---|---|---|
| Eastman | 1 | 2/7/08 4:51 | 2/7/08 6:34 | **1.72** | **0.07** | Y | F | Unit tripped | Unit tripped after start-up ( did not pick up load fast enough) |
| Eastman | 1 | 3/26/08 8:43 | 3/26/08 11:05 | **2.37** | **0.10** | Y | F | Line Fault | 337 line fault |
| Eastman | 1 | 6/26/08 19:58 | 6/26/08 21:58 | **2.00** | **0.08** | N | F | Unit tripped | Unit tripped on overspeed ( faulty speed switch ) |
| Eastman | 1 | 9/2/08 8:00 | 1/1/09 0:00 | **2896.00** | **120.67** | Y | S | Annual Inspection | Annual Inspection / Rewind / Overhaul |
| Eastman | 2 | 3/13/08 10:30 | 3/13/08 14:30 | **4.00** | **0.17** | Y | S | Filter Change | Took unit O.O.S. to change oil filters ( Quarterly filter change ) |
| Eastman | 2 | 3/26/08 8:43 | 3/26/08 10:00 | **1.28** | **0.05** | Y | F | Line fault | 337 line fault |
| Eastman | 2 | 5/28/08 16:58 | 5/28/08 18:59 | **2.02** | **0.08** | N | F | Unit Tripped on Startup | Unit failled to pick up load quick enough and tripped |
| Eastman | 2 | 6/11/08 0:03 | 6/11/08 8:34 | **8.52** | **0.35** | N | F | Station Alarm | Water mixed with oil in hydraulic unit caused high sump alarm ( unit was off at the time ) |
| Eastman | 2 | 6/23/08 0:17 | 6/23/08 1:44 | **1.45** | **0.06** | N | F | Unit tripped | Unit tripped due to high sump oil level. (Water got into sump) |
| Eastman | 2 | 6/26/08 6:14 | 6/26/08 7:03 | **0.82** | **0.03** | N | F | Station Alarm | Creep detector alarm ( unit was not running ) |
| Eastman | 2 | 6/27/08 14:13 | 6/27/08 14:33 | **0.33** | **0.01** | N | F | Station Alarm | Creep detector alarm ( unit was not running ) |
| Eastman | 2 | 8/4/08 7:00 | 8/28/08 13:00 | **582.00** | **24.25** | Y | S | Annual Inspection | Annual Inspection |

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
GARVINS - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| Site | Unit Number | Date & Time OFF line | Date & Time ON line | Outage Duration - Hours | Outage Duration, Days | Water Available for unit? (Y or N) | Forced (F) or Scheduled (S)? | Cause of Outage | Comment |
|---|---|---|---|---|---|---|---|---|---|
| Garvins | 1 | 6/9/08 7:00 | 6/24/08 9:34 | **362.57** | **15.11** | N | S | Annual Inspection | Annual Inspection |
| Garvins | 1 | 8/25/08 4:51 | 9/20/08 14:00 | **633.15** | **26.38** | N | S | Scheduled Outage | TB-36 transformer replacement ( TB-21 O.O.S. ) |
| Garvins | 1 | 9/27/08 12:41 | 9/27/08 14:00 | **1.32** | **0.05** | Y | F | Unit would not phase | Had to start localy ( Hasn't run for while ) |
| Garvins | 2 | 8/25/08 4:54 | 9/20/08 14:00 | **633.10** | **26.38** | N | S | Scheduled Outage | TB-36 transformer replacement ( TB-21 O.O.S. ) |
| Garvins | 2 | 11/3/08 7:11 | 12/10/08 16:13 | **897.03** | **37.38** | Y | S | Annual Inspection | Annual Inspection and headgate repair |
| Garvins | 3 | 6/23/08 7:00 | 6/25/08 14:45 | **55.75** | **2.32** | N | S | Annual Inspection | Annual Inspection |
| Garvins | 3 | 8/25/08 4:56 | 8/30/08 13:26 | **128.50** | **5.35** | Y | S | Scheduled Outage | TB-36 transformer replacement |
| Garvins | 4 | 6/16/08 7:00 | 6/20/08 11:37 | **100.62** | **4.19** | N | S | Annual Inspection | Annual Inspection |
| Garvins | 4 | 6/22/08 13:04 | 6/22/08 14:32 | **1.47** | **0.06** | N | F | Unit tripped | Pond control took unit off line due to low hw ( 2.8' ) Adjusted pond control perameters |
| Garvins | 4 | 8/25/08 5:03 | 8/30/08 13:39 | **128.60** | **5.36** | Y | S | Scheduled Outage | TB-36 transformer replacement |

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
GORHAM - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| Site | Unit Number | Date & Time OFF line | Date & Time ON line | Outage Duration - Hours | Outage Duration, Days | Water Available for unit? (Y or N) | Forced (F) or Scheduled (S)? | Cause of Outage | Comment |
|---|---|---|---|---|---|---|---|---|---|
| Gorham | 1 | 10/6/08 8:00 | 10/9/08 14:00 | 78.00 | 3.25 | N | S | Annual Inspection | Annual Inspection |
| Gorham | 1 | 10/25/08 8:22 | 10/25/08 8:58 | 0.60 | 0.03 | Y | F | Line Fault | The unit tripped offline due to an operation on the 352 line. |
| Gorham | 1 | 10/29/08 8:11 | 10/29/08 12:03 | 3.87 | 0.16 | Y | F | Drafttube Inspection | Divers inspected drafttube area. |
| Gorham | 2 | 1/24/08 8:29 | 1/24/08 8:35 | 0.10 | 0.00 | Y | F | Hot Spot on DX5308 | Took units offline exercised DX5308 and put units back online. |
| Gorham | 2 | 3/11/08 20:06 | 3/11/08 20:34 | 0.47 | 0.02 | Y | F | Line Fault | Raccoon on middle phase of the 247 line at Eastside Substation caused fault at Gorham Substation. |
| Gorham | 2 | 6/10/08 16:32 | 6/10/08 17:43 | 1.18 | 0.05 | Y | F | Line Fault | Severe lightning storm in the north country. |
| Gorham | 2 | 10/6/08 8:00 | 10/9/08 14:00 | 78.00 | 3.25 | N | S | Annual Inspection | Annual Inspection |
| Gorham | 2 | 10/29/08 8:10 | 10/29/08 12:02 | 3.87 | 0.16 | Y | F | Drafttube Inspection | Divers inspected drafttube area. |
| Gorham | 3 | 1/24/08 8:29 | 1/24/08 8:35 | 0.10 | 0.00 | Y | F | Hot Spot on DX5308 | Took units offline exercised DX5308 and put units back online. |
| Gorham | 3 | 2/7/08 10:59 | 2/7/08 12:12 | 1.22 | 0.05 | Y | F | Bad Power Supply | Power supply for tach and overspeed device failed. |
| Gorham | 3 | 3/11/08 20:07 | 3/11/08 20:40 | 0.55 | 0.02 | Y | F | Line Fault | Raccoon on middle phase of the 247 line at Eastside Substation caused fault at Gorham Substation. |
| Gorham | 3 | 3/17/08 8:52 | 3/17/08 9:11 | 0.32 | 0.01 | Y | F | Worn Brushes | The unit was taken offline to replace the exciter brushes. |
| Gorham | 3 | 4/28/08 19:01 | 4/28/08 20:54 | 1.88 | 0.08 | Y | F | Bad Power Supply | Power supply for tach and overspeed device failed. |
| Gorham | 3 | 6/3/08 8:05 | 6/3/08 8:22 | 0.28 | 0.01 | Y | F | Brush Springs | Unit taken offline to replace the exciter brush springs which were not keeping the proper tension on the brushes. |
| Gorham | 3 | 6/10/08 16:48 | 6/10/08 17:47 | 0.98 | 0.04 | Y | F | Line Fault | Severe lightning storm in the north country. |
| Gorham | 3 | 6/7/08 17:25 | 6/7/08 18:23 | 0.97 | 0.04 | Y | F | Unit tripped | High thrust bearing temperature |
| Gorham | 3 | 7/8/08 18:40 | 7/9/08 7:30 | 12.83 | 0.53 | Y | F | Unit tripped | Unit tripped on high bearing temp. |
| Gorham | 3 | 7/17/08 7:00 | 7/19/08 15:10 | 56.17 | 2.34 | N | S | Annual Inspection | Annual Inspection |
| Gorham | 3 | 9/1/08 15:26 | 9/1/08 16:06 | 0.67 | 0.03 | Y | F | Unit tripped | Unit tripped when KX dropped and went negative |
| Gorham | 3 | 10/15/08 10:56 | 10/15/08 13:42 | 2.77 | 0.12 | Y | S | Substation Work | Hooksett relay crew working on grounding bank. Total station outage. |
| Gorham | 3 | 10/25/08 8:21 | 10/25/08 8:54 | 0.55 | 0.02 | Y | F | Line Fault | The unit tripped offline due to an operation on the 352 line. |
| Gorham | 3 | 11/26/08 10:31 | 11/26/08 10:38 | 0.12 | 0.00 | Y | F | Bad Power Supply | Power supply for tach and overspeed device failed. |
| Gorham | 4 | 1/24/08 8:29 | 1/24/08 8:35 | 0.10 | 0.00 | Y | F | Hot Spot on DX5308 | Took units offline exercised DX5308 and put units back online. |
| Gorham | 4 | 3/11/08 20:07 | 3/11/08 20:45 | 0.63 | 0.03 | Y | F | Line Fault | Raccoon on middle phase of the 247 line at Eastside Substation caused fault at Gorham Substation. |
| Gorham | 4 | 4/15/08 13:06 | 4/15/08 13:47 | 0.68 | 0.03 | Y | F | Actuator Problem | Actuator took the unit offline, checked actuator and phased unit. |
| Gorham | 4 | 4/16/08 12:52 | 4/16/08 14:22 | 1.50 | 0.06 | Y | F | Actuator Problem | Overloads tripped on the actuator which took the unit offline. |
| Gorham | 4 | 4/16/08 16:13 | 4/16/08 17:24 | 1.18 | 0.05 | Y | F | Actuator Problem | Overloads tripped on the actuator which took the unit offline. Ordered new overloads. |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gorham | 4 | 4/17/08 10:42 | 4/17/08 11:59 | **1.28** | **0.05** | Y | F | Actuator Problem | Took the unit offline to check bearing oil pump problem. Replaced oil pump and returned unit to service. |
| Gorham | 4 | 4/18/08 14:32 | 4/18/08 15:50 | **1.30** | **0.05** | Y | F | Actuator Problem | Overloads tripped on the actuator which took the unit offline. |
| Gorham | 4 | 6/10/08 16:48 | 6/10/08 17:52 | **1.07** | **0.04** | Y | F | Line Fault | Severe lightning storm in the north country. |
| Gorham | 4 | 10/15/08 10:56 | 10/15/08 13:53 | **2.95** | **0.12** | Y | S | Substation Work | Hooksett relay crew working on grounding bank. Total station outage. |
| Gorham | 4 | 10/25/08 8:21 | 10/25/08 8:50 | **0.48** | **0.02** | Y | F | Line Fault | The unit tripped offline due to an operation on the 352 line. |
| Gorham | 4 | 11/10/08 7:49 | 11/26/08 12:32 | **388.72** | **16.20** | Y | S | Annual Inspection | Annual Inspection, replaced lower guide bearing and rebuilt actuator piston.. |

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
HOOKSETT - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| Site | Unit Number | Date & Time OFF line | Date & Time ON line | Outage Duration - Hours | Outage Duration, Days | Water Available for unit? (Y or N) | Forced (F) or Scheduled (S)? | Cause of Outage | Comment |
|---|---|---|---|---|---|---|---|---|---|
| Hooksett | 1 | 3/4/08 8:50 | 3/4/08 9:23 | **0.55** | **0.02** | Y | F | Scheduled Outage | While cleaning racks, rack rake boom failed in the down position. Needed to shut unit down to lift rake |
| Hooksett | 1 | 4/7/08 8:15 | 4/7/08 9:30 | **1.25** | **0.05** | Y | F | Governor problem | Adjusted synchronizing motor ( gov. not responding to raise and lower pulces ) |
| Hooksett | 1 | 7/21/08 6:32 | 8/18/08 9:16 | **674.73** | **28.11** | Y | S | Annual Inspection & intake rack replacement | Annual Inspection and intake rake replacement |
| Hooksett | 1 | 10/15/08 7:33 | 10/15/08 11:36 | **4.05** | **0.17** | Y | S | Planned Outage | Divers installing shims between intake racks and support structure. |

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
JACKMAN - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| Site | Unit Number | Date & Time OFF line | Date & Time ON line | Outage Duration - Hours | Outage Duration, Days | Water Available for unit? (Y or N) | Forced (F) or Scheduled (S)? | Cause of Outage | Comment |
|---|---|---|---|---|---|---|---|---|---|
| Jackman | 1 | 2/1/08 23:21 | 2/2/08 1:11 | **1.83** | **0.08** | **N** | F | Line fault | Line fault on the 3170 line |
| Jackman | 1 | 2/13/08 16:47 | 2/13/08 18:12 | **1.42** | **0.06** | **N** | F | Line fault | Line fault on the 2140 line |
| Jackman | 1 | 3/28/08 11:43 | 3/28/08 14:15 | **2.53** | **0.11** | Y | S | Scheduled Outage | Installed trip circuit for mobile S/S in 115 kva yard |
| Jackman | 1 | 4/18/08 16:26 | 4/18/08 17:32 | **1.10** | **0.05** | Y | F | Unit tripped | Unit tripped due to high bearing temperature |
| Jackman | 1 | 5/5/08 10:02 | 6/4/08 15:49 | **725.78** | **30.24** | **N** | F | Line Fault | Unit tripped due to backhoe making contact with station transformer leads ( transformer failure ) Installed mobile sub. |
| Jackman | 1 | 8/8/08 18:17 | 8/9/08 2:21 | **8.07** | **0.34** | Y | F | Line Fault | Temporary mobile substation tripped due to severe thunderstorms in the area |
| Jackman | 1 | 9/9/08 20:10 | 9/9/08 20:56 | **0.77** | **0.03** | Y | F | Unit tripped | Unit went out on overspeed. Could not find any problems |
| Jackman | 1 | 11/6/08 8:33 | 11/6/08 14:37 | **6.07** | **0.25** | **N** | F | Line Fault | TB-33 relay operated and tripped the 86/TS-TB-33 lockout and the 86-G-1 lockout |
| Jackman | 1 | 12/2/08 10:08 | 12/2/08 10:24 | **0.27** | **0.01** | **N** | F | Line Fault | Breaker for mobile S/S opened causing the unit to trip ( contractor was removing breaker access panel ) |

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
LOST NATION - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| Site | Unit Number | Date & Time OFF line | Date & Time ON line | Outage Duration - Hours | Outage Duration, Days | Water Available for unit? (Y or N) | Forced (F) or Scheduled (S)? | Cause of Outage | Comment |
|---|---|---|---|---|---|---|---|---|---|
| Lost Nation | 1 | 4/14/08 7:00 | 4/18/08 15:00 | **104.00** | **4.33** | **N** | S | Annual Inspection | Annual Inspection |

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
SMITH - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| Site | Unit Number | Date & Time OFF line | Date & Time ON line | Outage Duration - Hours | Outage Duration, Days | Water Available for unit? (Y or N) | Forced (F) or Scheduled (S)? | Cause of Outage | Comment |
|---|---|---|---|---|---|---|---|---|---|
| Smith | 1 | 3/11/08 20:11 | 3/11/08 22:41 | **2.50** | **0.10** | Y | F | Line Fault | Raccoon contacted middle phase of the 247 line at the Eastside Sub-satation. |
| Smith | 1 | 3/31/08 0:44 | 3/31/08 2:02 | **1.30** | **0.05** | Y | F | Unit Tripped | The unit tripped due to a loss of turbine bearing oil pressure. |
| Smith | 1 | 3/31/08 9:06 | 3/31/08 10:29 | **1.38** | **0.06** | Y | F | Unit Tripped | The unit tripped while adjusting flow switch on the DC turbine bearing oil pump. |
| Smith | 1 | 4/12/08 8:20 | 4/12/08 19:23 | **11.05** | **0.46** | Y | S | Scheduled Outage | The unit was taken offline to move the control cable to the new poles which were installed earlier in the month. |
| Smith | 1 | 6/10/08 16:49 | 6/10/08 17:10 | **0.35** | **0.01** | Y | F | Unstable System | The ESCC dispatcher took the unit offline due to the unstable system voltage caused by severe thunderstorms in the area. |
| Smith | 1 | 9/6/08 7:18 | 9/11/08 13:13 | **125.92** | **5.25** | Y | S | Annual Inspection | Annual Inspection |
| Smith | 1 | 10/14/08 15:54 | 10/14/08 17:17 | **1.38** | **0.06** | Y | F | Unit taken off line | Turbine bearing oil line leaking |

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
WHITE LAKE - UNIT OUTAGE LIST
JANUARY TO DECEMBER

| Site | Unit Number | Date & Time OFF line | Date & Time ON line | Outage Duration - Hours | Outage Duration, Days | Water Available for unit? (Y or N) | Forced (F) or Scheduled (S)? | Cause of Outage | Comment |
|---|---|---|---|---|---|---|---|---|---|
| White Lake | 1 | 3/11/08 12:09 | 3/11/08 19:37 | **7.47** | **0.31** | **N** | F | Station Alarm | PLC Communication Failure ( Unit not on at the time ) |
| White Lake | 1 | 4/28/08 7:00 | 5/2/08 7:00 | **96.00** | **4.00** | **N** | S | Annual Inspection | Annual Inspection |
| White Lake | 1 | 6/2/08 18:06 | 6/3/08 1:45 | **7.65** | **0.32** | **N** | F | Station Alarm | Bad module caused 86 device to lockout. (Changed module) |
| White Lake | 1 | 6/13/08 15:45 | 6/13/08 17:53 | **2.13** | **0.09** | **N** | F | Station Alarm | Computer failure |
| White Lake | 1 | 7/18/08 16:42 | 7/18/08 19:55 | **3.22** | **0.13** | **N** | F | Station Alarm | Thunderstorms in the area caused vibration alarm to come in. ( unit was off at the time ) |
| White Lake | 1 | 7/24/08 15:44 | 7/24/08 17:25 | **1.68** | **0.07** | **N** | F | Station Alarm | Thunderstorms in the area caused vibration alarm to come in. ( unit was off line at the time ) |
| White Lake | 1 | 9/26/08 20:15 | 9/26/08 23:53 | **3.63** | **0.15** | **N** | F | Station Alarm | Gen. trip relay tripped. ( unit was not on at the time ) |

# ATTACHMENT WHS-2

# PUC OUTAGE REPORTS

# PSNH

# FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2008-01 (SR5- 01)

**Station/Unit:** Schiller Unit No. 5

**Dates:** January 3 – January 10, 2008

**Duration:** 6.8 days

**Immediate Cause:**
The Unit was removed from service due to low bed material temperatures causing the bed to agglomerate and crust over.

**Discussion / Remedy:**
The unit had been operating at low loads to allow bag house bag replacements and condenser cleaning. Maintaining adequate bed material temperatures and pressure differentials can be challenging. With the unit at about 30MW, the bed temperature on the west side of the furnace began dropping rapidly and the bed material began crusting over. After attempts to break up the crust were unsuccessful, station management decided to take the unit off line to avoid further agglomeration of the bed or potential damage to the unit and to complete the bag replacement and condenser cleaning.

Background: The unit was at reduced load to facilitate the repair and replacement of two bag-house modules. With two modules of the eight out of service and one module always in cleaning mode it is necessary to lower load in order to maintain proper delta P across the bag house. The bag house is operated and maintained and bags replaced to comply with opacity limits in the units operating permit. With the unit already at a reduced load to work on the bag house, it was decided to main condenser at the same time. The condenser had been being monitored recognizing during the next opportunity that presented itself the condenser should be cleaned.

The load was dropped to 35 MW. To supplement the bed temperature operators attempted to start the gas burner. The attempt was unsuccessful so troubleshooting of the burner began. The unit's load was further reduced while troubleshooting continued. At just below 30 MW the bed temperatures dropped rapidly resulting in a main fuel trip.

The gas burner was successfully started and though the bed temperature was approximately 500 + degrees, the on-duty crew was able to keep the turbine on line, and

the condenser cleaning job was started. The burner was firing and the bed material temperatures rebounded back to 900F. Wood firing was reestablished. Operators continued to work to maintain adequate bed temperatures; however, at around 1050 F on the bed temp and a load of 30 MW the west side of the furnace bed began dropping rapidly. This is indicative of agglomeration (crusting) of the bed. The decision was made to take the unit offline to prevent further agglomeration of the material.

During the outage, the bag-house repairs and bag replacement was completed and the condenser cleaning was completed.

**Remedy:** Unit 5 was taken off line Thursday evening January 3rd. Vendors were notified that evening, so that mobilization of manpower and equipment could start. The unit went into a cool down phase that evening and through the day on Friday. Prep work commenced with all rigging being set up for cyclone cover removal, boiler entry, spider lift scaffolds, safety lines, as well as bed removal lines, debris shoots, air manifolds, etc. Mobilization was complete for both the boilermakers as well as the vacuum contractor.

The start up burner failure which was a contributing factor to this outage was inspected.

> During the troubleshooting with the unit on line, the linkage rod was found to have pulled out of its attachment block on the damper shaft. It was suspected that the damper blades had bound up and the actuator had enough force to pull the linkage apart at the weakest link. With the linkage rod disconnected, the damper didn't move to the right position for purge and the attempt to light the burner failed. Instrumentation personnel reconnected the linkage rod and adjusted the rods position until it could be verified that the switch connected. When the burner still would not light, the technician used a jumper to get the light-off position indication and let the start sequence continue. The limit switches were then adjusted and re-aligned to correct the situation.

During the shutdown the damper was inspected internally and externally and stroked. One broken weld on a damper blade shaft-to-linkage connection was repaired. An interference between the linkage and lagging material was removed. The damper position switches used as permissive's for burner light-off were readjusted and the damper was stroked repeatedly. Linkage arms were welded to their drive rods as necessary. An expansion joint vendor was brought in to repair the insulation pillow in the dilution air damper inlet expansion joint, just above the damper.

In addition to furnace bed removal, tuyeres cleaning, cyclone cleaning, other areas of unit 5 boiler and its components were opened, inspected, and cleaned. Cleaning of material from FD fan silencer in FD fan duct, air heater air side, and furnace tuyeres went on in parallel with furnace and cyclone cleaning. Repairs to Vortex finders in cyclones 4 & 5 were completed as well as final boiler inspections on the night shift. All boiler doors were re-bricked, ducts closed, cyclone covers installed and unit turned over to operations for start up.

**Additional work completed during the outage.**

**Mechanical Dept.**

1. WO# SR0701330; Replace inlet flange gasket on Sootblowing relief valve.
2. WO# SR0800008; Replace BFP warm-up valves to both feed pumps.
3. WO# SR0701319; Replaced gasket on blowdown tank manway.
4. WO# SR0701311; Replaced quenching water outlet valve on blowdown tank
5. WO# SR0800019; Installed bleeder valves for each module on baghouse puffer air system.
6. WO# SR0701263; Installed new grommet kit to repair oil leak on inboard ID fan bearing. Also changed oil, both bearings.
7. WO# SR0800009; Reinforced and weld repaired bedash piping line fitting.
8. WO# SR0701425; Changed oil in both FD fan bearings.
9. WO# SR0800017; Aligned internal damper vanes and repaired broken weld. Adjusted externally as needed and welded control arm to drive assembly.
10. WO# SR0800016; Replaced turbine above seat drain valve, north side.
11. WO# SR0701298; Inspected set screws on Governor Servomotor drive coupling. No issues found.
12. WO# SR0701251; Installed new grommet kit on inboard FD fan bearing to repair oil leak.
13. WO# SR0701474; Replaced "return trainer" roller on C5, on boiler roof. Replaced "troughing trainer" roller in woodyard (C5). Replaced (3) additional "troughing" rollers on C5.
14. WO# SR0701449; Replaced 10th. stage extraction valve outlet flange gasket.
15. WO# SR0701364; (M.P.S.) Opened sootblowing root vavle to inspect. Found "wedge" with slight crack. Valve reassembled and to be replaced in Spring outage.
16. WO# SR0701270; (M.P.S.) Repacked steam drum blowdown valve.
17. WO# SR0800018; Inspect, adjust/replace drive belts on C1 - C6. Replaced drive belt on C5. Installed belt and aligned sheaves on C1 magnet. Replaced C4 scraper. Tightened belts (belts changed a couple of days before outage) on #2 hog, Inspected belts on #1 hog. Inspected scalping screen belts.

**Wood Yard**

1. Replaced north drag chain on #2 truck dumper.
2. Repaired broken flight on reclaimer.
3. Fabricated and installed a screen over yard drain under C5.
4. Replace 18th. stage level control valve, el.99.
5. Replaced gasket on steam supply line to DA heater.
6. Replace desiccant on air dryer.
7. Installed heli-coils as needed in moly cooler covers.
8. H.I.S. water blasted condenser and moly cooler tubes.
9. Modified air/water spray system for the cyclones.
10. OPS tested the low level alarm switch on the lube oil tank. No issues found.

**I&C dept**

1. Rod/ blowdown Bed pressure sensing lines.
2. Blowdown Drum level sensing lines. (Transmitters and Aquarians)
3. Stroke Dilution Air damper, after damper inspection and repairs completed. Adjust Purge and Lightoff switches.
4. Rod/ blowdown Cyclone manometer sensing ports. During Cyclone cleaning.
5. Baghouse, replace Bray solenoids with another type, same as on hopper knife valves.
6. 5A BFP support for new pump installation. Oil skid reassembly of instrumentation.
7. WO# SR 07 01324, Soot blowing Control valve leaking by. Obtain as found stroke data prior to removing air/signal lines for valve repair. Sign on MTO.
8. WO SR 07 01441, Remove 18th Stage FW Control valve actuator and bring to I&C shop. New England Controls technicians installed new valve on actuator.
9. Furnace Riser Out Temp, CFB-TE-009, reading low and erratic. Remove TC and inspect. Check Ovation by simulating inputs. Replaced TC and reseated module in Ovation cabinet.
10. Remove all Cyclone Outlet Temperature TCs and wells to support Cyclone work. Replace TCs and wells as necessary.
11. Calibrate O2 Probe. (Located North end El. 21')
12. WO SR 07 01481, Low Turbine Lube Oil sump alarm is in alarm. Oil level is normal. Alarm clear, Ops to lower oil and verify alarm operation.
13. WO SR 07 01475, Dust Collectors Wood Silo, both dust collectors show no DP and both are in alarm.
14. Calibrate Turbine/Generator Machine Gas Pressure gauge, El 11'.
15. WO SR 07 01316, Replace Air Dryer desiccant with mechanical assist.
16. Vacuum inside Ovation cabinet, RIO 2-1, Turbine deck. During cleaning Main Power Supply shorted out.
17. Replaced feedback potentiometers on SAS-DMP-001.
18. Inspect/clean Wood Silo #1 and #2 level transducers.
19. Review Ovation System Status checking for blown fuses in all Drops.

**Electrical dept.**

1. Provide outage support to all other departments
2. Replaced the level control system in the waste water lift station
3. Replaced 4 baghouse hopper level detectors, troubleshoot why alarms from high hoppers did not appear on the DCS
4. Provided start up coverage

# PSNH

# FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2008-02 (MK1-01)

**Station/Unit:** Merrimack /Unit 1

**Dates:** January 7 – January 10, 2008

**Duration:** 2.9 days

**Immediate Cause:**
The unit was removed from service on January 7 to conduct preventative maintenance after a 105-day run.

**Discussion/Remedy:**
The need for an air heater wash typically occurs every 3 to 4 months. ISO was contacted; and contractors were notified to expedite the length of the outage. This 105 day run was the 10th longest in Unit 1's history.

An air heater inspection was completed. The inspection indicated that the circumferential seals (top and bottom) were in good condition and only a minimal amount would need to be replaced. The 1A and 1B air heater baskets were water washed. Removing a sampling of the cold end baskets prior to the wash allowed a thorough physical inspection which indicated that the baskets were still in good condition therefore the cold end baskets were washed rather than replaced. . Water washing of 1A and 1B air heaters was the critical path of the outage

A complete boiler inspection was performed and found one boiler tube leak in "B" cyclone. Also, a sizable number of maintenance items that had accumulated in the outage back log list were completed as shown below.

This maintenance outage enabled the unit to run successfully to the next air heater wash outage which was taken the end of April.

**Additional work completed during the outage.**

Mechanical Department:

- Opened "A","B", and "C" cyclone doors.
- Replaced intermediate head and lance tube on G9B-OS soot blower.
- Repacked G9B-10 sootblower.

- Repacked IK-2 and replaced wallbox seals, yoke, copper gasket.
- Replaced poppet valve on IK-7 and IK-11 sootblowers.
- Repaired the stop block on IK-8 and inspected drive unit.
- Replaced IR -14 sootblower with a rebuilt unit, cleaned out aspirating head and seal air piping.
- Washed out trough on the slag tank.
- Opened door to the cooling water heat exchanger.
- Inspected and greased 1-A and 1-B Forced Draft Fan inlet and outlet dampers. Replaced one bearing on the east side of 1B outlet.
- Changed the oil in 1-A and 1-B forced draft fan inboard and outboard motor bearings.
- Changed oil in 1-A and 1-B forced draft fans.
- Tested operation of the south mud drum drain valve.
- Inspected, greased and cleaned "A" and "B" air heater cleaning device couplings and gearboxes.
- Inspected and cleaned 1-A and 1-B primary fan coils.
- Inspected, greased crusher, and lubed chain on slag tank.
- Cleaned ammonia injection nozzles.
- Inspected 1-A, 1-B and 1-C blast gate, cleared 1-B blast gate of coal.
- Repaired 1-C coal feeder belt.
- Replaced slag tank viewing port glass, upper level, west side.
- Weld repaired firemain line on 1-C coal downcomer.
- Pad welded 1-C coal feeder discharge blast gate.
- Replaced slag breaker and sections of piping.
- Repaired concrete wall in 1-B forced draft fan intake.
- Replaced drive gear inboard and outboard bearings for 1-C coal feeder motor.
- Replaced southwest port water wash supply valve and copper piping.
- Pad welded drain piping to the blowdown tank.
- Cleaned vent stack piping water drain for the sample water system.
- Repaired leak in 1-B primary fan coils.
- Pad welded 1-A fan coil steam supply piping.
- Replaced southwest slag tank viewing port piping and three way valve.
- Repaired oil leak on seal oil pressure regulator #122.
- Repaired leak in the gland water piping for the slag tank fill pump.
- Repaired leak in the SCR flyash piping at the boiler front.
- Replaced DA door gasket.
- Replaced the south SCR inlet damper bearing.
- Replaced vent valve on TRCV -4 1-B SSH attemperation station.
- Repaired oil leak on oil level sight glass for 1-A boiler feed pump hydraulic coupling.
- Replaced flange gaskets on cuno filter for 1-A boiler feed pump hydraulic coupling.
- Replaced all gaskets on the lube oil pump reservoir for 1-A boiler feed pump motor.

- Checked oil supply and bearing tolerances on 1-A boiler feed pump inboard bearing.

Boiler and Valve Work:

- Rebuilt both south vent valves on the steam drum.
- Repacked the root valve on the air ejector steam supply.
- Adjusted limits on 1-A condenser inlet valve limotorque motor.
- Repacked 1-B boiler feed pump drain valve.
- Replaced the door on the SCR catalyst dummy layer.
- Performed complete boiler inspection.
- Inspected 1-A and 1-B air preheater steam cleaning devices.
- Replaced a small percentage of the top and bottom circumferential seals in 1-A and 1-B air heater.
- Repaired cooling water jacket on "A" cyclone scroll burner.
- Repaired tube leak in "B" cyclone on the knee bends ($8^{th}$ tube from the neck).
- Pad welded "C" cyclone door.
- Repaired casing leak on $5^{th}$ floor, west side, below G9B-3.

Electrical Department:

- Replaced terminal blocks, cleaned junction box, sealed, marked and tested wiring on the sootblowing system.
- Performed operational Test on the north and south SCR bypass dampers.
- Tested operation of SCR inlet damper.
- Performed operational check on the north and south economizer dampers, adjusted limotorque close settings.
- Replaced motor on 1-A precipitator air purge blower.
- Performed test on air heater trip indication lights.
- Inspected original electrostatic precipitator.
- Replaced all collector ring brushes on the exciter.
- Replaced contactor on the inverter.

Instrument Department:

- Investigated computer point #1052 and repaired with new isolator.
- Tightened loose feedback arm on FCV-16 1-B boiler feed pump recirc control valve.
- Tested TT-1041 SCR catalyst layer 1B, pile temperature indicator.
- Verified operation of secondary superheater spray block valve and adjusted to correct pressure.
- Performed operational test on 1-B forced draft fan outlet damper drive.
- Investigated concerns of different readings from the ADH computer and the Metso computer, both O.K.

Chemical Department:

- Brush cleaned south side condenser tubes.
- Brush cleaned north side condenser tubes.
- Brush cleaned the cooling water heat exchanger.

North American:

- Vacuumed the SCR inlet and outlet, breech room, economizer by-pass dampers, precipitator, wet ash sludge basin (located under unit 2 SCR reactor) and the supplemental precipitator hopper room.
- Water washed 1A and 1B air preheaters.

# PSNH

# FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2008-03 (MK2-01)

**Station/Unit:** Merrimack/ Unit No. 2

**Dates:** January 30 – February 4, 2008

**Duration:** 5.3 days

**Immediate Cause:**
The unit was removed from service after a 117 consecutive day run, 5th longest in the unit's history, due to a secondary superheater tube leak.

**Discussion / Remedy:**
A boiler inspection was completed. A failed secondary superheater inlet bank tube leak was identified as the primary leak. The tube was the trailing edge tube, located on the 11th pendant row counting from north to south at elevation 350'. The tube failed 9' down from the roof tubes and consequently damaged two other tubes adjacent to it on the same pendant. The failed superheater inlet tube was severed and bent beyond repair. A total of 124' of tube was needed to make the proper repairs. This involved making two new lower bends and 15 welds working from the scaffolding and in the penthouse. Once the welds were complete, a black light examination was performed to make sure that the welds met code. The pendant sections were re-aligned and the alignment castings were reinstalled.

To insure the safety of the workers, prior to entering the lower furnace or superheater areas, ash clinkers (ash build-up) overhead of the work areas had to be removed. Once the ash was removed, installation of staging commenced. This involved four levels of staging brackets and planking that were installed in-between the intermediate and the superheater inlet pendants, each one spanning 36' (the width of the boiler). In addition to the staging, two suspended scaffolding units were installed in the furnace to access all the leading edge tubes. This scaffolding facilitated the superheater boiler tube repairs and provided access to perform a thorough inspection of the SSH. Also tube thickness readings by non-destructive examination (NDE) of the SSH inlet pendants in the affected area were taken and documented. Before the new tube was welded in place, the SSH bottle headers were borescoped to ensure that there were not any restrictions.

The boiler inspection also identified cyclone tube leaks. Weld repairs in the boiler were completed on the water tube leaks in 2B and 2C cyclones, a furnace wall leak 3' south of

"G" cyclone slag tap at approximately the same elevation as the slag tap. Multiple floor leaks were also repaired.

When the repairs were completed, the four levels of staging and the suspended scaffolding were then removed and a boiler pressure test was performed on the waterside tubes. Additional tube leaks were found on the floor, and were pad weld repaired and again pressure tested. These smaller leaks in the floor had not been identifiable on the initial inspection due to the amount of water coming from larger tube leaks.

Periodic replacement of high wear areas of the boiler are performed as part of our long term routine maintenance plans. During the upcoming 2008 planned overhaul, the secondary superheater inlet pendant section of the boiler and the boiler floor section are scheduled for replacement.

**Additional work completed during the outage.**
The following is a list of other work that was performed during the outage. It includes jobs that were in the priority backlog and jobs that were found during the inspection of the boiler at the beginning of the outage. The jobs that are in priority backlog are jobs that can only be completed with the unit off line.

**Maintenance Department:**

- Opened and closed all boiler and cyclone doors.
- Repaired the fan coil steam supply piping.
- Repaired support on outboard side of fan cage grating on 2-B GRF.
- Installed additional isolation valve and replaced another on the common ammonia chemical pump line.
- Inspected and tested 2-B slag swiper cooling bar.
- Replaced drain valve for level alarm, on 2nd point high pressure feedwater heater.
- Overhauled PCV-300 steam sootblowing valve.
- Replaced flange on the inlet side of LCV-106 –A 1st Point Heater emergency drain valve.
- Opened and closed heat exchanger doors.
- Rebuilt 2-A and 2-B slag swipers.
- Inspected slag tank, cleaned, replaced crusher, slag inlet, gate components, venturi and nozzle.
- Removed and replaced slag line blank for freeze protection.
- Cleaned slag tank warm up line.
- Replaced gaskets on NE slope nozzle in the slag tank.
- Replaced the slag sluice pump shaft seal.
- Repaired slag tank overflow warm up line piping.
- Inspected the slag tank over flow box.
- Cleaned slag tank neck troughs.
- Replaced slag sluice piping in the plant and rotated others.
- Repacked LCV – 106 1st point heater level control valve.

- Disassembled and inspected LCV-41 (241) flash tank level control valve.
- Rebuilt 1st point high pressure heater feedwater dump valve.
- Replaced 2-B gravimetric coal feeder belt.
- Inspected equalizer valve on precipitator airlock #11.
- Replaced seal air supply valve on 2-B coal feeder.
- Replaced elbow and piping on the SCR/Econ ash system.
- Inspected all seven cyclone secondary air shut off damper guillotines.
- Replaced deareator storage tank gasket.
- Replaced 2-A gas recirculation fan seal air hose to the shaft seal.
- Replaced elbow on 1st point high pressure feedwater heater emergency dump system.
- Inspected and cleaned slag tank overflow line.
- Removed and re-installed blank on slag sluice piping.
- Repaired holes in casing of one section of secondary air preheater steam coils.
- Inspected and changed the oil in 2-B Gas Recirc fan inboard and outboard bearings.
- Changed oil in 2-B Gas Recirc fan motor inboard and outboard bearings.
- Changed oil in 2-B inboard and outboard bearings, Forced Draft Fan and motor.
- Disassembled and inspected 2-A Forced Draft Fan motor inboard and outboard bearings; performed oil change on same.
- Changed oil and inspected 2-A Forced Draft Fan inboard and outboard fan bearings.
- Changed oil in inboard and outboard bearings on 2-A Gas Recirc Fan and motor.
- Repaired casing on 2-A Gas Recirc Fan at inboard side of shaft seal.
- Repaired flyash reinjection line on elevation 238'.
- Replaced nipples and fittings on 2-C drip return pump, discharge for gland water to mechanical seal piping.

**Electrical Department:**

- Inspected electrostatic precipitators, original and supplemental.
- Replaced power inverter for 2-A Gas Recirc Fan and tested circuit.
- Replaced 2-F coal feeder motor filled gearbox with oil, tested.
- Replaced circuit breakers #2 and #10 for the supplemental precipitator.
- Cleaned AC/DC board transfer switch.
- Repaired gear boxes on 2-E and 2-F secondary air shut off damper guillotine.
- Tested motor operator on 210 valve turbine main steam drain valve.

**Instrument Department:**

- Replaced pressure gauges on SUBFP/MBFP gland water discharge piping.
- Checked operation of SV-570 on the SCR, wrote TR to perform more detailed work in the A.O.
- Installed condensate flow nozzle instrumentation valves.

- Performed troubleshooting exercise on the positioner for FCV-12 Reheat attemperator control valve.
- Replaced MBFP lube oil supply pressure gauge along with isolation valve.
- Inspected flash tank system control valves, 200's, 201's, 202's, and 207.
- Calibrated 2-C coal feeder.
- Tested Precipitator Accuray level detector controller system.

**Chemical Department:**

- Brush cleaned heat exchanger.
- Brush cleaned both sides of the condenser.

**North American Industrial Services:**

- Vacuumed gas recirc. duct.
- Vacuumed tempering duct.
- Vacuumed D-O1 duct.
- Vacuumed D-O2 duct.
- Vacuumed Supplemental precipitator floor and cleaned hoppers.

**Boiler Work:**

- Performed a complete boiler inspection.
- Cleaned boiler nose, SSH and VRSH pendants of ash, cleaned primary superheater.
- Repaired casing leak under IR-16.
- Repaired water tube leak in 2-B cyclone, 3' up behind the square studs, 2nd neck tube from barrel.
- Repaired water tube leak in 2-C cyclone, 1st neck tube, looking in radial burner at 5 o'clock.
- Repaired wall tube leak 3' south and on center with "G" cyclone tap hole.
- Repaired floor water tube leaks, 1st one SW corner, 4" from south wall and 18" from the west wall; 2nd leak 6' from the south wall and 24" from the west wall; 3rd leak on the south wall 6" east of the west corner; 4th and 5th leaks were on the same tube 4" apart 5' east of the south slag tap.
- Replaced rotating assembly on IK-4 sootblower.
- Replaced IK-6 sootblower feed tube and lance assembly.
- Replaced poppet Valve and packing on sootblowers IK19 and IK35.
- Replaced poppet valve on sootblowers SB-9 and SB-10.
- Replaced poppet valve on sootblower IK-30.
- Replaced lance, feed tube and wall box seals on IK-2
- Repaired IK-3 wall box tube.

- Replaced gasket and hardware on the boiler feed pump recirc common connection flange, at the DA.
- Replaced worn wear plates on 2-B redler.
- Changed oil in 2-B and 1-B horizontal redler gearbox.
- Repaired boiler casing 5' below economizer expansion joint, west side.
- Inspected north side of windbox internally.
- Installed condensate flow orifice plate and 30' flow nozzle as part of the turbine efficiency test.
- Repaired casing leak on the west side, lower flange of the economizer expansion joint.
- Repaired D-O1 casing leak on the east side, 5th floor.
- Replaced 2-A cyclone flyash reinjection stab.

# Wyman Unit 4

# FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2008-04 (Wyman )

**Station/Unit:** Wyman/ Unit No. 4

**Dates:** February 11– February 17, 2008

**Duration:** 6.0 days

**Immediate Cause:**
The unit was placed in unavailable status when the station service start-up transformer, PWF-04 T12 transformer bus, experienced a fault.

**Discussion/Remedy:** The unit was in reserve shut-down. A loud noise was heard from outside near the T-12 transformer bus. Vapor was seen rising from the low side bus near the transformer.

An inspection of the transformer suggested that the T-12 section of the low side of the transformer experienced a fault. The differential relay indicated the fault occurred from B phase to C phase. Further investigation determined that the heaters in the bus sections were non-functional. This contributed to moisture build-up in the bus sections. Subsequent freezing / melt cycles resulted in tracking to insulators in the Z-section. The Z-section failed on the insulator side, low side of the start up transformer. To support this discussion, megger readings were found below specifications, probably due to moisture. Inspection of the remaining sections indicated excessive moisture including observation of water droplets. The heater draw was minimal and indicated only possibly one of twenty heaters was functioning.

The emergency generator was started and a back feed from the 345kV switchyard was initiated. The Z-section was repaired and installed. Because readings were sub-standard, welders were hooked up to the bus from the breaker side to the transformer side providing about 2100 amps for twelve hours. Once the readings became acceptable and the system was normalized, a 200-amp load was maintained on the bus until there was the opportunity to install the heaters. The unit was returned to an available status.

A survey was completed to confirm the draw on heaters on similar bus types including 4A and 4B auxiliary transformers and also JPN 07140 were satisfactory. To address a long term solution, a budgetary quote for a heater purchase and installation was requested. This work is planned to be performed at the earliest opportunity, currently projected to be in the spring.

# PSNH

# FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2008-05 (SR5-03)

**Station/Unit:** Schiller/ Unit No. 5

**Dates:** February 22 – March 8, 2008

**Duration:** 14.9 days

**Immediate Cause:**
The unit was removed from service with low furnace bed temperature readings. Removing the unit from service before bed temperatures remain low for an extended period of time, limits the amount of bed agglomeration that occurs.

**Discussion/Remedy:**
Once off-line, the unit was vented and drained while the forced draft and induced draft fans were left in operation to cool the boiler and allow access for inspection and repair. Two crews were quickly established to work the day and night shifts. As soon as the unit conditions allowed, a work crew began inspecting the bed material area.

The low furnace temperatures had caused the bed sand to agglomerate (form into lumps). The agglomerated bed sand then had to be broken up and vacuumed out of the tuyere area. With the vacuuming complete and the unit clean the unit was ready for new bed material to be installed. The material was put into the boiler and fans started to level off the bed material. To improve the start-up condition of the material a crew was sent in to level the bed by hand. The covers on the cyclones that had been removed for access were reinstalled, the furnace doors were bricked up and closed, and the unit was turned over to operations. Upon completion of that task the unit was returned to operations for startup.

During the start up the forced draft fan encountered a fault. The motor was damaged. Unclear as to how long a repair might take on the motor, it was decided to have the workforce begin performing preplanned overhaul maintenance packages. The motor was inspected and it was determined that the motor would be sent out to be repaired. Once disassembled the cause of the motor failure was able to be determined. The winding had failed on the connection end of the stator at the edge of a stator slot due to motor insulation failure.

Arrangements were made to have all the necessary parts in the motor repair shop and to commence the rewind of the motor as the coils arrived. The shop was reminded that PSNH wanted maximum resources expended and the repair work should be performed around the clock. The motor winders were put on two shifts. The rewinding was

completed. The stator underwent two insulating processes. The unit was then baked, reassembled, test run and painted. The motor was returned to Schiller on Friday 03/07/08 at 02:00. Once returned the motor was placed back on its pedestal, reconnected, bumped for rotation, coupled to the fan, aligned, and test run without incident.

The motor, as returned to Schiller after the rewind had a higher class of insulation than as provided by TECO Westinghouse who is the OEM. The motor as supplied had class F insulation. The motor as rewound has class H insulation.

The on-going outage effort remained focused on completing the preplanned overhaul work. The spring "mud season" outage was canceled. The planned maintenance activities would continue through this outage and other remaining outage work would be completed during subsequent outages as allowed.

All departments prioritized work from the preplanned lists of maintenance activities that had been previously identified for the spring outage recognizing that some of the ordered material was on-site while some material was awaiting delivery. Workscopes were updates as materials became available.

The boiler inspector completed the annual operating permit inspection with no issues noted in the boiler or the dearator. Thielsch Engineering performed inspections and NDT on boiler internals.

**Additional work completed during the outage.**

**I&C**

20. **DONE 02/24/08,** Inspected Broken Bag Detector Probes **only**. Detector out of service. Need nonconductive conduit run to sensors installed.
21. **DONE 02/23/08,** Calibrate O2 Probe.
22. **DONE 02/24/08,** Rod/ blowdown Cyclone manometer sensing ports.
23. **DONE 02/22/08**, Rod/ blowdown Bed pressure sensing lines.
24. **DONE 02/22/08**, Blowdown Drum level sensing lines. (Transmitters and Aquarians)
25. **DONE 02/24/08,** Blowdown DA Level/ Pressure transmitters.
26. **DONE, 02/23/08**, (WO: SR 08 00076) Desuperheater Spray Water Control valve, replaced air supply regulator, stroked valve, calibrated positioner.
27. **DONE, 02/25/08,** Calibrated Baghouse Magnehelic D/P local indicators for each compartment.
28. **DONE 03/02/08,** Remove/reinstall instrumentation on V-112 to support Millenium.
29. **DONE 02/29/08,** Wood Silo #2 alarm not actuated with silo empty.
30. **DONE 03/02/08,** 5B BFP Recirc valve/actuator removal/install support.
31. **DONE 03/04/08,** Repair Cyclone water spray tips.
32. **DONE 03/05/08,** Remove/ reinstall solenoids on Baghouse slide gates to support mechanics.

33. **DONE 02/26/08,** WO# SR 08 00227, Replaced Bed Material Drain valve 112 booster regulator.
34. **DONE 02/23/08,** Stroke Dilution Air damper. Adjust/verify Purge and Light off switches. Install feedback module.
35. **DONE 02/23/08,** Stroke SUB Gas Air damper. Install feedback module.
36. **DONE 02/29/08,** Calibrate Drum pressure control loop.
37. **DONE 03/02/08,** Calibrate Hotwell Level control loop and stroke valve.
38. **DONE 03/02/08,** Turbine/ Generator Support. Remove/reinstall brg #2 & #3 VB probes.
39. **DONE 03/04/08,** Repair BN TSI Panelview.
40. **DONE 02/29/08,** Calibrate/ stroke Turbine Lube Oil cooling control valve. Possibly leaking by. WO# SR 08 00038.
41. **DONE 03/01/08,** Calibrate Dump valve pressure switch.
42. **DONE 03/01/08,** Clean/check DA Tank K-Tek.
43. **DONE 03/01/08,** Calibrate DA Level control loop.
44. **DONE 03/02/08,** Calibrate DA Inlet Control valve. Replaced Bailey positioner with Fieldvue DCV6000.
45. **DONE 03/01/08,** Calibrate DA Suction pressure control loop.
46. **DONE 03/01/08,** Calibrate DA Tank pressure control loop.
47. **DONE 03/01/08,** Calibrate DA Pump Discharge pressure control loop.
48. **DONE 03/01/08,** Calibrate DA Outlet Flow loop.
49. **DONE 02/24/08,** HP Drip pump discharge local gauge.

50. **DONE 03/04/08,** Replace Furnace Bed Temp TC, CFB-TE037. Obtained replacement, located in the shop, 02/04/08.
51. **DONE 02/24/08,** Replace Furnace Riser TC (South) with correct size.
52. **DONE 03/05/08,** Remove Cyclone TC's and wells to support Cyclone inspections.
53. **DONE 03/03/08,** Install A/B BFP Leakoff transmitter and orifice.
54. **DONE 02/29/08,** Inspect Wood Silo Hi Level probes and Ultrasonic level detectors.

**Mechanical**

Boiler: Boiler insurance inspector in 02/27/08 internal inspection.
(New operating permit good to 02/27/09).
Gas burner:
(01) Inspect burner components.
(02) Stroke burner air registers.
(03) Inspect burner outlet duct refractory/expansion joint.
(04) Inspect tuyere "duct side".
(05) Inspect cooling plenum refractory.
(06) Stroke/inspect burner damper.
(07) Replace dilution air damper including exp. joint.(on order)
(08) Stroke/inspect secondary air dampers.
Furnace:

(01) Vacuum bed.
(02) Tuyere inspection.
(03) Inspect/ repair bed thermocouples.( replace TE 037).
(04) Inspect/repair refractory.
(05) Inspect/repair bed instrument taps and connections.
(06) Inspect bed material inlet piping/ash outlet piping.(replace nozzle Alstom)
(07) Inspect fuel supply entering bed.
(08) Inspect in bed evaporator tubes.
(09) Inspect free board evaporator tubes.
(10) Inspect urea nozzles.
(11) Inspect dip legs.
(12) Calibrate oxygen probes.
(13) Calibrate bed dp transmitters.
(14) Calibrate tuyere dp transmitters.

Risers/cyclone:

(01) Vacuum cyclones and dip legs.
(02) Inspect/repair refractory.
(03) Inspect repair thermocouples/thermo well.
(04) Replace all cyclone thermo well penetration.
(05) Inspect/repair cyclone vortex finders.
(06) Inspect grease air ports.
(07) Inspect air cannon ports.
(08) Inspect cyclone flanges/expansion joints.
(09) Inspect urea nozzles.
(10) Inspect water/air spray nozzles.

Furnace outlet flue:

(01) Inspect/repair refractory.
(02) Inspect expansion joint, repair internal pillow (Wahlco elv.99)
(03) Install lifting picks for beam change out.

Back pass:

(01) Visual and u t inspection incline evaporator section.
(02) Visual and u t inspection primary super heater section.
(03) Visual and u t inspection secondary heater section.
(04) Soot blowing fireside inspection.
(05) Inspect ash diverter.
(06) Membrane wall inspect

Economizer/Air heater:

(01) Visual and u t inspection economizer section including tube legs.
(02) Expansion joint inspection.
(03) Soot blowing system fireside inspection.
(04) Air Heater tube inspection.
(05) Inspect inlet/outlet ducts.

Soot blowing system:

(01) Change oil soot blower gear box.
(02) Inspect soot blower lances.

Bag house:

(01) Inspect inlet and outlet duct.
(02) Inspect bag house modules.
(03) Inspect inlet dampers.
(04) Inspect all expansion joints.
(05) Inspect blower belts/sheaves. (Belts changed and aligned)
(06) Air blower, change oil.
(07) Air blower inlet filter, change filter.
(08) Rotary feeders, change oil.
(09) Rotary feeders, inspect chain/sprockets.
(10) Rotary feeders, check shoe clearance.(No known issues,not completed this outage)
(11) Service ash blower motor.
(12) Sr0701377 Repair items from last outage. (See separate report)
(13) Replace bags?(rps was not available)
(14) Replace broken bag detector.

Force draft fan:

(01) Inspect outlet silencer ( Still intact, no issues found)
(02) Grease damper drive and vane bearings. ( greased as needed)
(03) Clean motor filters.
(04) Check fan/hold down bolts. ( All bolting found to be tight )
(05) Internal fan inspection, including the wheel.
(06) Inspect fan inlet/outlet duct including expansion joint.
(07) Stroke vanes.
(08) Remove motor prepare for shipping.
(09) Motor sent out for rewind.
(10) Install motor and align.
(11) Bump motor for rotation.
(12) Grease/couple motor to fan.
(13) Install view port I R window camera.
(14) Perform vibration readings ( R L Smith engineering).
(15) Change oil fan bearing oil.

Induce draft fan:

(01) Change fan oil
(02) Check hold down bolts including motor. ( All bolting found to be tight )
(03) Inspect/lubricate vane drives and linkages.
(04) Internal fan inspection including wheel.
(05) Change motor oil.
(06) Stroke vanes.
(07) Clean motor filters.
(08) Inspect inlet/outlet duct and expansion joints.
(09) Install silencer.(2009 ?)
(10) Perform vibration readings (R L Smith engineering).

Stack

(01) Stack inspection.(Due 2012)
(02) C E M probe and port inspection.
(03) Blast and prime lower section.
(04) Install ladder for inspection.
(05) Clear stack drain.

Ash System:
Bed ash blower:

(01) Blower, change oil.
(02) Blower, change inlet filter. ( Filter changed )
(03) Blower, inspect belt and sheaves. ( New belts installed )
(04) Service ash blower motor.

Bed ash screw:

(01) Gear box, change oil and lubricate bearings.
(02) Gear box, inspect chain oil/sprockets.
(03) Remove top cover and inspect screw.

Back pass / Economizer ash Hoppers:

(01) Vacuum hoppers.
(02) Replace air slide stones.
(03) Change oil rotary feeders.
(04) Inspect rotary feeder chain/sprockets. (installed new sprockets and chain on Backpass feeder)
(05) Rotary feeders, inspect shoe clearance.
(06) Replace all level detectors.

Bed, Make Up System

(01) Blowers, change oil.
(02) Replace belts, inspect sheaves and check alignment.
(03) Replace inlet filters.
(04) Install isolation valve above 108 valve (waiting for quote Alstom).
(05) Install bed material vent valve (to isolate blr from bed makeup silo).
(06) Bed material sys, install stabs to support the new bed ash screen.
(07) Sr0800058, 112 Valve, install grade 7 heat treat bolts. (Millennium disassembled valve and reworked)

Feed water/Condensate system:

(01) D A, open clean and inspect.
(02) D A, inspect nozzles, make sure all nozzles are tight.(No issues found)
(03) D A, calibrate level instruments.
(04) D A, calibrate pressure instruments.
(05) Steam drum, open clean and inspect.
(06) Steam drum, blow down drum level transmitters.
(07) Steam drum, calibrate drum level instruments.
(08) Steam drum, calibrate drum pressure instruments.
(09) Boiler feed pumps, calibrate transmitters.

(10) Condensate pump motors, change oil.
(11) Boiler feed pumps, change filters/oil. (Both pumps done)
(12) Replace feed boiler feed pump leak off orifice/transmitter.
(13) "A" boiler feed pump, shim pump back to lower leak off pressure.
(14) "B" boiler feed pump, south rtd indicating plus 200 degree, north indicating 137 degree, inspect.(hold for rtd parts)

Cooling water system:

(01) Change oil furnace plenum return cooling water pumps.
(02) Change oil furnace cooling water circulation pumps.
(03) Service #2 cooling water plenum "return" pump motor.
(04) Service#2 cooling water "circulation" pump.
(05) Install/align both #2 cooling water pump motors.

Screen House:

(01) Divers to assist in closing gates.
(02) Divers to inspect trash rack.
(03) Divers to inspect floating boom.
(04) De-water circulating pit/tunnel.
(05) Vacuum/water wash pit/tunnel.
(06) Clean cooling water heat exchanger intake pipe.
(07) Inspect butterfly valves.
(08) Inspect circulating pump impellers. (5A= .040/.050, 5B= .040/.050)
(09) Clean fire pump strainer.
(10) Traveling water screens gear boxes, change oil.
(11) Inspect drive chain /sprockets.
(12) Inspect traveling screen structure. (No issues found)
(13) Inspect nozzles.
(14) Change oil Circulation pump motors.
(15) Sr0701387,Circulation pump need to cut a hole in both pumps to allow gland water to drain.
(16) Replace rubber mats screens. (Done)
(17) Sr071384 replace ladder west side of screen (2009).

Condenser/Close cooling heat exchanger:

(01) Clean condenser. (Tubes blasted by H.I.S.)
(02) Clean cooling water heat exchanger. (Tubes blasted by H.I.S.)
(03) Inspect all door/cover gaskets replace as needed.
(04) Repair/replace flow channels covers and zincs. (Replace "west" channel on north cooler. Mushroom studs installed in all heads)
(05) Replace East condenser butter fly valve/expansion joint. West butterfly valve/expansion joint installed 3/7/08.
(06) Install plate, discharge weir.

Turbine:

(01) Kaydon, change filters.
(02) Air ejector, disassemble locate and repair leak.(outage 2009)
(03) Air ejector, rebuild nozzles.
(04) Oil leak turbine pedestal, locate repair wipe down piping all the way to 11. ( Found gap at bottom of #2 oil seal. Removed, cleaned and reinstalled.)
(05) Sr0800036, PM, servo motor coupling, inspect set screw. (Screw found to be tight.)
(06) Sr0700790, turning gear oil leak.
(07) Sr0701297, Seal oil system, inspect level control valves.
(08) Sr0600834, Hydrogen dryer, clean trap.

Major Valves:

Elevation 11:

(01) "A" Boiler feed pump recirculation control valve.
(02) "B" Boiler feed pump recirculation control valve.
(03) "A" Boiler feed pump discharge gate valve.
(04) "B" Boiler feed pump discharge gate valve.
(05) "A" Boiler feed pump discharge check valve.
(06) "B" boiler feed pump discharge check valve.

Elevation 60:

(01) Main feed water bypass control valve.
(02) Main Feed water control valve.

Elevation 99

(01) New item, ***D A inlet control valve leaks by *** Priority #1.Schedule for next time unit is off line, call in Millennium power services.

Elevation 110'4"

(01) Main steam stop gear box.(warranty, waiting for parts)
(02) Disassemble and inspect main steam valve.(warranty, waiting for parts).

Safety valves:

(01) Steam drum north valve.(staging requires)
(02) Steam drum south valve.(staging require)
(03) Super heater outlet valve (Valve inspected Nov.2007)
(04) D A safety valve.(staging required)
(05) 18th stage heater, water side valve elevation 38.

Misc. Mechanical:

(01) Sr0800075, boiler feed pump suction line "a" orifice flange. Flanges found to be cut, replace with new.)
(02) Sr0800063, D A heater l p drip line check valve, replace cover.
(03) Overhaul high pressure traps, 3 total on elevation 24 underneath turbine belly, main steam trap completed.

(04) Hot well tank, open and clean.
(05) Sr0800235, Bed ash drain screw, cooling water flex hose leak. (Replaced hose with new.)
(06) Sr0800237, SNCR back flow preventer, relief check failed.
(07) Sr0800271, condenser drain crossover pipe,leaking @ union (Work order added 3/10).

Misc. Welding:

(01) Sr0800025, replace soot blowing root valve.
(02) Sr0800051, replace main steam line automated vent valve.
(03) Sr0701434, boiler steam drum sight level indicators, install drain valves/line so it can be blowned down without tripping unit.
(04) Sr0800049, economizer vent line, reposition valves and install slop drain.
(05) Bag house hopper room, replace valves in each hopper for ash removal.
(06) Turbine gland steam control valve, replace valve. (Valve ordered)
(07) SR0800103, tie D A pump to feed water discharge pipe for hydro purposes.
(08) Replace "a" boiler feed pump leak pressure gage drain valve.
(09) Sr0701265, 20 lb station bypass valve, leaks by.
(10) SR0800231, soot blowing block valve leaks by.

Misc I&C:

(01) Sr0800125, P M, SNCR system instruments.

Electrical

(01) Main transformer, install 2 lower cooling fan motors.

Wood supply:

Truck dumpers:

(01) Spike rolls, inspect chain/sprocket
(02) Drive gear boxes, in etc.inspect chain/sprockets.
(03) Inspect drag chain assembly for wear.
(04) Truck dumper inspection (vendor).
(05) Service all motors #2 truck dumper including #2 A and B hydraulic pumps.
(06) #3 Dumper, third stage repair wiper left cylinder (vendor).

C 1 to C6 conveyor:

(01) Inspect belts/sheaves.
(02) Inspect head /tail rolls.
(03) Inspect all conveyor belts.
(04) Inspect all primary/secondary and v plow scrapers.
(05) Inspect c6 cables (Bruce L).

(06) Inspect c5 diverter plate/chute head section end.
(07) Service c1 conveyor motor (re-install/align replace belt).
(08) Service c5 conveyor motor (re-install/align/replace belt (crane required).
(09) C5 increase speed by 100fpm(hold per Granger/Gregoire)
(10) Calibrate c5 belt scale.(vendor)
(11) Vacuum belly pan over tracks.
(12) Install stub pulley (granger).
(13) D G 4 linear actuator, replace.
(14) C5 replace 5 troughing rollers by scale (see D Gregoire).
(15) Replace c 4 motor/align.

Pocket belt:

(01) Inspect all conveyor rollers, replace as needed.
(02) Inspect sheaves replace belts.
(03) Conveyor belt inspection.
(04) Change position 2 rolls based on analysis.
(05) Inspect splice.
(06) Inspect chute at transition to pb1.
(07) Install stub roller (Granger).

Pocket belt clean out conveyor:

(01) Visual drag chain inspection.
(02) Inspect channel iron wood scraper.

C3 wood tripper

(01) Change oil tripper gear box.
(02) Inspect drive sprockets/chain.
(03) Install cable reel.
(04) Program unit switches to avoid beams.
(05) Sr0800222, Replace deflector plate wood tripper.

Reclaimer:

(01) Inspect secondary chain.
(02) Replace primary chain.
(03) Change oil Primary/secondary gear boxes.
(04) Service primary chain motor.
(05) Service secondary chain motor.
(06) Inspect cable, lubricate.(Hooksett)

Hogs:

(01) Inspect belts/sheaves.
(02) Inspect wear liners/bits.

(03) Change hydraulic pump filters.

Scalping screen:

(01) Inspect belts/sheaves.
(02) assemblies (3men/3 days).Tighten screen disc
(03) Fuel sizing change? (Pete L)

Magnetic separator C1 and C5:

(01) Inspect drive belts/sheaves.
(02) Inspect conveyor belts/rollers.
(03) Sr0800126, adjust magnet down.

Emergency hopper:

(01) Inspect belt/sheave.
(02) Replace screw
(03) Install clean out doors, wood building side.

Wood Silos:

(01) Service "A" and "B" dust collector fan motors.
(02) Empty/inspect "A" and "B" silos.
(03) Grease diverter gate bearings.
(04) Clean out dust collectors, reset cleaning cycle.

Wood silo discharger "A" and "B":

(01) Change oil gear boxes "A" and "B".
(02) Assist (Elec. Dept) in removing/installing "A" and "B" motor.
(03) Service "A" and "B" motor.
(04) Replace belts/inspect sheaves.
(05) Replace claws

Wood screw:

(01) Change oil gear boxes.
(02) Assist (Elec. Dept) in removing /installing "A" and "B" gear motor.
(03) Service "A" and "B" gear motor.
(04) Inspect "A" and "B" screw.
(05) Sr0800032, wood isolation valves "B" and "D", inspect/repair lubricators (waiting for parts).
(06) Sr0800099, hole in "A" pant leg below elevation 60.

Pneumatic Distribution blower:

(01) Service fan motor.
(02) Inspect fan wheel.
(03) Grease bearings/damper linkage. (Greasing completed)

Pneumatic fuel spreaders (Detroit stokers):

(01) Grease all bearings (1-4).
(02) Change oil gear reducers (1-4).
(03) Trim back blow back dampers.

**Misc. items completed:**

WO # SR0800257; Repaired oil leak on east side of 5A-BFP.
WO# SR0800205; Changed oil and filter on 5A & B – BFP's.
WO# SR0800235; Replaced cooling water hose on Bedash Drain Screw.
Replaced all hopper room knife valve "knives" (8 total).
Replaced #1 hopper room rotary feeder.

**Start-up checks completed:**

1)Re-torqued main steam drum, DA & DA heater door gaskets.
2)Check/tighten packings on Sootblowing root valve, blocking valve and 5B-BFP re-circ valve.
3)Check for oil leaks on running BFP.
4)Monitor wood feed system when equipment started.

# PSNH

# FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2008-06 (MK2-02)

**Station/Unit:** Merrimack/ Unit No. 2

**Dates:** March 2 – March 7, 2008

**Duration:** 4.45 days

**Immediate Cause:**
The unit was taken offline due to excessive water caused by a secondary superheater tube leak.

**Discussion / Remedy:**
A boiler inspection was performed. The primary tube leak was found on pendant 5 counting from the north on the leading edge tube out of the SSH inlet header. The failure was a full tube failure which suggests that there was not a lot of corrosion or erosion to the tube, the more typical tube failure mechanism. The circumferential break, according to the original equipment manufacturer and our boiler consultant, B&W, is usually stress related. There was also a significant amount of collateral damage caused by the failed tube whipping around and striking other tubes within the pendant section. The failed tube also shook the pendant section with enough force that many of the alignment castings that hold the tubes in place broke causing severe misalignment throughout the pendant section.

To insure the safety of the workers, prior to entering the lower furnace or superheater areas, ash clinkers (ash build-up) overhead of the work areas had to be removed. Once the ash was removed, a 4' barricade wall was secured to the screen tubes. This barricade protects the workers below from having any material or tools falling or being dropped. This physical barrier allows the two work zones to be worked on in parallel otherwise each job would have to be completed in series and thus lengthen the duration of the outage.

When the barricade was complete, the erection of two 2-man suspended scaffolds, and boiler tube scaffolding on 4 elevations began. When the staging and scaffolds were in place, removal of the failed tube began and a closer inspection of the area was completed. During this inspection it was determined that the U bends on the SSH inlet pendant 5, tubes 2, 3 & 4 (west to east) were bent so badly that they would have to be removed in order to get the pendant section back into alignment. Back-to-back channel iron brackets were then used on the upper and lower sections of the pendant to pull all the tubes within the pendant section back into alignment so new U bends could be installed on tubes 1, 2,

3 & 4. Pad welding was performed on tubes 5, 6, & 7 on steam cuts that were caused by the failed tube.

While the scaffolding and tube removal was taking place a separate crew was set up to make the 8 bends that constitute the bottom U bends. The tubes were then brought up to the area and were first fit up and tacked into place before the final field welds (15) were done. When the welding was complete Baker Testing was brought in to perform black light examinations. The welds all passed the weld examination.

Once the weld inspections were complete the suspended scaffolds were brought down to the boiler floor to be dismantled and brought out through the cyclone doors. The 4 elevations of staging were removed and brought out through the boiler doors. The remaining boiler doors and cyclone door were then closed and the boiler was turned over to operations for start-up.

Other boiler leaks that were repaired during the overhaul were as follows:

- 2 Leaks were repaired on the south wall one was 18" from the west wall 2" up from the floor and another one 15" from the west wall 1" up from the boiler floor.
- 2 C-Cyclone had 2 leaks that were repaired, one on the slag tap, and one on the neck at the 8 o'clock position (looking west) 24 inches in from the radial burner.
- 2 leaks were repaired on the boiler north wall just under IK 1 where the Tempering duct attachment ties into the boiler wall.

**Remedy**: Periodic replacement of high wear areas of the boiler are performed as part of our long term routine maintenance plans. During the upcoming 2008 planned overhaul, the secondary superheater inlet pendant section of the boiler and the boiler floor section are scheduled for replacement.

**Additional work completed during the outage.**

**<u>Maintenance Department:</u>**

- Opened and closed all boiler and cyclone doors.
- Installed brackets to support sample water line.
- Replaced manual knife gate valve for the SCR Economizer ash blower.
- Cleaned the Hot Reheat steam sample line.
- Repaired 3" elbow on the piping for LCV – 108.
- Weld repaired the fan coil steam line piping.
- Inspected and cleaned both ends of the slag tank warm-up line.
- Repaired and re-located LCV-42 slag tank level control valve.
- Replaced secondary fan coil drip return trap and piping.
- Removed and replaced blank flange for freeze protection on the slag sluice line.
- Inspected and repacked the SCR xv-530 ammonia block valve.
- Replaced the mechanical seal on the slag sluice pump.
- Cleaned slag tank neck troughs.

- Replaced the 100# service air supply valve to "G" cyclone.
- Weld repaired 2-B Forced Draft Fan outlet duct.
- Replaced 2-A Forced Draft Fan cooling water return root valve.
- Rebuilt boiler drain valves #3, 4, 5, 6, 15, 44, 50 and 56.
- Inspected the 210 main steam drain valve, found to be O.K.

**Electrical Department:**

- Disconnected and reconnected the slag tank sluice pump motor.
- Repaired AVC 1 control cabinet handle/switch on the door of the supplemental precipitator.
- Replaced TR 5 bushing "A" with a different style connector on the supplemental precipitator.

**Instrument Department:**

- Inspected and cleaned LCV- 130 lower Magnetrol.
- Inspected and reattached TC on north windbox duct.

**North American Industrial Services:**

- Vacuumed gas recirc. duct.
- Vacuumed tempering duct.
- Vacuumed D-O1 duct.
- Vacuumed D-O2 duct.

**Boiler Work:**

- Performed a complete boiler inspection.
- Cleaned boiler nose, SSH and VRSH pendants of ash, cleaned primary superheater.
- Repaired casing leak in the SW corner of the firebox.
- Repaired water tube leaks in 2-C cyclone, boiler floor, south wall in the firebox, the north wall on elevation 323'. (Details on page one)
- Replaced the carriage on IK-36 sootblower.
- Replaced gearbox, drive pinion and shaft on IR'S 8 and 20.
- Repaired crack in the lower flange on the west side of the economizer expansion joint.

# PSNH

# FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2008-07 (NT1-XX)

**Station/Unit:** Newington/ Unit No 1

**Dates:** March 14 – April 9, 2008

**Duration:** 26.2 days

**Immediate Cause:**
The unit's forced outage occurred when the exciter was subjected to a thermal excursion which resulted in damage to the AC generator rotor windings fiberglass banding. .

**Discussion/Remedy**
On Friday, March 14, 2008, the Unit was being brought on line for testing when the Exciter became overheated. The Exciter was at operating speed, 3,600 RPM, for approximately 2 hours, but had not been electrically energized, when the incident occurred. The Exciter is part of the Turbine/Generator System and provides the DC power to the Generator rotor allowing it to create electricity. The brushless Exciter is rigidly coupled to the generator rotor. The main components of the Exciter are a permanent magnet generator, an ac generator, and a rectifier. During the incident, the two fiber reinforced "glass" bands on the Exciter's ac generator rotor (winding) began to soften which allowed them to expand radially. Several of the fibers contained in the "glass" bands frayed as well. As a result of the "glass" banding relaxing, the copper winding end turns lifted several thousandth of an inch. Inspection of the exciter resulted in the need to remove this unit from service for repairs. Ultimately in order to minimize the outage duration and ensure the continued reliability of the equipment, the damaged Exciter rotor was replaced with a completely refurbished rotor from the original equipment manufacturer (OEM). The outage spanned 26.2 days.

**Cause:** The overheating of the Exciter was caused by a lack of closed cooling water (CCW) to the two coolers mounted inside the Exciter enclosure. A failed three way solenoid valve prevented the Exciter CCW pneumatically operated control valve from opening and allowing CCW to flow thru the coolers. Due to the absence of cooling water to the Exciter, the temperature inside the Exciter increased as a result of the heat generated by the Exciter rotor turning within its enclosure. As noted above, the exciter was never electrically energized on the day of the incident.

**Root Cause:** Four high Exciter temperature alarms came into the plant's automatic data handling system (ADH) during the incident. Both Exciter coolers are equipped with two temperature sensors and alarms, one monitors the hot air entering the cooler and one

monitors the cold air leaving the cooler. During the event, all four points came into alarms over a period of 35 minutes. The first two alarms came in about 2 ½ minutes apart from one another and indicated high cool air temperatures above 110 F. The second two alarms came in 9 minutes apart from one another and were for high hot air temperature above 170 F. The alarms were displayed on a computer screen dedicated to displaying plant alarms. The screen is one of five on the CO's desk. The CO stated during the investigation that based upon his experience with a normal start-up, when the Unit is at synchronous speed of 3,600 RPM for five minutes or less, that he believed everything was fine with the Unit while the turbine was being held at this speed for an extended period of time. Consequently, he assumed that the alarms that were coming in were not serious. He, therefore, did not look at the alarms or assess the equipment condition as critically as he should have. During the incident, the temperature inside the Exciter enclosure increased to over 280 F. The overheating was discovered by other plant operating personnel who were investigating a burning smell in the turbine hall. The smell appears to have been the result of oil inside the enclosure getting hot and volatizing creating a detectable odor and vapor.

**Contributing Cause(s):** (1) The three-way solenoid valve that permits CCW to flow thru the two Exciter coolers failed. Inspection of the solenoid valve, following the incident, revealed that the seat of the valve was broken. The solenoid valve was included in the original design of Exciter CCW control system to reduce the thermal stress on the Exciter during the cycling of the plant. The three-way solenoid valve is energized whenever the Unit is on turning gear which stops cooling water flow. The controller was designed to maintain the temperature of the air inside the Exciter enclosure at 99F. The CCW control valve is a fail open valve upon loss of air to the positioner.

(2) During the second start-up of the Unit, following the Annual Inspection (AI) was extended for approximately two hours, as additional tuning of the Turbine Distributed Control System (DCS) which had been upgraded during the AI, was performed. The turbine speed was varying by plus/minus 15 RPM at the Unit's synchronous speed of 3,600 rpm during this time which is not desirable and needed to resolved. Historically, the variation in speed, at this point in the start-up, was one or two RPM. The need for tuning of the DCS was fully expected and had been built into the start-up schedule. The Generation Staff Control's Group and a technician from the DCS's OEM were on site and in the process of making changes at the time of the incident. In addition to having a fully qualified CO present, we had a second fully qualified CO and a CO Trainee, in the Control Room to provide them training on the upgraded system at the time of the incident. Despite the presence of additional personnel in the Control Room, the CO on duty stated that he knew he was responsible for running the Unit and that he, personally, should have reviewed the alarms more closely. He also stated that although at the time he was concerned about learning the updated DCS, that he did not feel overwhelmed by the situation.

**Background:** The Unit had begun a two week AI, on Saturday, March 1st. One of the main projects to be completed during the AI was the upgrading of the existing ABB (formerly ETSI Bailey Infi 90) DCS, that had been installed in 1992. ABB had earlier

informed PSNH that they would no longer be supporting the hardware we had installed. ABB had offered PSNH an upgrade option, where all of the power supplies modules and circuit board cards would be replaced with new ones of a current design. As a result of upgrading, ABB also stated that they would continue to provide their full range of technical and field support for the DCS. PSNH elected to make the upgrade at this time as a cost effective alternative to replacing the entire system.

In addition to the many activities completed during the AI, the Exciter diode wheel fuses were inspected and tested, as they are each year. To facilitate testing, the Exciter enclosure was removed which made the "glass" bands on the rotor readily visible. No problems were noted or detected. The last complete inspection of the Exciter was performed in 2005 when it was found to be in good condition.

All of the plant work including the initial off-line tuning of the control system was complete by Wednesday, March 12th. In order to ensure the Unit's reliability and availability, we had planned on several days of testing following the completion of the physical work. On Wednesday, March 12th the Unit went into start-up mode. On Thursday, March 13th, the Unit phased on line and ramped to full load before being cycled off-line Thursday night for economics.

The following day, Friday, March 14th, the Unit was in the process of being brought back on line, as planned, when the incident occurred. The problem with the varying turbine speed at the synchronous speed of 3,600 RPM was noted on the initial start-up and plans were made before shutting the Unit off on Thursday to perform additional turbine control tuning during the start-up that had been planned for Friday. In addition to tuning the DCS, the original plan included verifying the programming changes made within the Burner Management System (BMS). A representative from BMS manufacturer was on site to support the start-up of Unit, as well. As Newington is a dual fuel Unit, capable of burning oil and/or natural gas, testing on both fuels was required. Testing on oil only was planned for the first day and a combination of oil and gas for the second day.

A review of the history of alarms in the ADH from the first Exciter Cooler Temperature "high" to the last "high" temperature alarm reveals that 91 alarms came in during this 35 minute period. Of these alarms, a significant portion was from a limited number of alarm points. Specifically, 66 of the alarms were associated with three points coming into alarm and then dropping out of alarm repeatedly.

Each time an alarm set point is outside its normal operating parameters, an alarm comes into the ADH, in red, green, yellow, or purple. The color of the alarm is determined by the system that is involved and is not associated with the alarms priority. The alarm will have one of these colors as the back ground w/ black letter until it is acknowledge by the CO. The color of the background and the letter reverse after the alarm is acknowledged by the CO. Each alarm is displayed on a separate line on the computer screen located on the CO's desk.

When the alarm point returns to normal operating conditions a new entry comes into the ADH. All cleared alarms come in with black lettering with a green background until acknowledged by the CO. The original alarm and notice that it had cleared remain on the alarm display until the cleared alarm is acknowledged. Up to 23 alarms are displayed in chronological order at one time. Once the alarm screen is full, a new alarm comes in on the top line of the screen and the alarm that was on the bottom of the screen is moved to the second page of the alarms which is off the screen. By paging down, repeatedly if necessary, the CO is able to view the entire list of alarms that have yet to be cleared or be acknowledged.

The CO has the option of acknowledging alarms individually or a screen or page at a time. Acknowledging alarms requires 2 or 3 mouse clicks and takes less than 5 seconds to accomplish. An alarm remain on the summary and accessible to the CO until the it clears and has been acknowledged. A history of the alarms is stored in the ADH.

The number of alarms received during two hours that the Unit was at 3600 RPM was higher than a normal due to the extended duration of time the Unit was held at this speed but this number is not viewed as an excessive number for a CO to manage. A summary of the alarms and the information displayed during the 35 minutes the period involved in descending order of number of occurrences follows.

- Aux Steam System, point 255, thirty three entries
- Start-up Boiler Feed Recirc Valve's, twenty three entries
- Condensate Pump Discharge, point 1404, ten entries
- Boiler Drum Level, point 153, four entries
- Economizer Inlet O2, point 1417, three entries
- Feedwater Suction Pressure, point 193, two entries
- Hydrogen Coolers Cold Gas Temperature, point 386, two entries
- Hydrogen Coolers Cold Gas Temperature, point 387, two entries
- Air Compressor 1A Low Oil Pressure, point 881, two entries
- Air Compressor 1A Low Oil Pressure, point 883, two entries
- CEM Watchdog, point 483, two entries
- Opacity 6 minute Average, point 492, one entry
- Delphi Steam Drum, point 1711, one entry
- Exciter Cooler Cold Gas Temperature, point 384, one entry
- Exciter Cooler Cold Gas Temperature, point 383, one entry
- Exciter Cooler Hot Gas Temperature, point 382, one entry
- Exciter Cooler Hot Gas Temperature, point 381, one entry

**Repair of Equipment Discussion:** Due to the construction of the end turns, it was not possible to simply replace the "glass" bands and guarantee the Exciter's continued operational reliability. The OEM has been unable to develop a reliable means of either testing or inspecting the end turns once the "glass" bands have been replaced on rotors that have already been in service. Consequently, the OEM recommended we either replace the winding and "glass" bands on the Newington Exciter rotor, a process estimated to require 18 to 22 weeks, or to participate in their exciter rotor exchange

program and reduce the time to return the Unit back to service to approximately 4 weeks. Due to the length of time required to rebuild an exciter rotor, the OEM had established an exchange program where they completely recondition spare exciter rotors and keep them in stock ready for immediate sale. A reconditioned spares includes new winding and "glass" bands. PSNH elected to participate in the exchange program to minimize the outage duration and to guarantee the Exciter rotor's continued availability and reliability.

**Action to Prevent a Re-occurrence:**

1. Replace the failed solenoid valve on the Exciter CCW system. Completed March 17, 2008.
2. As a precautionary measure, replace the identical solenoid valve on the Generator Hydrogen Cooler system that also receives its signal from the turning gear. Completed March 17, 2008.
3. Review with all CO the longstanding expectation that alarms will be continuously monitored and that the Unit be operated in accordance with procedures and training. Assigned: Denis Drapeau , completed by April 30, 2008.
4. Complete a comprehensive review of the ADH alarm management practices to improve and update the existing system. Assigned: Denis Drapeau , completed by December 1, 2008.

# PSNH

## FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2008-08 (MK1-02)

**Station/Unit:** Merrimack/Unit 1

**Dates:** April 25- April 29, 2008

**Duration:** 3.6 days

**Immediate Cause:**
The unit was removed from service for preventative maintenance after 105.97 days of continuous operation.

**Discussion/Remedy:**
The need for an air heater wash typically occurs every 3 to 4 months. ISO was contacted; and contractors were notified to expedite the length of the outage. The 106-day run is the 10th longest in Unit 1's history after operating since January 10, 2008.

An air heater inspection was completed. The inspection indicated that sections of the circumferential seals (top and bottom) would require replacement. A physical inspection of the cold end baskets before the wash was completed which determined that because of the condition and pluggage of the baskets, it would be more timely and effective to replace or exchange out the plugged cold end baskets and install the clean baskets kept in inventory. Water washing of 1A and 1B air heaters and replacement of the clean cold end baskets would be critical path.

A complete boiler inspection was performed and did not reveal any boiler tube water or steam side leaks. Also, a sizable number of maintenance items that had accumulated in the outage back log list were completed by the maintenance department and vendors as shown below.

**Additional work completed during the outage.**

Mechanical Department:

- Opened "A","B", and "C" cyclone doors.
- Replaced IK -1 soot blower lance and feed tube.
- Repacked IR – 13 sootblower.
- Replaced flange gasket on sootblowers IK-3 and IR-8.
- Replaced G9B# 8 sootblower with a rebuilt unit.
- Inspected the SCR sootblowers; replaced the scavenger valves.

- Inspected the IK sootblowers, adjusted and lubricated the chains.
- Opened door to the cooling water heat exchanger.
- Inspected and greased 1-A and 1-B Forced Draft Fan inlet and outlet dampers.
- Changed the oil in 1-A and 1-B forced draft fan inboard and outboard motor bearings.
- Changed oil in 1-A and 1-B forced draft fans.
- Replaced valve and section of pipe on the 100 lb. compressed air system ($4^{th}$) floor.
- Repacked the $2^{nd}$ point heater normal level drips to the DA tank isolation valve.
- Inspected and cleaned 1-A and 1-B primary fan coils.
- Inspected, added oil and tested the air heater air drives.
- Inspected 1A and 1B air heater motor coupling.
- Removed and replaced the primary air duct expansion joint to 1B cyclone.
- Removed and replaced the continuous blowdown piping from the third floor to the second.
- Cleaned the oil coolers on 1-A boiler feed pump.
- Cleaned the viewing port that is used to see the slag tap.
- Inspected 1-A, 1-B and 1-C coal feeders.
- Inspected, greased crusher, and lubed chain on slag tank.
- Replaced venturi and nozzle on the slag tank discharge piping.
- Repaired seal leakage around 1-A air heater (upper) drive shaft.
- Replaced the gate gaskets on the Elliott river water strainer.
- Inspected 1-A, 1-B and 1-C blast gate, cleared 1-B blast gate of coal.
- Repaired fitting on the boiler drum sample line, top of drum south end.
- Replaced the door gasket on the deaerator tank.
- Adjusted lower gate on "F" SCR hopper.
- Replaced upper piston on "C" SCR hopper.
- Inspected SCR hopper vent valves.
- Lubricated all feeder gate arms in the new precipitator hopper section.
- Replaced valve for the 100 lb. service air at the east end of the heat exchanger.
- Repaired leak in plant steam heat supply line to the LP drip tank.
- Replaced both vacuum breakers on 1-A air preheater steam coil outlet.
- Repaired elbow in the auxillary steam trap piping ($4^{th}$ floor).
- Removed traveling screens to provide access for dredging, then reinstalled.
- Prefabed and installed bracket to stabilize the boiler water sample root valve and piping.
- Inspected limestone additive system to insure availability.

<u>Boiler and Valve Work:</u>

- Performed complete boiler inspection.
- Rebuilt PCV-1A auxilliary steam high pressure control valve.
- Rebuilt boiler chemical discharge valve.

- Adjusted stops on FCV-8 1-A SSH Attemperation drain valve.
- Repacked isolation valve for slag tank agitating nozzles.
- Weld repaired economizer draft connection.
- Weld repaired boiler casing leak on G9B3 support tube.
- Welded casing leak by north economizer ledge blower.
- Welded penthouse casing leak on the north side of the steam drum.
- Replaced the SSH, HRH and CRH expansion joints on the penthouse roof.
- Removed cold end baskets and replaced with spare set in 1-A and 1-B air preheaters.
- Inspected 1-A and 1-B air preheater steam cleaning devices.
- Replaced several top and bottom circumferential seals in 1-A and 1-B air heater.
- Cleaned SCR ammonia injection nozzles.

Electrical Department:

- Inspected original electrostatic precipitator; adjusted plates on "C" field.
- Replaced all collector ring brushes on the exciter.
- Replaced motor, cable and Deion switch on IK-3.
- Cleared ground on 1LA switchgear 480 volt.

Instrument Department:

- Repaired left turbine throttle valve, freed switch plunger and checked indicator.
- Replaced air line above the controller for the 1-A boiler feed pump.
- Repaired the T/C input to TCV-8 which reads 1B air heater inlet temperature.

Chemical Department:

- Brush cleaned south side condenser tubes.
- Brush cleaned north side condenser tubes.
- Brush cleaned the cooling water heat exchanger.
- Pressure tested 1-B Ammonia vaporizer, confirmed no leaks.

North American:

- Vacuumed the SCR inlet and outlet, breech room, economizer by-pass dampers, precipitator and the wet ash sludge basin (located under unit 2 SCR reactor).
- Water washed 1A and 1B air preheaters.

# PSNH

# FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2008-09 (SR4 2-08)

**Station/Unit:** Schiller/ Unit No. 4

**Dates:** May 18 – May 23, 2008

**Duration:** 4.7 days

**Immediate Cause:**
The unit was taken off line with excessive boiler water usage due to tube leaks in the area of the steam cooled spacer tube.

**Discussion/Remedy:**

Upon shutdown, the unit was vented and drained. The forced draft and induced draft fans were left on for cooling. The vacuum contractor was notified and requested to begin cleaning the unit when it was sufficiently cool, safe, and accessible. The boiler, air heater and economizer were all found in a relatively clean state. No water blasting was required.

With the unit turned over to the maintenance crews, the boiler was filled and the inspection started. Two crews were set-up for around the clock repair of the unit. A boiler was located in the area of the steam cooled spacer tube on the south side of the boiler at elevation 83. The boiler was drained to a level to facilitate the leak repair. The north and south walls were opened to access the repair area. From the inspection, it appeared that the refractory around the spacer tube had pulled away from the tube and allowed the gas path flow to erode the tube on either side of the boiler. The repairs on the south side of the boiler consisted of (4) Dutchmen in rows 2 and 3 from the east, in the 1st. and 2nd tubes from the south. There were 8 separate pad weld repairs completed on vertical tubes in row 1, tube 1; row 2, tubes 3&4; and row 3, tube 3. The north side repairs consisted of 7 pad welds in various locations in the 1$^{st}$ tube of each of rows 1, 2, and 3.

For the spacer tube repair, a used spacer tube was utilized to hold everything in place while the leaking tube was cut out and removed. The south end of the spacer tube repair had 2 leaks. Both areas were pad welded as needed. The north end had a worn area that was pad welded as well.

Two existing dutchmen picture welds were found leaking. The first tube needed to be removed to access the leaking tube behind it. New dutchmen were installed in each of

the tubes. A number of smaller leaks were also found in the superheater section of the boiler and were pad weld repaired.

Two waterwall tubes were found to be leaking on the south wall at elevation 38. To locate the leaks the south wall was opened. Pad weld repairs were made to the waterwall tubes. A final boiler hydro confirmed that all the tube repairs were completed. Refractory work was completed and unit was turned over to operations to be returned to service.

**Additional work completed during the outage.**

**Electrical**

1. Oil changed 4B pulverizer
2. Checked and changed out exciter brushes that were needed
3. Installed the last two level probes in the precipitator that we were short the last outage.

**Mechanical**

1. Seal welded threaded nipple on bottom of K-Tek sightglass.
2. Replaced coupling grease seal on AH drive unit. Greased coupling, checked alignment and hold down bolts.
3. Replaced mechanical seal on Kaydon purifier oil pump.
4. Replace soft iron gasket on Air Ejector.
5. Replaced outlet cooling water valve on #2 hydrogen cooler.
6. Replaced coal barrels on #4,5 & 6 burners with rebuilt units.
7. Replaced cooling water flex hose on 4B pulverizor.
8. 4A pulverizor. Removed cooling water sightglass, flushed lines (no restrictions found) and installed a new sightglass.
9. Replaced coupling and realigned air heater lube oil pump.
10. Removed, cleaned and reinstalled left side turbine throttle valve. Pilot valve found to be froze up.

# PSNH

# FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2008-10 (MK1-XX)

**Station/Unit:** Merrimack / Unit No. 1

**Dates:** June 6 – June 9, 2008

**Duration:** 3.1 days

**Immediate Cause:**
The unit was removed from service due to high water usage due to boiler tube leaks in the vertical reheater.

**Discussion / Remedy:**
A boiler inspection was conducted. A boiler inspection identified 4 tubes in 2 pendants that were leaking. The primary tube leaks were found in the vertical reheat section of the boiler in pendant 10, north to south, tubes 7 and 8 west to east and in pendant 11, tubes 7 and 8 west to east. The tube damage appeared to be from flyash erosion. Four dutchmen, each approximately 2 feet long, were installed to complete the tube repairs.

This area of the boiler had been inspected during past overhauls for indications of tube wear. While these past inspections have not indicated any specific wear or aging issues, these boiler tubes have been in service for 12 years. These tubes with an original wall of 0.150" wall thickness are also thinner than the much heavier-walled tubes in other areas of the boiler. Therefore, while there has been no history of failures in this section the plant personnel are aware that as the plant continues to age different inspection scopes and schedules will be necessary. During the fall outage a thorough non-destructive examination will be completed and some tube replacements will be made if necessary. The condition of this area will be monitored to determine if and when a replacement of these tubes should be undertaken.

The boiler inspection indicated no other tube leaks, problems or issues. An air heater inspection indicated that the circumferential seals (top and bottom) were in good condition. The air heater was washed during the boiler repairs to improve efficiency and extend the time necessary before the next cleaning. Critical path was the boiler repairs with a small backlog of outage related jobs being performed by the maintenance department and vendors as shown below.

**Additional work completed during the outage.**

Mechanical Department:

- Opened "A","B", and "C" cyclone doors.
- Replaced IR -1 soot blower scavenger valve.
- Replaced soot blower poppet valves on IR'S – 4, 5, 6 and 7.
- Inspected the SCR sootblowers.
- Inspected the IK sootblowers, adjusted and lubricated the chains.
- Opened door to the cooling water heat exchanger.
- Changed the oil in 1-A and 1-B forced draft fan inboard and outboard motor bearings.
- Changed oil in 1-A and 1-B forced draft fans.
- Inspected and cleaned 1-A and 1-B primary fan coils.
- Inspected, added oil and tested the air heater air drives.
- Inspected 1A and 1B air heater motor couplings.
- Repaired 1-B air heater steam cleaning device.
- Cleaned the viewing port that is used to see the slag tap.
- Inspected 1-A, 1-B and 1-C coal feeders.
- Inspected, greased crusher, and lubed chain on slag tank.
- Replaced venturi and nozzle on the slag tank discharge piping.
- Inspected 1-A, 1-B and 1-C blast gate, cleared 1-B blast gate of coal.
- Inspected gates on flyash hoppers in the old precipitator hopper room.
- Inspected limestone additive system to insure availability.
- Inspected and cleaned 1-A and 1-B boiler feed pumps.
- Repaired seats in "A" and "E" SCR ash hoppers.
- Cleaned turbine lube oil strainers.
- Replaced 1-A cyclone aspirating air port 3 way valve.
- Replaced the LP drip tank sight glass gaskets.
- Repacked sootblowing air supply valve.
- Inspected and adjusted 1-A and 1-B economizer by-pass dampers.
- Inspected slag tank trough for build-up. O.K.
- Repaired section of suction line for the screen wash pump.

Boiler and Valve Work:

- Performed complete boiler inspection.
- Inspected 1-A and 1-B air preheater steam cleaning devices.
- Welded in four 2' Dutchmen in the reheat superheater.(information in opening paragraph)
- Inspected circ seals on 1-A and 1-B air preheaters.
- Water washed baskets in both air preheaters.
- Repaired metal expansion joint on 1-A forced draft fan duct.

- Repaired casing leak on the main steam line penetration on the penthouse roof.

Electrical Department:

- Replaced all worn collector ring brushes on the exciter.
- Test ran IK-8 sootblower. O.K.

Instrument Department:

- Repaired 1A secondary air flow transmitter(FT-101A)
- Corrected and tested switch on FCV-6 1B boiler feed pump recirc control valve.
- Verified calibration of the temperature indicator for 1-B boiler feed pump coupling cooling water.
- Checked operation of the generator condition monitor.
- Repaired linkage and calibrated gauge on the primary inlet pressure gauge for the turbine.
- Tested accuray level detector controller system.
- Replaced and calibrated the gland steam exhauster magnahelic vacuum gauge.
- Tested PCV-17 gland steam seal, valve works O.K.

Chemical Department:

- Brush cleaned south side condenser tubes.
- Brush cleaned north side condenser tubes.
- Brush cleaned the cooling water heat exchanger.

Clean Harbors/North American:

- Vacuumed the SCR inlet, SCR outlet, breech room and economizer by-pass dampers.
- Water washed 1A and 1B air preheaters.

# PSNH

# FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2008-11 (MK2-05)

**Station/Unit:** Merrimack/Unit No. 2

**Dates:** June 20– July 14, 2008

**Duration:** 23.9 days

**Immediate Cause:**
The Unit was removed from service to open and inspect the new HP/IP turbine that was installed during the annual outage.

**Discussion/Remedy:** Unit 2 was removed from service on June 20, 2008 to open and inspect the new HP/IP turbine that was installed during the annual outage. The unit had been in operation for 28.3 days after returning to service from the annual outage on May 22, 2008 and was not producing the expected incremental output.

A variety of external inspections and performance testing had not identified a cause. Siemens, PSNH and others had conducted external inspections and performance tests, seeking to determine the cause of the limited output of the unit, and specifically the limited performance of the new HP/IP turbine. The extensive investigation included design analysis, manufacturing review, and performance tests. As part of this investigation, Siemens reviewed the bladepath design, manufacturing quality control records, and checked for reports of conformance issues during manufacturing and associated resolutions. This effort also included the review of installation quality control records, design information, plant data, and a review of plant chemistry records made available by plant personnel. Despite these multiple efforts Siemens was unable to determine the root cause of the turbine output shortfall. Based on its risk analysis, Siemens recommended that PSNH remove the unit from service to open the HP/IP turbine for internal inspection.

This inspection outage would satisfy multiple objectives: first, safety - to insure that no risk existed for employees or equipment with continued operation of the turbine; second, to help determine the cause for low output; and third, to determine if continued operation would have any adverse effect on the turbine.

The inspection of the turbine found deposits of foreign material under all HP and IP rotating blade shrouds. The deposits were located at the junction of the blade and shroud. There was significant solid particle damage and roughness of the blades observed on

every stage of the HP/IP turbine. The blades also showed various degrees of erosion and curling of the trailing edges. Labyrinth seals were also noted as severely worn.

The hotwell was also inspected and a sample of a similar contaminant was collected. This material consisted of round magnetic balls, similar in size and appearance to poppy seeds. Subsequent laboratory analysis results proved the materials found on the blade shrouds and the hotwell were identical; specifically, similar in size and metallurgy. It was determined that the contaminant was a steel shot material, as is often used for shot-blasting purposes. It was later confirmed that there is no record or knowledge of steel shot blast material ever being used at Merrimack Station. This would indicate that the material was probably contained in the piping or tubes from one of the three major replacement projects during the outage.

With the initial inspection areas completed the scope of necessary inspections broadened and a systematic inspection of the boiler, valves, pumps, heaters and tubes was conducted to locate any additional foreign material and to remove it as necessary. It was essential to know what equipment and systems contained the shot blast. These inspections would identify any other damage that occurred, determine a process for removal of the shot blast material, and help determine a root cause. This effort was also completed to provide additional information to assist in determining the possible source of the foreign material. Varying amounts of material were found in the condenser hotwell, main boiler feed pump, condensate pumps, and deaerator. BORESCOPE inspection of related components, valves, and piping systems was conducted to investigate the possibilities of any foreign material, deposits and erosion. The scope ranged into the LP-1 and LP-2 turbines, condensate and feedwater systems, boiler headers and tubes, and turbine piping.

**Additional Discussion**: A number of vendors and consultants were used in the inspection, cleaning and repair process. Chemistry and metallurgy analysis was provided both on-site and off-site with a number of companies.

All of the turbine deposits were removed, and the turbine blades and rotor were inspected; cleaned and repaired to the extent possible. Samples of the material were collected from the turbine and taken to a local laboratory. The foreign material was present in the HP section, IP section and the first few blade rows of the two LP sections of the turbine. The HP/IP rotating blades and stationary blade path looked to be in poor condition relative to the short period of time which the unit had operated.

**Boiler Inspection:** Upon shutting down, a boiler inspection on 6/21/08 revealed the boiler tube leaks listed below, which were subsequently repaired during the outage. A final pressure test was performed on 7/12/08 to confirm the integrity of the repairs.

Water Side Leaks:

- 1-leak on the north wall, 6" up from the nose, where the nose turns down to make the rear wall.

- 2-leaks on the superheater floor outlet header tubes, where they lead out of the end of the header. The leaks were above the Redler shack with one leak on the north box and one on the south box.
- 1-leak on a furnace roof tube, 1 foot off the front wall, directly in the center of the boiler roof.
- 1-leak in G cyclone behind a flat stud on the short wall.
- 1-leak in C cyclone behind a flat stud on the left side looking in, 6 feet up, 4 feet off the neck.

**Steam Blow Preparations:** Merrimack Station brought in Boyle Energy Services and Technology, Inc. (BES&T) on 6/26/08 to start preliminary discussions on performing a steam blow on Unit 2. If the steam blow was required, it would have become critical path for the unit's return to service. BES&T worked on a proposal over the weekend and had it completed by early the following week. If accepted, they would have then provided necessary engineering to complete a flow model for the blow and determine required temporary piping. Later in the outage, after much analysis, it was deemed by Siemens, B&W, Sheppard T. Powell, and PSNH that a steam blow was not required.

**Inspections, Sampling, and Analysis:** Plant management and engineering personnel completed a unit inspection plan on 6/27/08. Some of the inspections were performed in house, but the majority was performed by the following outside vendors:

- Thielsch Engineering
- Team Industrial Services
- GE Inspection Technologies
- Baker Testing

For professional assistance in chemistry and metallurgy analysis, the following companies provided on-site service:

- Sheppard T. Powell Associates: Dave Cline & Gary Roberts
- Babcock & Wilcox: Ken Hansen

Off-site analysis was provided by:

- Sheppard T. Powell Associates
- NH Material Laboratory
- Alstom Power

A final list of inspections that were performed during this outage as well as the inspection date, the person (s) who performed the inspection, and the inspection notes is included as Attachment A at the end of this report.

All inspected areas which contained any signs of the shot blast material were thoroughly cleaned by vacuuming and / or flushing of the material.

**Apollo Root Cause Analysis Process:**
On July 11, 2008 PSNH and representatives from Siemens, Babcock & Wilcox and Sheppard Powell Associates conducted a five-hour "Apollo" root cause review to determine a root cause of the contamination. The formal "Apollo" process is a structured investigation method selected to:

- Identify the problem.
- Organize the thoughts and actions of the team.
- Communicate the information to other parties.

The Apollo technique focused on the cause and effect of the relationships based upon existing or obtainable evidence and data with each cause indentified as being the result of both a cause and an action. A number of possible causes were ruled out during the session while other causes were identified as requiring additional information or further evaluation. Although the analysis to date showed the contamination to be shot blast material, no definitive conclusions were reached by the Apollo analysis as to the source of the material.

**Merrimack Station Root Cause Analysis:**
In-house personnel reviewed Merrimack Station inspection results, possible sources for the origination of the shot blast material, quality assurance measures that were taken at manufacturing facilities during fabrication of the turbine piping and boiler tubes, quality assurance measures that were taken at Merrimack Station during installation, and reports of samples that were sent out for analysis. The following is a summary of those findings.

Inspection results show that after the unit was shut down, material was contained to the following systems and equipment: HP/IP Turbine, HP/IP turbine extractions and thus associated feedwater heating components, the Main Boiler Feed Pump, LP Turbine, LP turbine extractions and thus associated condensate heating components, Condenser Hotwell, Condensate Pumps, DA Pumps, and Condensate Polisher.

There is no record or knowledge of steel shot blast material ever having been used at Merrimack Station. This would indicate that the material was probably contained in the piping or tubes from one of the three major replacement projects during the outage. These projects were:

- The new HP/IP Steam turbine, whose piping was manufactured by BendTec. The piping they supplied was shot blasted at their facility and a preservative later added to the inside diameter. BendTec supplied Merrimack Station with a sample of their unused shot blast material. Prior to installation, the turbine piping was inspected with a BORESCOPE at Merrimack Station.
- The 23 Secondary Superheater Inlet bank pendants were manufactured by B&W (IMC) in Mexico. Neither the tube IDs or ODs were shot blasted. However, the fabrication facility does use shot blast material in their shop for other purposes. A sample of IMC's unused shot blast material was supplied to Merrimack Station. The tubing supplier was Benteler, who does not blast tubes at all. The Secondary

Superheater Inlet bank tubes were blown out at Merrimack Station prior to installation.

- The 5 Furnace Floor panels were manufactured at B&W's West Point Mississippi facility. These panels were shot blasted externally and a sample of unused shot blast material was supplied to Merrimack Station. The tubing supplier was MST, who does not blast tubes at all. The Furnace Floor panel tubes were blown out at Merrimack Station prior to installation.

Extensive laboratory tests were performed on shot blast deposit samples and manufacturing facility supplied samples. The following is a brief summary of the analyses done and report findings:

Sheppard T. Powell (STP) performed a wide array of tests on samples that were supplied by Merrimack Station in order to determine elemental makeup. The methods of analysis they used included Scanning Electron Microscope (SEM) and Energy Dispersive X-ray Spectroscopy (EDXS). The Spectroscopy was performed on as-supplied samples, chemically cleaned samples, and ground samples. STP also subcontracted Bodycote Testing Group to perform additional tests. Bodycote used an Inductively Coupled Plasma (ICP) analysis using dissolved samples. STP determined that the deposits were a shot blast material. From the multitude of tests, they concluded that the deposit samples re consistent with all three shot blast samples supplied from BendTec and B&W, all of which contained a percent of chrome content.

New Hampshire Materials Laboratory (NHML) was supplied with samples from two areas of the HP Turbine, a sample of the BendTec shot blast material, and samples from the two B&W facilities. Using EDXS, ICP, and analysis of the microstructure, the results showed that the deposit was an abrasive medium and the BendTec and B&W samples were similar in composition and particle size to the deposit. All analyses revealed a degree of chrome content, with the B&W samples having the lowest concentration.

Samples of the deposit material and BendTec samples were also sent to Alstom Power, Materials Technology Center for analysis. Using EDXS, they determined that the samples were similar to each other in elemental makeup, although their results revealed no chrome content. Follow up testing by Alstom, using the ICP method, did show that the BendTec sample had a chrome content of 0.21% as compared to the control sample at 0.19%.

Upon request, specifications for shot blast materials used by B&W were received, and the data approximates the deposit analyses.

**Inspections, Sampling, and Analysis Conclusions:**
Root Cause: The original source of the shot blast material has not been determined but appears to be from a single event that occurred during the May 22-23, 2008 start-up. This is supported by the following facts:

- The turbine never reached its design load. It was not a case of reaching full load and then experiencing a degradation of output over time.
- Some valves malfunctioned during the start-up, which indicates that the material was traveling through the turbine extraction lines and causing problems with the condensate and feedwater heater level control valves.
- Once through the ramp at approximately 130 MW, a data comparison of the actual performance scaling data and the Siemens supplied design curves for the new turbine could be made and it confirmed that the two data groups deviated
- The turbine operated for over 28 days with no further degradation of output.
- Although less than the designed output for the new turbine, Unit 2 maintained a constant output after returning to service from this outage.

**Unit 2 Return to Service:**
Unit 2 was synchronized at 1346 on 7/14/08.

**Additional work completed during the outage:** A list of the additional work completed during the outage is contained in Appendix B.

## ATTACHMENT A

The following is a final list of inspections that were performed during this outage, with results relative to finding any shot blast material:

| Equipment | Inspection Date | Inspection By | Shot Blast Found? | Inspection Notes |
|---|---|---|---|---|
| Hotwell | 6/25/08 | Chris Nedeau | YES | The areas where the debris settled was mapped by D. Fradette and then cleaned. Volume removed was about 3/4 of a 5 gallon pail. |
| Deaerator | 6/26/08 | Chris Nedeau | YES | Small amount found in DA. |
| DA Storage Tank | 6/26/08 | Chris Nedeau | YES | Removed 1 gal can of shot blast from east end DA storage tank. |
| Deaerator | 6/27/08 | Chris Nedeau / GC&M | NO | Pulled all baskets. No sign of impact damage or debris. Inside door broke free and damage 5 baskets |
| Condensate Storage Tank | 7/11/08 | Ben Marshall - O'Connor | NO | A magnet was attached to a rope and dropped into 20 different places on the tank bottom |
| SUBFP Gland Water Receiver | 7/11/08 | Chris Nedeau | NO | Opened tank, cleaned, and magnet tested bottom. |
| Flash Tank | 6/27/08 | Chris Nedeau | NO | Opened and inspected tank. |
| Polishers | 7/2/08 | Chris Nedeau | YES | Dropped magnet into B Polisher - debris stuck to magnet – sent sample out for analysis. |
| LP Heaters (4th) - Extraction / Drain Side | 7/7/08 | GE Inspection Technology | NO | Entered bottom of the vessel and articulated the camera head around. |
| LP Heaters (4th) - Main Condensate Side | 7/7/08 | GE Inspection Technology | NO | From Heater Head: Going up travel a total distance of 23.6 ft. Going down the line we were able to travel a total distance of 17ft |
| LP Heaters (5th) - Extraction / Drain Side | 7/7/08 | GE Inspection Technology | NO | Entered bottom of the vessel and articulated the camera head around. |
| LP Heaters (5th) - Main Condensate Side | 7/7/08 | GE Inspection Technology | NO | From Heater Head: Going up travel a total distance of 22.5 ft. Going down the line we were able to travel a total distance of 20.1 ft. |

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| LP Heaters (6th) - Extraction / Drain Side | 7/7/08 | GE Inspection Technology | NO | Entered bottom of the vessel and articulated the camera head around. |
| LP Heaters (6th) - Main Condensate Side | 7/7/08 | GE Inspection Technology | NO | From Heater Head: Going up travel a total distance of 24 ft. Going down the line we were able to travel a total distance of 13.6 ft. |
| LP Heaters (7th) - Extraction / Drain Side | 7/7/08 | GE Inspection Technology | NO | Entered bottom of the vessel and articulated the camera head around. |
| LP Heaters (7th) - Main Condensate Side | 7/7/08 | GE Inspection Technology | NO | From Heater Head: Going up travel a total distance of 28.8 ft. Going down the line we were able to travel a total distance of 16.5 ft. |
| HP Heaters 1st Extraction / Drain Side | 7/8/08 | GE Inspection Technology | NO | Travel a total distance of about 4 ft, and used the camera's articulating head to look all the way around the bottom. |
| HP Heaters 2nd - Extraction / Drain Side | 7/7/08 | GE Inspection Technology | YES | Able to travel about 8 ft. into the bottom of the vessel. With this camera able to see a total distance of about 12ft. Located small amount shot blast which was flushed out. |
| HP Heaters 2nd - Feedwater Side (Head) | 7/11/08 | GE Inspection Technology | NO | |
| Condensate Drip Tanks (Primary) | 7/6/08 | Team Industrial | NO | |
| Condensate Drip Tanks (Secondary) | 7/6/08 | Team Industrial | NO | |
| HRSH Inlet Header | 6/27/08 | GC&M and Mark Todd | NO | One tube was cut to access header. |
| HRSH Inlet Header | 7/3/08 | Thielsch Engineering | NO | Scoped in through cut tube. |
| HRSH Inlet Header | 7/7/08 | GE Inspection Technology | NO | Able to run the full length of the header. |
| HRSH Inlet Header Material Retrieval and Final Inpspection (3' spool piece cut | 7/11/08 | GE Inspection Technology | NO | Ran camera through header. |

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| from CRH inlet line). | | | | |
| HRSH Outlet Header (East) | 7/3/08 | Thielsch Engineering | NO | Reached in 30' and scoped 2 tubes. |
| HRSH Outlet Header (West) | 7/3/08 | Thielsch Engineering | NO | Reached in 22' and scoped 2 tubes. |
| PSH Inlet Header | 7/3/08 | Thielsch Engineering | NO | |
| SSH Inlet Tubes UT | 7/5/08 | Baker Testing | N/A | Tests performed at different levels across pendants, covering areas of unique thickness. All above MWT |
| SSH Inlet Tubes X-ray | 7/9/08 | Baker Testing | NO | Films reviewed by Ken Hansen of B&W |
| SSH Outlet Header | 7/3/08 | Thielsch Engineering | NO | Reached 21' into header |
| SSH Spare Tubing | 7/10/08 | GE Inspection Technology | NO | Opened and inpsected all spare tubing received per proposal with new SSH Inlet Section |
| SSH Inlet Section Cut Loop | 7/7/08 | Inhouse & Sheppard T Powell | NO | |
| SSH Inlet Section Cut Loop | 7/8/08 | GE Inspection Technology | NO | BORESCOPEd loop before reinstallation |
| SSH Inlet Section BORESCOPE two cuts to new weld in penthouse | 7/8/08 | GE Inspection Technology | NO | Traveled up approximately 34 ft and took still images of the welds. Also, we made live video coming out of the tube just to show the general condition. |
| SSH Intermediate Section Cut Loop | 7/7/08 | Inhouse & Sheppard T Powell | NO | |
| SSH Intermediate Section Cut Loop | 7/8/08 | GE Inspection Technology | NO | BORESCOPEd loop before reinstallation |
| SSH Intermediate Section X-rays | 7/9/08 | Baker Testing | NO | Films reviewed by Ken Hansen of B&W |
| SSH Outlet Section Cut Loop | 7/8/08 | GE Inspection Technology | NO | BORESCOPEd loop before reinstallation |
| SSH Outlet Section X-rays | 7/9/08 | Baker Testing | NO | Films reviewed by Ken Hansen of B&W |
| Vertical Reheater Cut Loop | 7/8/08 | GE Inspection Technology | NO | BORESCOPEd loop before reinstallation |

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| Vertical Reheater X-rays | 7/9/08 | Baker Testing | NO | Films reviewed by Ken Hansen of B&W |
| Cold Reheat Piping - 2nd floor 4" connection to Turbine & Up to and including 3rd floor horizontal | 7/10/08 | GE Inspection Technology | NO | Traveling east: able to travel a total distance of 36ft. |
| Cold Reheat Piping - 5th floor spool piece cut-out down as far as can reach | 7/11/08 | GE Inspection Technology | NO | Able to travel a total distance of 49.5 ft. We dropped down the vertical. |
| North Wall - center of 3 headers (2) furnace supply supply tubes from mixing bottle | 7/10/08 | GE Inspection Technology | NO | Traveled to orifice in both lines and to mixing bottle in opposite direction. |
| Economizer Inlet Header | 7/6/08 | GE Inspection Technology | NO | Able to go the total distance in the header. We also ran into 2 pendants. |
| 2C Cyclone Barrel Inlet Header | 7/9/08 | GE Inspection Technology | NO | Able to travel west all the way to the end of the header, 6-7'. |
| Gland Steam Condenser | 7/8/08 | GE Inspection Technology | NO | Able to go into drain valve and get visual on tubes that run through. Not able to gain entry to shell because tubes were too close to the bottom. |
| Main Boiler Feed Pump | 6/30/08 | Chris Nedeau | YES | Disassembled inboard end of MBFP- found shot blast. |
| MBFP Post-reinstallation FME Assurance | 7/10/08 | GE Inspection Technology | NO | Final inspection of pump connections after pump reinstallation for foreign material check. |
| Start-Up Boiler Feed Pump | 7/2/08 | Chris Nedeau | NO | |
| Condensate Pumps | 7/1/08 | Chris Nedeau | YES | Small amount of shot blast in suction wells, more found up near expansion joints. |
| DA Pumps | 6/30/08 | Chris Nedeau | YES | Shot blast seen via BORESCOPE. |
| 2A DA Pump | 7/6/08 | GE Inspection Technology | YES | GE scoped into pump. Ray Macwhinnie had 10 gals water flushed through pump, strained and collected. |

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| 2B DA Pump | 7/6/08 | GE Inspection Technology | YES | GE scoped into pump. Ray Macwhinnie had 10 gals water flushed through pump, strained and collected. |
| HP/IP Turbine | 6/24/08 | Siemens, Gruwell, Brendle | YES | All blades of all rotating rows on HP & IP had deposits on blade ends where they join the shroud. None found on stationary |
| LP-1 Turbine | 6/30/08 | Siemens, Gruwell, Brendle | YES | Some build-up on first three stationary & rotating blades and some erosion and thinning. |
| LP-2 Turbine | 7/1/08 | Siemens, Gruwell, Brendle | YES | Some build-up on first four stationary & rotating blades and some erosion and thinning. |
| HP East -side Throttle Valve | 7/7/08 | Siemens, Gruwell, Brendle | NO | Wear on the back side of the pilot valve (see pictures) |
| HP West -side Throttle Valve | 7/7/08 | Siemens, Gruwell, Brendle | NO | |
| HP/IP Turbine Piping - IP 3rd Point Extraction | 7/1/08 | Thielsch Engineering | NO | |
| HP/IP Turbine Piping - E Bottom IP Inlet | 7/1/08 | Thielsch Engineering | NO | |
| HP/IP Turbine Piping - W Bottom IP Inlet | 7/1/08 | Thielsch Engineering | NO | |
| HP/IP Turbine Piping - E Bottom HP Inlet - After TVs | 7/1/08 | Thielsch Engineering | NO | |
| HP/IP Turbine Piping - W Bottom HP Inlet - After TVs | 7/1/08 | Thielsch Engineering | NO | |
| HP/IP Turbine Piping - HP Exhaust (CRH) | 7/1/08 | Thielsch Engineering | NO | |
| HP East -side Throttle Valve - Into HP Inlet Pipe | 7/2/08 | Thielsch Engineering | NO | |
| HP West -side Throttle Valve - Into HP Inlet Pipe | 7/2/08 | Thielsch Engineering | NO | |

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| LP-1 Turbine - HP End W Extraction | 7/1/08 | Thielsch Engineering | NO | |
| LP-1 Turbine - HP End E Extraction | 7/1/08 | Thielsch Engineering | NO | |
| LP-1 Turbine - Middle Extraction | 7/2/08 | Thielsch Engineering | NO | |
| LP-1 Turbine - Gen End W Extraction | 7/2/08 | Thielsch Engineering | NO | |
| LP-1 Turbine - Gen End E Extraction | 7/2/08 | Thielsch Engineering | NO | |
| LP-2 Turbine - HP End W Extraction | 7/2/08 | Thielsch Engineering | NO | |
| LP-2 Turbine - HP End E Extraction | 7/2/08 | Thielsch Engineering | NO | |
| LP-2 Turbine - Middle Extraction | 7/2/08 | Thielsch Engineering | NO | |
| LP-2 Turbine - Gen End W Extraction | 7/2/08 | Thielsch Engineering | NO | |
| LP-2 Turbine - Gen End E Extraction | 7/2/08 | Thielsch Engineering | NO | |
| System Valves & Piping | | | | |
| DA Normal Level CV LCV-1 | 7/4/08 | Team Industrial | NO | 0-2' from valve upstream - at elbow 0-5' from valve downstream - at elbow. |
| DA Start-up Level CV LCV-1-1 | 7/4/08 | Team Industrial | NO | Scoped upstream of valve. |
| Flash Tank Level CV LCV-41 | 7/4/08 | Team Industrial | NO | 0.5' / 2' / 10' from valve. |
| Flash Tank Level CV LCV-41-1 | 7/4/08 | Team Industrial | NO | 1.5' / 7' / 8.5' from out side of stop valve to elbow. |
| Flash Tank Auxillary Level CV LCV-41-2 | 7/4/08 | Team Industrial | NO | 0' / 1.5' / 8' / 12' / 13' / 18.5' from valve. |
| Flash Tank Auxillary Level CV LCV-41-2 | 7/8/08 | GE Inspection Technology | NO | Traveled a total distance of 15 ft north to the larger line that ran into it. Traveling south total distance of 2 ft. |
| 1st Point Heater Normal Level CV LCV-106 | 7/4/08 | Team Industrial | NO | 1.5' / 5' from valve. |

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| 1st Point Heater Normal Level CV LCV-106 | 7/9/08 | GE Inspection Technology | NO | South total distance of 5'. North total distance of 12.5' through two 90s and two 45s up into horizontal. Ran magnet in about 5'. |
| 1st Point Heater Emergency Drain CV LCV-106A | 7/5/08 | Team Industrial | NO | 8.5' from valve. |
| 2nd Point Heater Normal Level CV LCV-107 | 7/6/08 | Team Industrial | NO | Able to scope 2'. |
| 2nd Point Heater Normal Level CV LCV-107 | 7/9/08 | GE Inspection Technology | NO | Traveling down the line we were able to go a total distance of 60ft. |
| 4th Point Heater Normal Level CV LCV-108 | 7/5/08 | Team Industrial | NO | 0' / 1' from valve. |
| 4th Point Heater Normal Level CV LCV-108 | 7/8/08 | GE Inspection Technology | NO | South total distance of 18ft. North able to go a total distance of 20ft. |
| 5th Point Heater Normal Level CV LCV-109 | 7/4/08 | Team Industrial | NO | Scoped up to 2nd valve. |
| 6th Point Heater Normal Level CV LCV-110 | 7/4/08 | Team Industrial | NO | 1' upstream valve. |
| 7th Point Heater Normal Level CV LCV-111 | 7/5/08 | GE Inspection Technology | NO | Traveling east total distance of 18': Traveling west distance of 10'. |
| 2nd Point Heater Drain Dump CV LCV-112 | 7/5/08 | GE Inspection Technology | NO | Traveling east total distance of 18': Traveling west distance of 8'. |
| 4th Point Heater Drain Dump CV LCV-113 | 7/5/08 | GE Inspection Technology | NO | Traveling east total distance 21': Traveling west total distance 23': |
| 5th Point Heater Drain Dump CV LCV-114 | 7/5/08 | GE Inspection Technology | NO | Traveling east total distance of 17': Traveling west total distance 20': |
| 6th Point Heater Drain Dump CV LCV-115 | 7/5/08 | GE Inspection Technology | NO | Traveling east total distance of 25': Traveling west total distance of 22'. |
| 7th Point Heater Drain Dump CV LCV-116 | 7/5/08 | GE Inspection Technology | NO | Traveling east total distance of 18': Traveling west total distance of 23': |

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| Superheat Attemperator Spray CV TCV-3A | 7/7/08 | GE Inspection Technology | NO | Only able to travel one direction. Traveling northeast we were able to go about 17 ft. |
| Superheat Attemperator Spray CV TCV-3B | 7/7/08 | GE Inspection Technology | NO | Only able to travel one direction. Traveling northeast we were able to go about 17 ft. |
| Primary Fan Coil CV TCV-56 | 7/5/08 | Team Industrial | NO | 6' Upstream valve. |
| Primary Fan Coil CV TCV-57 | 7/5/08 | Team Industrial | NO | 2.5' toward tee. |
| Secondary Fan Coil CV TCV-58 | 7/6/08 | Team Industrial | NO | 0.5' / 1' at valve - very limited access. |
| Secondary Fan Coil CV TCV-59 | 7/5/08 | Team Industrial | NO | Access to only 6'. |
| 1st Point Bleeder Check Valve NRV-1 | 7/5/08 | Team Industrial | NO | 0' / 10' upstream valve. |
| 1st Point Bleeder Check Valve NRV-1 | 7/9/08 | GE Inspection Technology | NO | Traveling east we were able to go a total distance of 23ft. Traveling west we were able to go a total distance of 33ft. |
| 2nd Point Bleeder Check Valve NRV-2 | 7/5/08 | Team Industrial | NO | |
| 2nd Point Bleeder Check Valve NRV-2 | 7/9/08 | GE Inspection Technology | NO | West total distance of 41ftEast total distance of 60 ft. |
| 3rd Point Bleeder Check Valve NRV-3A | 7/5/08 | Team Industrial | NO | 11' past check valve. |
| 3rd Point Bleeder Check Valve NRV-3A | 7/9/08 | GE Inspection Technology | NO | Traveling west we were able to go a total distance of 39ft. Traveling east we were able to go a total distance of 16ft. |
| 3rd Point Bleeder Check Valve NRV-3B | 7/9/08 | GE Inspection Technology | NO | Traveling west we were able to go a total distance of 28ft. Traveling east we were able to go a total distance of 62.5 ft. |
| MBFP Recirc Valve FCV-5 | 7/6/08 | Team Industrial | NO | 6' at valve - limited access. |

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| SUBFP Recirc Valve FCV-6 | 7/5/08 | Team Industrial | NO | |
| Reheat Attemperator CV FCV-12 | 7/5/08 | Team Industrial | NO | 5' in from valve. |
| Reheat Attemperator CV FCV-12A | 7/8/08 | GE Inspection Technology | NO | Able to travel a total distance of 6.5 ft. |
| Reheat Attemperator Block Valve FCV-23 | 7/8/08 | GE Inspection Technology | NO | Able to travel a total distance of 14 ft. |
| DA Water Pegging CV PCV-29 | 7/5/08 | GE Inspection Technology | NO | Traveling west total distance of 5.2' Traveling east able to go 4 feet. |
| DA Water Pegging CV PCV-29 | 7/7/08 | GE Inspection Technology | NO | Able to travel a total distance of 10 ft to the "T". |
| DA Water Pegging CV PCV-29-1 | 7/5/08 | GE Inspection Technology | NO | Traveling west distance of 3.5 feet. |
| DA Water Pegging CV PCV-29-1 | 7/7/08 | GE Inspection Technology | NO | Able to travel a total distance of 30ft in to the horizontal run of the line. |
| Cold Reheat to Aux Steam CV PCV-37 | 7/9/08 | GE Inspection Technology | NO | West to a "T" and looked south to a closed valve. North of "T" to a closed valve. |
| DES-3 Desuperheater CV | 7/5/08 | GE Inspection Technology | NO | Traveling east total distance of 25'. Traveling west whole distance to the next valve. |
| DES-2 Desuperheater CV | 7/5/08 | Team Industrial | NO | |
| DES-2 Desuperheater CV | 7/8/08 | GE Inspection Technology | NO | Traveling left of valve total distance of 52.4'. Traveling to right total distance of 9.4' to next valve. |
| HP SH Stop Valve BW-200A | 7/4/08 | GE Inspection Technology | NO | Through valve & up: Distance of 52.5 feet. Down line: Able to get in to the header. |
| HP SH Stop Valve BW-200B | 7/4/08 | GE Inspection Technology | NO | Through valve & up: Distance of 60.2 feet. Down line: Able to get in to the header. |
| FCV-1A SSH Bypass Stop Valve BW-201A | 7/4/08 | GE Inspection Technology | NO | Total distance: 31'. Inlet line that runs into valve: 35.4'. |

| | | | | |
|---|---|---|---|---|
| FCV-1B SSH Bypass Stop Valve BW-201B | 7/4/08 | GE Inspection Technology | NO | Total distance: 29.5'. Inlet line that runs into valve: 36'. |
| PCV-7A PSH Bypass Valve BW-202A | 7/4/08 | GE Inspection Technology | NO | Total distance 19.6'. |
| PCV-7B PSH Bypass Valve BW-202B | 7/4/08 | GE Inspection Technology | NO | Total distance: 21'. Traveling down the inlet total of 9.5 feet. |
| LPSH Non Return Valve BW-205 | 7/4/08 | GE Inspection Technology | NO | West into boiler total 43'. East travel 33.2'. |
| TCV-6 SSH Bypass Valve BW-207 | 7/4/08 | GE Inspection Technology | NO | Total Distance: 22.6' on a straight run. |
| Resistor bypass MOV stop valve BW-203 | 7/4/08 | GE Inspection Technology | NO | Going down line total travel 28.5': Traveling up line total distance of 15.8. |
| Main Steam Drain Valve BW-210 | 7/5/08 | Team Industrial | NO | 18' down stream of valve. |
| Main Steam Drain Valve BW-210 | 7/7/08 | GE Inspection Technology | NO | Traveling toward condenser total distance of 22'. Toward MS line travel 20ft. |
| Main Steam Drain Valve BW-210 | 7/7/08 | Millenium Valve | NO | Inspection of ball and seat from 210 valve. |
| Economizer Check Valve | 7/6/08 | GE Inspection Technology | NO | Traveling down line total of 113.9'. Traveling horizontally, total distance of 3'. |
| HP Heater Bypass Valve (3-way) V-1M | 7/8/08 | GE Inspection Technology | NO | Traveling left up incline total distance of 17.8'. Traveling right total distance of 25.3'. Reached valves. Traveling down total distance of 39.3' towards end. |
| MBFP Suction Valve V-639GZ | 7/9/08 | GE Inspection Technology | NO | Right: Total distance of 25 ft up vertical line. Traveling down the line total distance of 32.7 ft. Ran magnet down about 25ft Left total distance of 20.4 ft until we hit an orifice. |
| SUBFP Suction Valve V-638Z | 7/9/08 | GE Inspection Technology | YES | A minor amount of the shot blast was noted on the upper horizontal of the valve when removed – having settled there |

| | | | | |
|---|---|---|---|---|
| | | | | from the DA Tank after the pump was shut down. |
| MBFP Discharge Valve | 7/6/08 | GE Inspection Technology | NO | Total travel: 50.8'. |
| MBFP Gland Water Pressure Control Valves DPCV 19&20 | 7/10/08 | GE Inspection Technology | NO | BORESCOPEd and insert magnet into both valves and lines. |
| SUBFP Discharge Valve | 7/4/08 | Team Industrial | NO | Able to scope 25' horizontal and 18' vertical |
| SUBFP Discharge Valve | 7/5/08 | GE Inspection Technology | NO | Traveling down: 60'. Traveling up: 55.8'. |

## ATTACHMENT B

**Additional work completed during the outage:**

Turbine Work:

- See Siemens report for full scope of work performed (MERRIMACK UNIT 2 HP/IP INSPECTION REPORT –dated July 30, 2008 and MERRIMACK UNIT 2: INSPECTION OF LP STEAM TURBINES – dated August 4, 2008). Brief summary as follows:
- Opened HP/IP turbine
- Removed HP/IP turbine rotor
- Cleaned sintered debris from HP and IP turbine blades
- Trimmed damaged (curled) trailing edges from HP and IP turbine blades
- Opened and inspected HP Throttle Valves and removed start-up strainers
- Repaired turbine seals as needed
- Opened LP-1 and LP-2 turbines
- Removed LP-1 and LP-2 rotors
- Cleaned blading on LP-1 and LP-2 turbines
- Inspected shaft bearings
- Reinstalled HP/IP, LP-1, and LP-2 rotors
- Closed HP/IP, LP-1, and LP-2 turbines

Mechanical Department:

- Millennium Valve was contracted to open and reinstall the valves listed in the inspection scope above
- Opened and closed all 7 cyclone doors
- Cleaned 2A & 2B Condensate Pump strainers
- Removed / Reinstalled 2A & 2B Condensate Pumps (2B with re-built pump)
- Replaced leaking flange gasket on LCV-106
- Repaired leaking pressure gauge fitting on ammonia system PCV-530
- Opened and inspected MBFP hydraulic coupling
- Replaced MBFP rotating assembly
- Repaired pin-hole leak on CRH pot drain line
- Replaced section of pipe from 6$^{th}$ point heater to condenser
- Replaced valve on Slag Tank Water Pump gland water supply
- Checked for leaks in 4$^{th}$ point heater
- Checked for leaks in 7$^{th}$ point heater
- Inspected and cleaned the Hotwell
- Made repairs to the Secondary Fan Coil ductwork
- Disassembled, cleaned, reassembled Flash Tank safety valve #2
- Replaced Slag Tank Fill Pump with rebuilt spare

- Checked alignment on 2A Cooling Water Pump
- Repaired leak on top of Gland Steam Condenser shell
- Replaced SCR ash hopper center dump valve
- Replaced Turbine oil transfer filter
- Replaced piping on Supplemental ESP flyash line near wall on 2nd floor
- Replaced and realigned 2B FD Fan inboard motor bearing
- Replaced and realigned 2A FD Fan inboard fan bearing
- Repaired leak in line from discharge side of firemain isolation valve to south cooling water heat exchanger
- Disassembled, inspected, repaired balance drum on SUBFP
- Disassembled, cleaned, and machined plug on HRH Steam lead right side drain valve
- Repacked BW-203 resistor system bypass valve
- Repacked FCV-12A RH Attemperator Spray vavle
- Repacked LPSH non-return valve 205
- Replaced gasket on leaking bonnet flange of PCV-37
- Inspected leak-by on BW-210 MS Drain Valve
- Installed new seat and stem assembly on Economizer vent valve (roof vent #4)
- Replaced isolation valve to 2nd Point Extraction drain trap
- Replaced 2A and 2B shot hopper knife gate valve
- Checked into oil leak from clutch / reduction gear on 2A GRF
- Replaced inboard shaft seals on 2A GRF
- Checked 2B Circ Water Pump impeller balance due to elevated vibration

Instrumentation Department:

- Checked West Throttle Valve Thermocouple (ADH 2278) for accuracy
- Checked pressure switches for MBFP Coupling Lube Oil Low Alarm
- Reinstalled thermocouple in north tempering bustle
- Replaced #3 West Rosemount Excess O2 analyzer probe
- Rewired feedback from FCV-1A (201A) valve
- Installed new LVDT on 200 B valve
- Tested and repaired leaky fittings on Secondary, Primary, and Tertiary Air sensing lines
- Installed new switch for 241 Valve dP permissives
- Re-wired TE-7A for PSH Inlet Steam temperature

Electrical Department:

- Repaired door on south side of ESP
- Tested and adjusted TCV-3B block valve
- Disconnected / Rewired 2A & 2B Condensate Pump motor leads for pump removal
- Disconnected / Rewired 2B Circ Water Pump motor leads for pump removal

- Removed Main Transformer cooling fan motors and replaced bearings as needed
- Re-wired, adjusted and tested BW-301-1 and BW-301-2 SSH Attemperator Drain Valves
- Stroked and adjusted position limit on V586M DA LCV Bypass Valve
- Extended line on ESP roof drain

Soot blowing Department:

- Installed test connection on soot blowing permissive switches for calibration needs
- Replaced IR-14
- Replaced scavenger valve on IK-30
- Checked and changed out SCR Sootblower packings
- Disassembled, cleaned and lubricated motor operator for sootblowing isolation valve
- Replaced nozzles on IR-4, IR-6, and IR-14

Chemical Department:

- Opened and inspected 2B Polishing Demineralizer. Performed resin transfer and regeneration
- Removed pluggage from HRH Steam Sample line (not shot blast material – normal preventive maintenance)

Boiler Work:

- Performed a complete boiler inspection
- Repaired boiler leaks as detailed above
- Performed air tests and repairs on the hot and cold sides of the air heater
- Replaced three Slag Tank view port windows
- Repaired leak on primary air duct on 2A Cyclone
- Repaired leak on boiler casing south of 2G Cyclone
- Repaired port on northwest corner of 7$^{th}$ floor
- Repaired cracks in expansion joints on recirc duct on 4$^{th}$ floor
- Inspected cracked door on south side of Supplemental ESP – deemed okay until future outage
- Replaced gasket on leaking door on cold-side of Air Heater
- Replaced gasket on manway door on 6 1/3 south
- Repaired casing leaks along wall east of 2B Horizontal Redler

# PSNH

# FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2008-12 (MK1-04)

**Station/Unit:** Merrimack/ Unit No. 1

**Dates:** August 20 – August 23, 2008

**Duration:** 2.1 days

**Immediate Cause:**
The unit was removed from service to repair a screen tube leak in the furnace. The unit had been operating for 72 days.

**Discussion/Remedy:**
A boiler inspection noted that a large ash clinker hanging from the SSH inlet tubes had fallen from the upper furnace area. The inspection found that a large clinker that had been hanging from the SSH inlet tubes fell down on the 4th upper screen tube (screen tube #62) tearing the clip and tube that connect the screen tube to the rear wall. The clip is intended to fail to prevent large catastrophic failures in such a circumstance. In this case most of the clip failed, but when it failed it also made a small crack that propagated in to the tube itself and caused the leak.

There was a large amount of ash build-up on the SSH Inlet tubes and screen tubes in the firebox. This all had to be cleared before any work could be performed. This screen tube was weld repaired. A portion of the screen tubes are scheduled for replacement during the upcoming overhaul as well as other maintenance initiatives to lessen the risk of forced outages associated with this area of the boiler.

A leak was also found in "C" cyclone near the secondary air damper on the 8th knee bend (west to east). The boiler inspection found no other tube leaks.

The unit's planned overhaul was scheduled to begin on September 9 (less than 3 weeks away). Therefore, when the air heater inspection indicated that it could run for another two to three weeks, no air heater wash was completed. Critical path for the outage would be the boiler repairs.

**Additional work completed during the outage.**

Mechanical Department:

- Opened "A" cyclone door.
- Lubed and inspected IK sootblower chains.
- Replaced the glass in the view port by IR -11.
- Replaced the slag service water pump.
- Opened door to the cooling water heat exchanger.
- Inspected screen wash pump, checked drains and inspected screenhouse.
- Changed oil, oil slinger ring and scraped bearing on 1-A forced draft fan inboard bearing.
- Repaired the local position indicator for the north SCR by-pass(1-A)
- Lubricated all flyash hopper gates in the new hopper room.
- Cleaned the viewing port that is used to see the slag tap.
- Inspected 1-A, 1-B and 1-C coal feeders.
- Inspected 1-A cooling water pump.
- Repaired piping to L.P. drip tank.

Boiler and Valve Work:

- Performed complete boiler inspection.
- Inspected 1-A and 1-B air preheater steam cleaning devices.
- Weld repaired lower furnace screen tube and cyclone water tube leak. (Information in opening paragraph)
- Inspected circ seals on 1-A and 1-B air preheaters.
- Rebuilt the reheat attemperator control bypass valve (TRCV-5 by-pass)
- Rebuilt PCV-1A Aux. steam high pressure control valve.
- Rebuilt TRCV-5 reheat attemperator control valve.

Electrical Department:

- Replaced sixteen collector ring brushes on the exciter.
- Calibrated, installed and tested 1-B high temperature trip switch.
- Investigated and repaired A-1 field in the electrostatic precipitator.
- Transmission Rep inspected oil circuit breakers BT-12, D-121 and Q-171; checked out O.K.

Instrument Department:

- Replaced vibration probe on 1-A forced draft fan inboard bearing.
- Inspected and verified operation of flyash level detection system.
- Repaired drum switch on 1-A FDF outlet damper drive.
- Checked operation of DA storage tank level controller LC-1.

- Checked vibration probe on turbine bearing 1X; will inspect further during the September overhaul.
- Performed troubleshooting exercise on LCV-8, 2nd point heater normal level controller.

Chemical Department:

- Brush cleaned south side condenser tubes.
- Brush cleaned north side condenser tubes.
- Brush cleaned the cooling water heat exchanger.

# PSNH

# FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2008-13 (MK2-06)

**Station/Unit:** Merrimack Station/Unit 2

**Dates:** September 19 – September 23, 2008

**Duration:** 4.2 days

**Immediate Cause:**
The unit was removed from service due to high water usage due to tube leaks in the horizontal reheat section of the boiler.

**Discussion/Remedy:**
A boiler inspection was completed and a number of boiler tube leaks were found.

The primary leak was in the 1st element, north to south, of the horizontal reheater at elevation 287'. This tube developed a leak and cut through two adjacent wall tubes. This northeast corner of the backpass area of the boiler is difficult to access so staging was erected, lagging and insulation removed, and membrane and wall tubes removed in order to make the necessary repairs. The difficulty in accessing this area and then the set-up, preparation and weld time required more time to complete the boiler tube repairs. The leak was in the 2nd bend of the element. A dutchman was installed to repair the leak. Pad weld repairs were also made on tubes three and four. The two damaged wall tubes leaks were repaired with dutchmen.

There were two leaks on the north wall (elev. 330') adjacent to the bottom of the superheat floor tubes that required the installation of dutchmen. The wall tube failure caused erosion and damage on nine tubes on the superheater floor that needed to be pad weld repaired. Several means of access were needed for the repair. A one man sky climber was brought in through one of the cyclones and set up in the firebox. A cable for the sky climber needed to be installed. This area requires the removal of insulation and lagging from below the superheater floor tubes. A one man crawl space is the only access to make the repair on the bottom side of the tubes. After completion of the repairs, the access door was welded back in place along with reinstallation of the insulation and lagging.

Other boiler leaks were identified during the inspection and repaired as described below.

- Two leaks in "A" cyclone, south side on the barrel, 18" from the neck, 4" from the elbows by the secondary air dampers, and the other leak on the neck (radial burner end), at the 3 o'clock position looking out of the cyclone.
- One leak in "C" cyclone on the neck (radial burner end).
- One leak in "G" cyclone, 1st neck tube (radial burner end) (9 o'clock).
- Pad Welded wall tube in the crawl space, 4th floor west side, in the crawl space below the recirculation duct floor.

The remaining boiler doors and cyclone doors were then closed and the boiler was turned over to operations for start-up.

**Additional work completed during the outage.**

The following is a list of other work that was performed during the outage. It includes jobs that were in the priority backlog and jobs that were found during the inspection of the boiler at the beginning of the outage.

**Maintenance Department:**

- Opened and closed boiler and cyclone doors.
- Checked belts on supplemental precipitator purge blower.
- Inspected and cleaned hydraulic coupling oil pump 2-A.
- Inspected and lubricated 2-A and 2-B cooling water pumps.
- Greased 2-A and 2-B Deaerator pump motor.
- Cleaned slag tank neck troughs.
- Replaced valve that feeds 2-A slag swiper.
- Replaced 2-C pinch valve on the limestone additive system.
- Replaced two failed compressed air valves located by the polishers.
- Welded patch over holes in 2D coal feeder downcomer pipe.
- Repacked the slag tank northwest slope nozzle control valve.
- Replaced drain valve on the 1st point high pressure heater; on the manifold below the level column.
- Repaired slag tank overflow loop seal piping and warm-up line.
- Replaced slag sluice piping on the outlet side of the venturi.
- Repaired slag line where it penetrates 3' above the 1st floor.
- Inspected, greased and checked belt tension on slag tank fresh air blower.
- Performed inspection, and checked oil levels on the cyclone stress- trolls.
- Inspected and changed the oil in 2-B outboard gas recirc fan bearing.
- Changed the oil in the inboard and outboard bearings on 2-B gas recirc fan motor.
- Cleaned 2-A gas recirc fan wheel.
- Cleaned the valve stems on the A and B superheater 200 valves.
- Repaired oil line on 2B ignitor assembly.
- Replaced rotating hub on IK-3 sootblower.
- Replaced boiler viewport glass by IR-25.
- Replaced the 2nd point heater level control valve (LCV-107).

- Cleaned 2-A and 2-B condensate strainers.
- Inspected and serviced screen house sump pump.
- Inspected and stroked LCV-41-2 (241-2) flash tank auxiliary level.
- Disassembled and inspected the west primary fan coil steam TCV valve.
- Rebuilt #1 drain valve on the line for the 2nd point heater drips to DA LCV-107.
- Repaired slag tank north fill nozzle control nozzle.
- Rebuilt economizer vent valve (8th floor, roof line).
- Rebuilt south outlet valve on 2-A secondary fan coil.
- Disassembled and cleaned the shell side drain valve on the 4th point heater.
- Repaired LCV-1 DA normal level manual valve.
- Rebuilt LCV-108 control valve.
- Rebuilt cold reheat drain control valve.
- Repacked main boiler feed pump discharge valve.
- Repacked LCV-106 1st point heater normal level control valve.
- Replaced shaft on manual handle for deareator block valve limitorque.
- Rebuilt LCV-112, 2nd point heater drain dump valve.
- Disassembled and cleaned PCV-300 B SCR steam sootblowing control valve.
- Inspected entire redler system.
- Inspected firemate blowers, feeders and piping.
- Performed inspection on all IK'S and IR'S, lubed chains.
- Changed oil in 2-B horizontal redler gearbox.
- Changed oil in 1-B horizontal redler gearbox.
- Changed oil in 2-A incline redler gearbox.
- Changed oil in 1-A incline redler gearbox
- Cleaned air line on IR -14 sootblower and tested
- Replaced lance and feed tubes on IK sootblowers 1, 2, 3, and 5.
- Cleaned 2-A polisher strainer.
- Inspected and lubed SCR sootblowers.
- Replaced flexitallic gasket on SB-19(sootblower).

**Electrical Department:**

- Repaired high voltage wire in original precipitator, refastened four ground wires.
- Inspected brushes on temporary exciter.
- Repaired high pressure heater bypass valve.
- Repaired and adjusted the DA level control block valve.
- Adjusted and tested the left side upper turbine intercept valves.
- Investigated possible ground on the control bus section of the AC/DC board, tested O.K.
- Tested relay associated with the annunciator alarm for the MBFP coupling lube oil pressure.

**Instrument Department:**

- Tested the vibration monitoring recording equipment for turbine.
- Checked scale range on ADH point 2011. O.K.
- Performed linearity test on the "mighty modules" CEM Monitoring System.
- Ammonia leak detectors checked for operation.
- Confirmed that the ADH computer point #'s 2841, 3101and 2818 are valid.
- Checked PCV-130 turbine gland steam start-up supply valve.
- Repaired the south seal oil pressure gauge on MK-2'S turbine deck.
- Replaced battery in 2-B Gravimetric coal feeder.
- Added vibration probe 3Y to turbine supervisory.
- Filled oil levels in 200's, 201's, 202's, and 207 valves.
- Stroked primary and secondary cyclone dampers.

**Chemical Department:**

- Brush cleaned both east and west sides of the condenser.
- Brush cleaned north and south heat exchangers.
- Greased all swivel joints on the ammonia unloading skid.
- Pressure checked FCV-531-B Ammonia Injection control valve.
- Checked and adjusted chlorine injection pump on the circulating water system.
- Visually Inspected A, B, and C ammonia tanks.

**North American Industrial Services:**

- Vacuumed gas recirculation duct.
- Vacuumed tempering duct.
- Vacuumed D-O1 duct, and the economizer hoppers.
- Vacuumed D-O2 duct.
- Vacuumed old hopper room.

**Boiler Work:**

- Performed a complete boiler inspection.
- Repaired boiler tube leaks as described above.
- Inspected SCR ammonia probes.
- Welded casing leak on the SCR roof.
- Welded patch on 2-A cyclone flyash injection tube.
- Repaired patch on penthouse pagoda seal.

# FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2008-14 (MK1-06)

**Station/Unit:** Merrimack Station/Unit 1

**Dates:** October 31 – November 2, 2008

**Duration:** 2.1 days

**Immediate Cause:**
The unit tripped off line when the 1HB switchgear - P-12 breaker over-current relay operated when the main fire pump motor was started. (2.88 hrs)
Extended Cause # 1: Boiler Tube Leak, start 17:29 (October 31, 2008) end 07:14 (November 02, 2008) (38.73 hrs)
Extended Cause # 2: 1A Condensate Pump Seal leak, start 07:14 (November 02, 2008) end 17:32 (November 02, 2008) (10.28 hrs)

**Discussion/Remedy:**
Unit 1 tripped off line 2 days just completing its 2008 Major Overhaul. The reason for the trip was that the new 1HB switchgear, P-12 breaker overcurrent relay operated during the start of the main fire pump motor, tripping the P-12 breaker which feeds the Unit 1 Circulating Water Pump motors.

The electricians were troubleshooting the problem and called the vendor that installed the new 1HA & 1HB 5KV switchgear. After inspecting the switchgear, the vendor found that the P-12 Breaker overcurrent relay setting for the screen house feed was set too low. The vendor had used the wrong CT ratio setting. The vendor made the necessary correction to P-12 relay settings and re-verified the settings were correct with the rest of 1HA &1HB.

Prior to the unit coming off line, it was apparent that a boiler leak existed. Not wanting to return the unit to service with a leak which would only put the unit at risk for a forced outage, the decision was made to repair the boiler tube leak. The outage was extended to repair (2) boiler wall tube leaks in the two wall tubes directly above IK-3 sootblower, 14" up from the center of the lance tube opening. The initial leak occurred in an old original weld that was made to install the lance tube port. The Unit 1 boiler wall tubes are a tangent design which caused the second tube to leak from erosion caused by the original leak where the two tubes meet each other. The leaks were repaired by removing the two tubes that were leaking and installing two new Dutchman 36" long. A black light exam was performed on the (4) Dutchman welds plus on the remaining tube welds on the tubes that make up the port for the sootblower.

The outage was further extended during start-up to repair the 1-A condensate pump mechanical seal. This is a two piece seal that failed during start-up and was replaced during this time.

**Additional work completed during the outage.**

Mechanical Department:

- Opened "A, B, C" cyclone door.
- Inspected Turbine Lead Diaphragms.
- Changed O-ring on 1B Forced draft fan inboard bearing shaft oil seal.
- Replaced 1-A Condensate pump mechanical seal.
- Changed oil in 1B FD Fan inboard and outboard fan bearings.
- Repaired leak at 1A fan coil steam controller

Boiler and Valve Work:

- Opened Boiler doors
- Performed complete boiler inspection.
- Repaired north wall leak above IK 3.
- VRSH and PSH look good no signs of leaks.
- Inspected all the fabric expansion joints, look good.
- Inspected circ seals on 1-A and 1-B air preheaters.
- Inspected AH Steam Cleaning devices
- Repaired #5 Flyash Hopper casing leak

Electrical Department:

- Worked with Eaton Corp verifying switchgear loads.

Instrument Department:

- Inspected and verified operation 1A, 1B, and 1C Secondary air dampers.
- Repaired PI-529 Ammonia Vapor Header pressure indicator gauge.

# FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2008-15 (MK2-09)

**Station/Unit:** Merrimack Station/Unit 2

**Dates:** November 3 – November 7, 2008

**Duration:** 3.6 days

**Immediate Cause:**
The unit was removed from service due to high boiler water usage due to a tube leak in the horizontal reheat superheat section (HRSH)of the boiler.

**Discussion/Remedy:**
A boiler inspection was performed. The primary tube leak was found in the HRSH section of the boiler in the 1st element against the south wall at elevation 330'. This leak cut into an economizer riser tube which supports the HRSH tubes. The primary tube leak in the HRSH tube also caused loss of material on three wall tubes.

The primary leak in the HRSH tube occurred over time as a result of the HRSH tube and the economizer riser tube as a result of the two tubes wearing against each other. These two tubes were weld repaired and then repositioned to avoid any future mechanical damage. All of the damaged tubes were repaired by pad welding bringing the wall thickness back to original.

The station personnel are aware that as the boiler and equipment continues to age new inspection schedules and scopes will be identified. This was the first leak in this physically restricting area which has limited access and visual vantage points to perform inspections as these tubes are in horizontal elements and extremely close to each other. During future annual overhauls, inspections of this area will be broadened to determine if a tube replacement plan is appropriate. The current tubes are over 20 years old.

Other boiler leaks that were completed by pad welding included:

- 2-A Cyclone had one leak at the 10 o'clock position on the barrel tube and 1 leak on the neck tube at the 9 o'clock position looking out of cyclone.
- 2B Cyclone had a leak on the leading edge tube at the 6 o'clock position looking into cyclone.
- 2C Cyclone had a leak on the barrel tube at the 10 o'clock position looking into cyclone.
- 2F Cyclone had 5 leaks all on the secondary air arch under the overlay.
- 2G Cyclone had a leak on the re-entry throat on the boiler side looking east at the 3 o'clock position.

- The firebox had a leak on the wall in the southwest corner.
- The front wall wind box attachment to the front wall headers had a crack in a wall tube and was repaired.

The remaining boiler doors and cyclone doors were then closed and the boiler was turned over to operations for start-up.

During start-up, operations noticed water entering the screen house through electrical conduits. The electrical conduits run parallel with the main circulating water and recirculation lines. Several inspection plans were developed and implemented to determine the source of the leak. Through the troubleshooting process we determined the leak was somewhere in the recirculation line. The system start-up was modified such that we could keep the line under vacuum to start and operate the unit. Further inspections were planned to pinpoint the source of the leak.

**Additional work completed during the outage.**

**<u>Maintenance Department:</u>**

- Opened and closed boiler and cyclone doors.
- Installed new flexitallic gasket in the turbine gland steam piping.
- Replaced nipple and drain valve on the main condenser (west inlet).
- Checked flange connections on SUBFP suction valve.
- Replaced slag sluice pump mechanical seal.
- Replaced flexitallic gasket in the SUBFP recirc piping.
- Replaced cooling water discharge valve on 2A DA pump.
- Replaced lance tube on IK-34 sootblower.
- Replaced bonnet gasket on FCV-12A reheat attemperator manual valve.
- Rebuilt steam sootblowing supply 300 A/B manual cross-connect valve.
- Adjusted packing on PCV-127 primary fan coil drip return control valve.
- Rebuilt PCV-300 B steam sootblowing control valve.
- Replaced glass lenses on the slag tank view ports.
- Weld repaired the secondary fan coil drip return trap.
- Installed 2A condensate pump motor cover.
- Differential pressure reported high on 2A condensate pump strainer, inspected and cleaned. 2B O.K...
- Repaired worn area in 2E coal feeder downcomer transition piece.
- Tightened flanges on the coupling oil cooler heat exchanger.
- Replaced sections of slag sluice line.
- Rebuilt slag sluice gate piston.
- Repacked the manual isolation valve for the HP/IP inner casing drain.
- Replaced flash tank atmospheric vent valve and piping.
- Inspected 2B flyash reinjection blower.
- Repaired leak in piping going to the 2A deaerator main lube oil pump.
- Inspected firemate system; cleaned nozzles.

- Inspected all IK, IR and SCR sootblowers.
- Replaced 2A polisher strainer.
- Replaced oil in 2B gas recirc fan outboard bearing.

**Electrical Department:**

- Cleaned, lubed and tested the 480 volt supply breaker for 2LC to the turbine deck.
- Rebuilt light fixture on top of the original precipitator.
- Repaired light fixture on elev. 315', north side, above IK 5.
- Installed 200A 480volt service for the trona trailer.

**Instrument Department:**

- Replaced vibration probes and cables for 2A and 2B inboard forced draft fans.
- Seated and stroked PCV-530 ammonia injection control valve.
- Inspected, cleaned and calibrated #1 west rosemount excess oxygen analyzer.
- Replaced and calibrated ammonia sensor in the compressor building.
- Replaced vent plugs on all feedwater flow transmitters.
- Calibrated and checked for proper operation of pressure switch on 2-A and 2-B DA Auxiliary lube oil pump motor.

**Chemical Department:**

- Brush cleaned both east and west sides of the condenser.
- Brush cleaned north and south heat exchangers.
- Visually Inspected A, B, and C anhydrous ammonia tanks.

**North American Industrial Services:**

- Vacuumed gas recirculation duct.
- Vacuumed tempering duct.
- Vacuumed D-O1 duct, and the economizer hoppers.

**Boiler Work:**

- Performed a complete boiler inspection.
- Repaired boiler tube leaks as described above.
- Inspected SCR ammonia probes.
- Welded casing leak on the SCR roof.

# FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2008-16 (MK1-07)

**Station/Unit:** Merrimack Station/Unit 1

**Dates:** November 25 – November 29, 2008

**Duration:** 4.0 days

**Immediate Cause:**
The unit was removed from service to repair a screen tube leak near the furnace floor.

**Discussion/Remedy:**
A boiler inspection was performed. The primary leak was found in the 36th screen tube from north to south. The leak was located near where the screen tube meets the floor and was below the cut point for the screen tube replacement that had occurred during the recent overhaul. There is refractory in this area and the pin stud was beneath the refractory so it was not visible during the overhaul inspection. The leak was caused by an old pin stud attachment spot weld. This location was in the center of the fire box (east or rear wall side) and was spraying water over the slag tap causing slag clinkers to form in the slag tank.

Twenty-five screen tubes supplied by Babcock & Wilcox were installed during the Unit 1 annual outage. O'Connor Construction performed all labor for the screen tube installation under the maintenance contract with them. The numbers of the screen tubes replaced were #25 through #48 and #62 on Babcock & Wilcox drawing #11144. It is suggested that tubes #49 through #61 and #63 through #72 be replaced in 2010. It is also suggested that tubes #1 through #24 be evaluated in 2010 and if needed be replaced in 2012. The screen tube installation, refractory and studding were completed on schedule. No leaks were detected on the new screen tubes during leak check.

A thorough boiler inspection of the rest of the water and steam side indicated no other problems or issues.

An inspection of the air heater did not reveal significant fouling of the baskets, but due to the increased differential pressure since the previous start-up, it made sense to perform a water wash while the boiler repairs were being performed. After the wash, an inspection of the upper and lower air heater seals (circumferential and radial) was performed. It was determined that Alstom will need to modify the design slightly to prevent rubbing which resulted in premature wear. The seals were replaced and adjusted under the direction of an Alstom representative. The representative was brought in to verify proper installation.

Critical path would be the boiler repairs with a backlog being performed by the maintenance department and vendors.

Also planned for the next outage, was the replacement of 1-B boiler feed pump discharge valve. 1-A boiler feed pump discharge valve is scheduled for replacement during the 2010 overhaul. Prior to shutting down, the pressure seal ring in 1-B discharge valve began to leak. Team Inc made an attempt to seal the leaking pressure seal ring while on line but was not successful. This original valve is a 10" heavy wall valve which is motor operated. The replacement involved setting up staging, removing the motor operator, rigging, cutting out the valve, prepping the weld joints, fitting the new valve in place, welding, x-raying the weld joints and stress relieving them. Once that process was complete, reassembly followed and the valve was then tested to validate with the Unit 1 control operator the position of the valve. Start-up immediately followed.

**Additional work completed during the outage.**

Mechanical Department:

- Opened "A","B", and "C" cyclone doors.
- Replaced copper gasket on IK-1 soot blower.
- Re-timed limit switch drive train on G9B-0-north soot blower.
- Inspected the SCR sootblowers.
- Inspected the IK sootblowers, adjusted and lubricated the chains.
- Repaired doors for drum shack for freeze protection.
- Inspected, added oil and tested the air heater air drives.
- Replaced solenoid valves on "A" and "I" precipitator hoppers.
- Repaired piping leak on 1-A boiler feed pump lube oil motor.
- Disassembled, repaired oil leak on 1-B forced draft fan bearing, reassembled and changed oil.
- Rebuilt slag sluice gate piston.
- Repaired 1-A cyclone aspirating air port.
- Replaced 1-B boiler feed pump discharge valve.
- Replaced TV-592 temperature control valve and by-pass valve.
- Repaired cracked motor mount on 1-A air heater drive gearbox.
- Verified positions of 1-A, 1-B and 1-C secondary air damper drives to match the internal position in the cyclones.
- Replaced sight glass on 1-B boiler feed pump lube oil system.
- Checked operation of DA-level control by-pass valve.
- Replaced 3rd point extraction freeblow valve.
- Rebuilt two solenoids and cleaned the bags on the flyash tank.
- Lubricated all precipitator hopper gates.
- Replaced drive gearbox on 1-B air heater.
- Replaced sump pump in 1-A fan room.
- Inspected all coal feeders and changed light bulbs.
- Replaced filters on 1-A sootblowing seal air blower (north).

- Inspected limestone additive system.
- Replaced 1-B condensate pump and mechanical seal.

Boiler and Valve Work:

- Performed complete boiler inspection.
- Weld repaired screen tube leak in the lower furnace.
- Inspected 1-A and 1-B air preheater steam cleaning devices.
- Inspected and replaced circ seals and outer most radial seals on 1-A and 1-B air preheaters.
- Water washed both air preheaters.
- Repaired casing leak 5' below the economizer expansion joint, (SW corner).
- Repaired casing leak on the south side of the precipitator inlet duct.
- Weld repaired mounting bracket for 1-B secondary air damper drive.

Electrical Department:

- Replaced all worn collector ring brushes on the exciter.

Instrument Department:

- Checked operation of LCV-13, 6$^{th}$ point heater emergency dump drain valve.
- Replaced pressure gauge on MOV-591 SCR sootblowing system.
- Checked the primary inlet gauge on the MK-1 turbine gauge board.
- Calibrated the temperature gauge on the #4 bearing on the turbine.
- Calibrated the air heater 02 probe (SW 02).
- Repaired 1-B boiler feed pump oil pressure gauge line.
- Repaired feedback arm on steam sootblowing control valve PCV 41-1-1.
- Replaced vibration pick ups (transducers) on 1-B forced draft fan.
- Modified all rosemount analyzer 02 probes.

Chemical Department:

- Brush cleaned south side condenser tubes.
- Brush cleaned north side condenser tubes.
- Checked operation of heat tracing at waste treatment plant.
- Performed chlorine analysis on the circulating system.

North American:

- Vacuumed the SCR inlet, SCR outlet, breech room and economizer by-pass dampers.
- Water washed 1A and 1B air preheaters.

# FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2008-17 (SR5-08)

**Station/Unit:** Schiller Station/Unit 5

**Dates:** December 7 – December 12, 2008

**Duration:** 4.7 days

**Immediate Cause:**
The unit was taken off-line due to problems controlling the boiler bed temperature which leads to fluidization problems and bed material agglomeration.

**Discussion/Remedy:** The decision was made to take the unit offline at this point to limit bed agglomeration. The unit was operating at a reduced load, as a result of leakage in the tubular air-heater causing high ID fan amps. This low load condition was a contributing factor impacting control of bed temperatures, and was also causing high cyclone temperatures and increased NOx emissions.

Boilermakers and vacuum contractors were notified of the outage and requested to mobilize. Night and day shifts were established. The fans were left running to expedite cooling the unit down for an inspection. The boiler doors were opened and an initial observation of the bed found it to have begun to agglomerate that is the low furnace temperatures had caused the bed sand to agglomerate or form into lumps. The fans were secured when the furnace was cool enough for work to begin. The unit was isolated and tagged out for maintenance activities.

The agglomerated bed sand was broken up and vacuumed out of the furnace. Number 2 and number 5 cyclone covers were removed for inspection purposes. No blockage or build up was found in the cyclones. The boilermakers reinstalled the covers and the instrument department reinstalled the associated probes. The SNCR, Schiller 5's NOx control system, valve positioner's were inspected and replaced. Corrosion Monitoring Services, Inc. inspected the airheater and plugged seven (7) failed tubes. Tube samples were taken from 11 tubes in the Tubular air heater section and were sent out for analytical testing to Sheppard T Powell. Air heater tube replacement was planned and completed during the 2009 April planned overhaul.

A hydro was completed and confirmed the boiler was ready for start up with no tube leaks. The bed twereye's were inspected; and the fan run to be sure the area was clear of material. The furnace bed was re-filled with clean sand directly from the delivery trailer trucks and spread out. The boiler doors closed and unit turned over to operations for service.

During start up activities, the FD fan motor drive end bearing overheated. This event extended the outage beyond the three-day projected turn around. Inspection of the motor bearings revealed that the inboard bearing's slinger ring had come apart. Without that slinger ring intact, the bearing was not getting sufficient amounts of oil to support proper lubrication and the bearing overheated and was damaged. The slinger ring, seals and bearing were replaced. The bearing housing was reassembled and the bearing refilled with oil. The fan motor was test run, checked for alignment and turned over to operations and the start up activities commenced. No additional issues were encountered with the fan and the unit was brought online at 11:10 on December 12, 2008.

**Additional work completed during the outage.**

**Mechanical**

1. FD-Fan, -Changed oil both bearings. Flushed inboard housing as oil was dirty when drained. -Disassembled coupling, checked for electrical center on motor(it was on center), re-coupled, greased as needed.
2. Dirty water lift pump #2 high amps, - pump discharge check valve had a piece of rubber and a bottle cap restricting operation. The check valve on pump #1 was stuck open and repaired.
3. Sootblower # 21A, Lance was bent. Replaced with new.
4. Replace leaking coupling on blow-down tank drain line.
5. Bedash drain screw, replaced rotating water joint with new.
6. Bedash drain screw hopper, installed vent line into top of hopper. Vents back to boiler to keep dust down.
7. FD Fan, See item #1, changed oil.
8. DA storage tank, repaired leaking pipe nipple at top of sightglass.
9. Backpass rotary feeder, replaced transition tee.
10. Reclaimer, replaced oil seal on traveling motor gearbox.
11. "B" wood gate valve, installed new lubricator. "D" had already been changed.
12. SNCR, replaced waterside relief valve.
13. 10th. stage FW heater, replace valve on level indicator.
14. Ash unloader, replaced water line valve.
15. Bedash drain screw cooler, replaced water side relief valve.
16. Sootblowing system, padwelded hole in warm-up discharge line.

**I&C**

1. Removed 2 T/C's from each of #2 and #5 cyclones. These T/C's were inspected and the ceramic coating of each was worn off. Some of these were Thermowells and some were protective sleeves. These 4 T/C's were put back in after cyclones were buttoned up.
2. The erosion of these T/C's is an ongoing problem, and we will see what other materials we can use to stop the erosion.
3. Calibrated the O2 probe. We found no problems with this.

4. Calibrated the Bed Differential Transmitter. No problem found.
5. Blew back Bed Differential and Twerye Differential lines. No blockage found.
6. Removed FDF RTD's for mechanics, replaced them after work was performed.
7. Replaced all SNCR skid valves' positioners. Replaced positioners were of poor quality.
8. Changed out SNCR Zone 2 Urea flow control valve. Old valve was leaking through the packing and the spare valve installed. Leaking valve has been repaired and will be placed in stock as spare.
9. A new Differential draft was installed across the silencer. Drafts are located alongside ductwork and have valves on the end for testing.
10. Various transmitters were blown down during unit 5 coming down and off-line.
11. The drum level transmitter was blown down during hydro when the drum was full to remove any air in the lines.
12. All bed T/C's were put back into the bed calculations.
13. The water supply pressure control valve to the SNCR skid was checked. This was found to be OK. After startup, we realized this system also supplied 4 and 6 when they are in use and may not need the 140psi for only unit 5. We dropped the setpoint from 140 to 120psi, and the pressure stopped fluctuating.
14. This system circulates water, then draws off what it needs. It will need to be checked when 4 and 6 start drawing off it to make sure we have enough water for all three units.

**Operations**

1. Cleaned east condenser tube sheet; removed 30 gals of debris from north and south sides.
2. Cleaned west side of Main Condenser - removed ~10 gallons of leaves from north and south sides.

# ATTACHMENT WHS – 3

# PSNH FOSSIL STEAM UNIT AVAILABILITY

## PSNH Fossil Steam Unit Availability
**January 2008 through December 2008**

| | Merrimack Unit 1 | Merrimack Unit 2 | Newington Unit 1 | Schiller Unit 4 | Schiller Unit 5 | Schiller Unit 6 |
|---|---|---|---|---|---|---|
| January | 90.5% | 9.4% | 99.1% | 100.0% | 70.4% | 100.0% |
| February | 100.0% | 88.4% | 100.0% | 100.0% | 74.0% | 90.7% |
| March | 100.0% | 85.6% | 2.0% | 80.3% | 76.1% | 97.5% |
| April | 87.9% | 1.9% | 69.2% | 68.4% | 100.0% | 51.7% |
| May | 100.0% | 28.5% | 100.0% | 84.8% | 100.0% | 100.0% |
| June | 89.8% | 65.5% | 100.0% | 100.0% | 99.3% | 94.8% |
| July | 100.0% | 56.2% | 97.3% | 100.0% | 100.0% | 92.5% |
| August | 93.3% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| September | 28.8% | 82.5% | 100.0% | 100.0% | 100.0% | 100.0% |
| October | 7.5% | 100.0% | 100.0% | 94.4% | 68.1% | 91.2% |
| November | 80.8% | 88.2% | 100.0% | 100.0% | 100.0% | 96.4% |
| December | 96.9% | 100.0% | 99.5% | 100.0% | 84.9% | 100.0% |

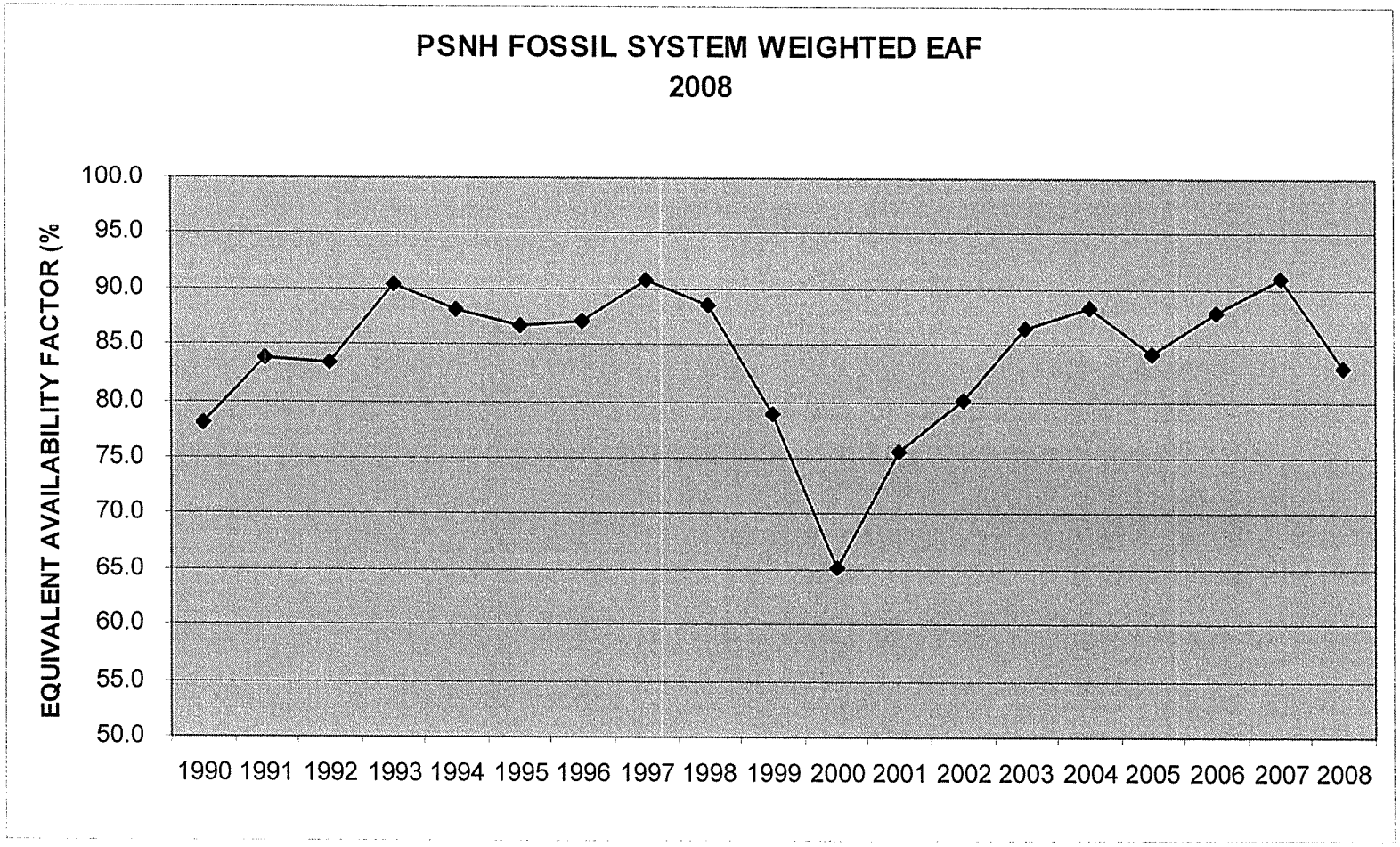
## Planned Maintenance Outages
**January 2008 through December 2008**

| Unit | Month(s) |
|---|---|
| Merrimack 1 | Sept, Oct |
| Merrimack 2 | Apr,May |
| Newington | Mar |
| Schiller 4 | Mar, Apr |
| Schiller 5 | Oct |
| Schiller 6 | Apr |

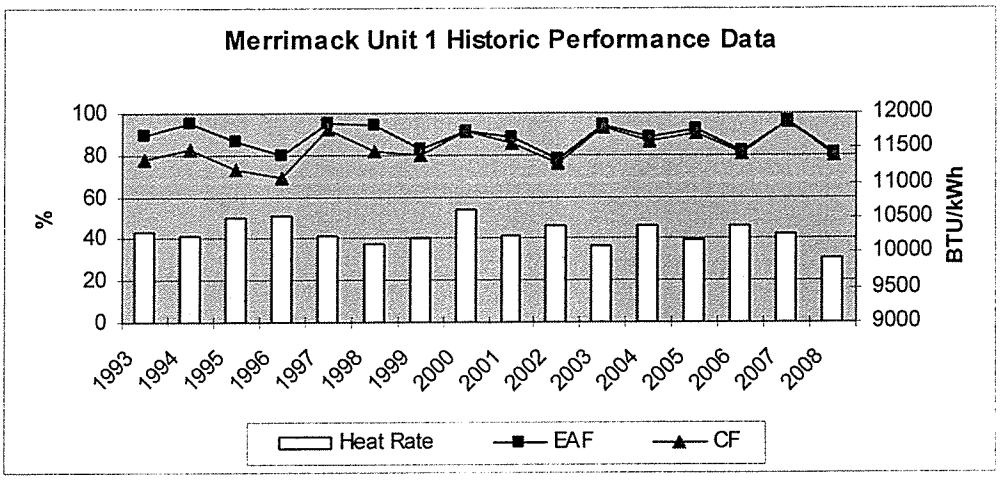
**DEFINITION:**

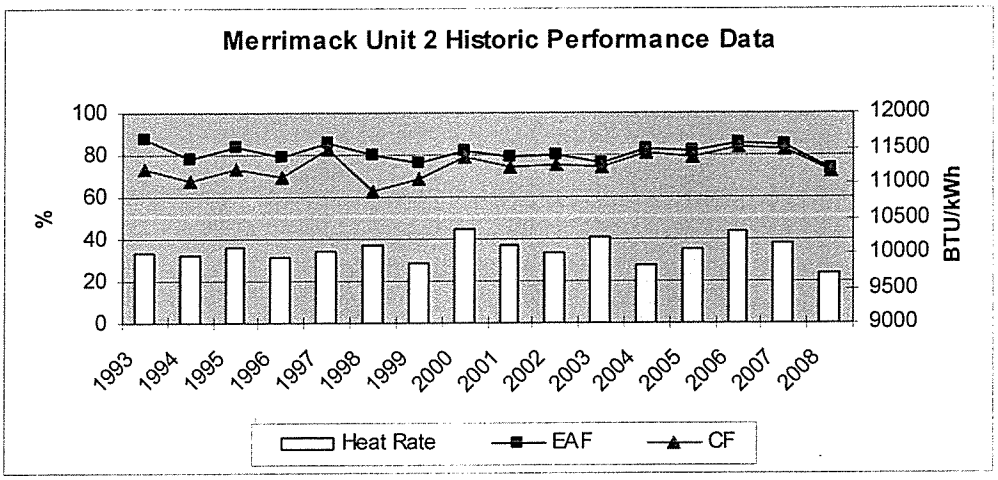
Unplanned Outage Equivalent Availability Factor - EAF(Unplanned):

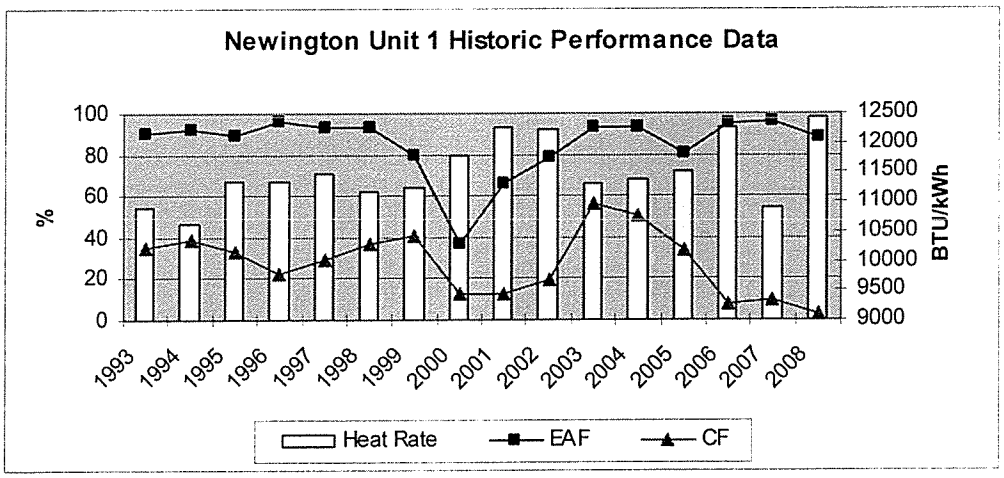
$$\frac{\text{(Available Hours + Planned Outage Hours - Equiv. Unit Derated Hours - Equiv. Seasonal Derated Hours)} \times 100}{\text{Period Hours}}$$


PSNH FOSSIL SYSTEM WEIGHTED EAF
2008
EQUIVALENT AVAILABILITY FACTOR (%
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008

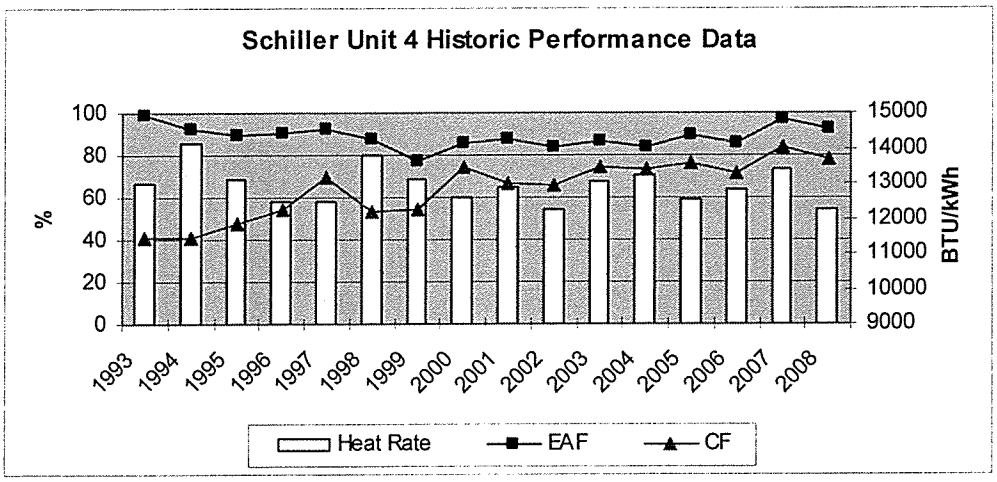
# Fossil Plant Graphs – Planned Outages Included

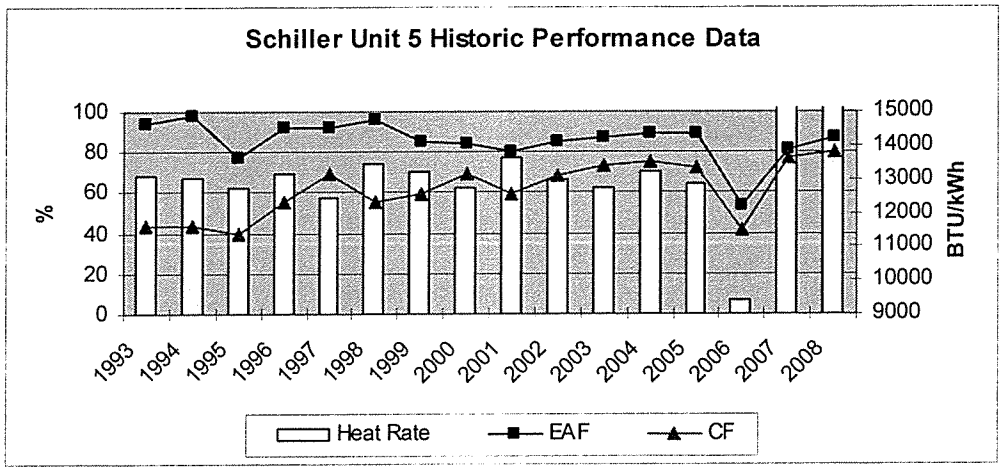


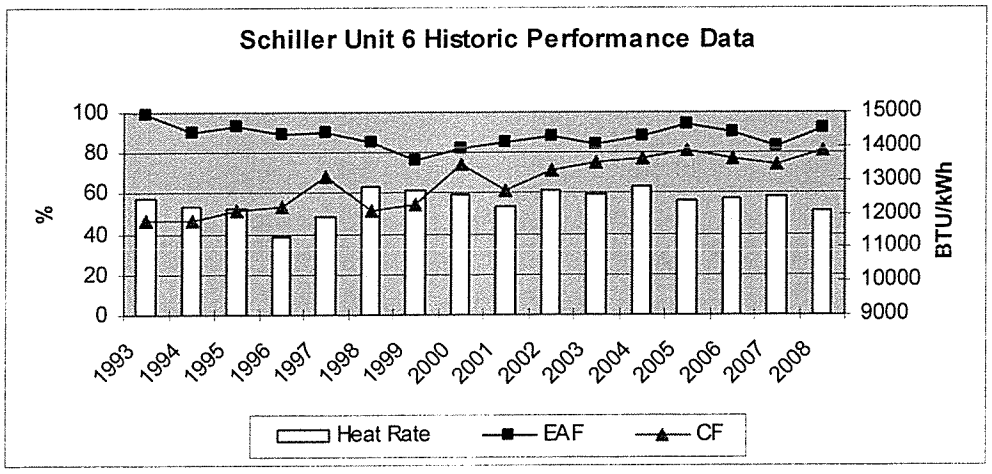



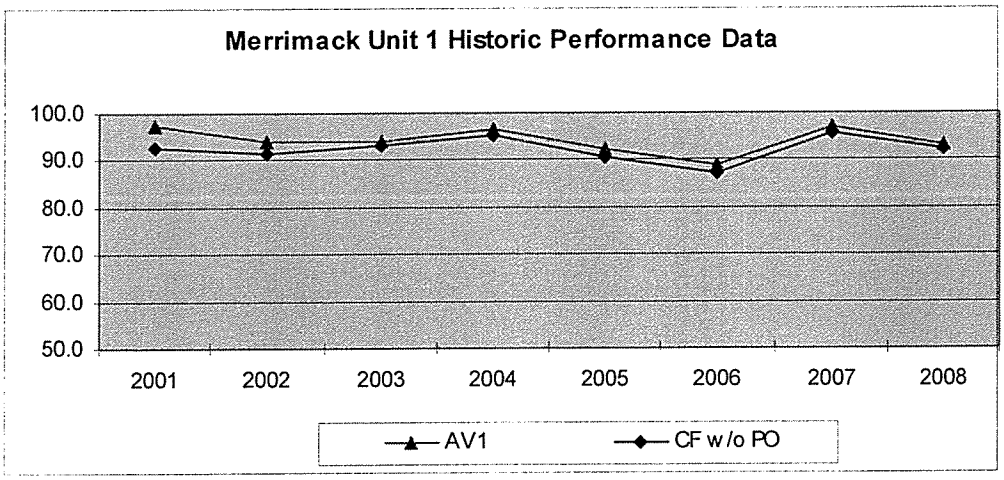
# Fossil Plant Graphs – Planned Outages Included

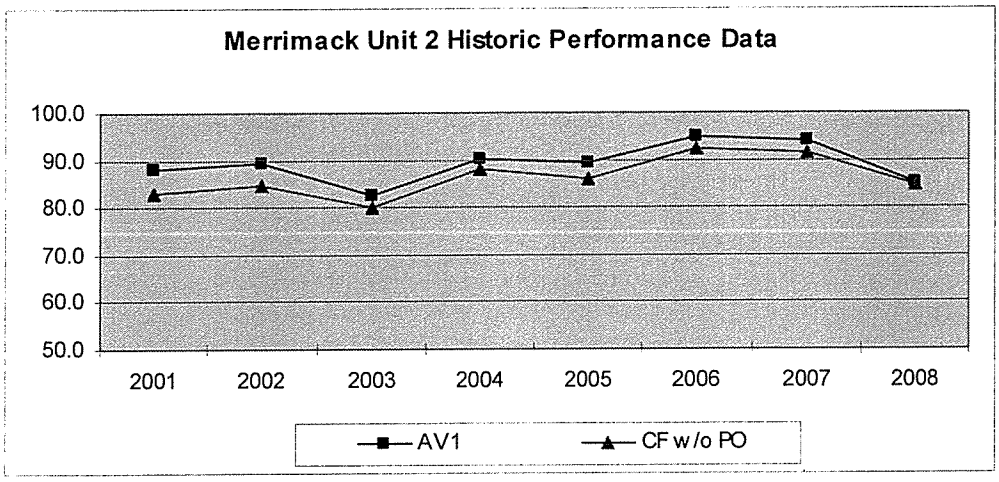


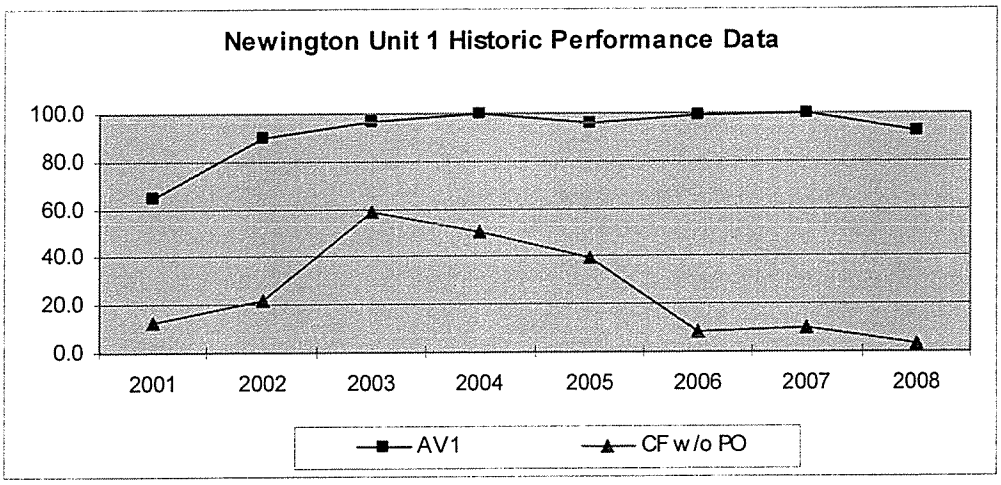
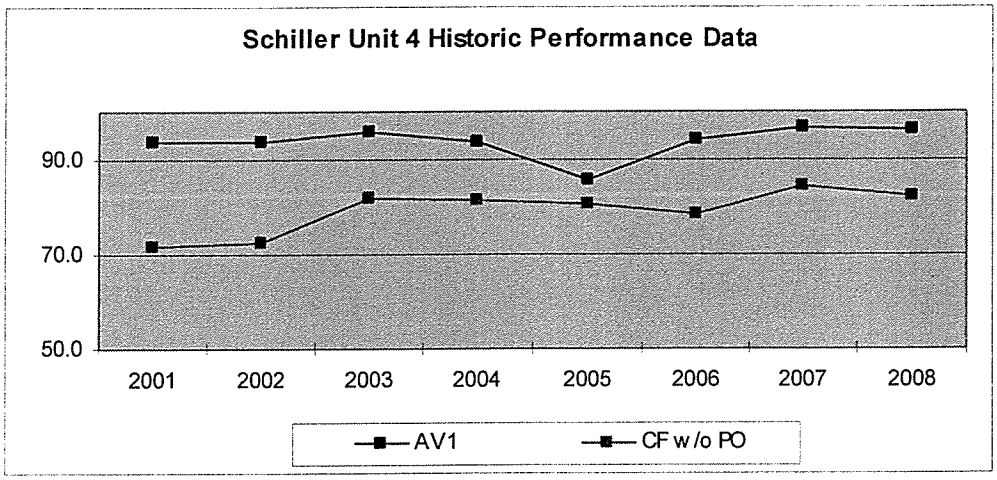
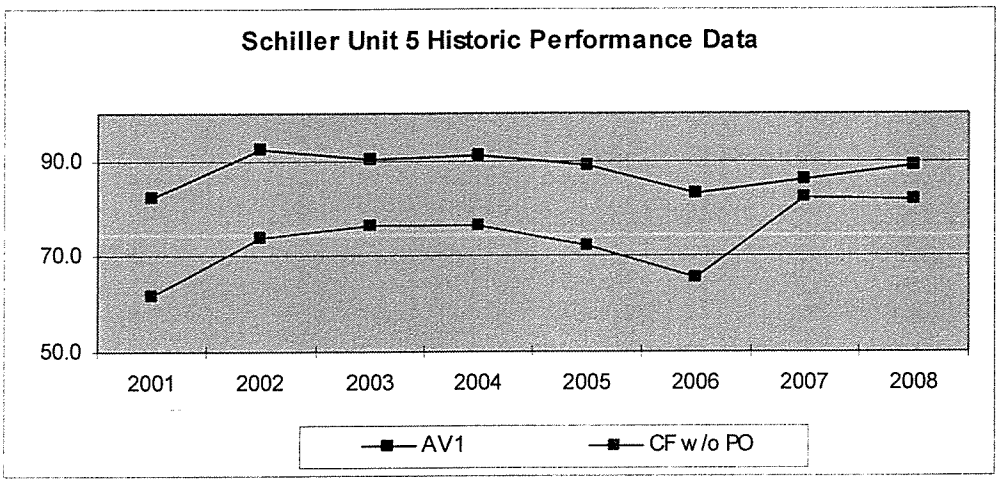
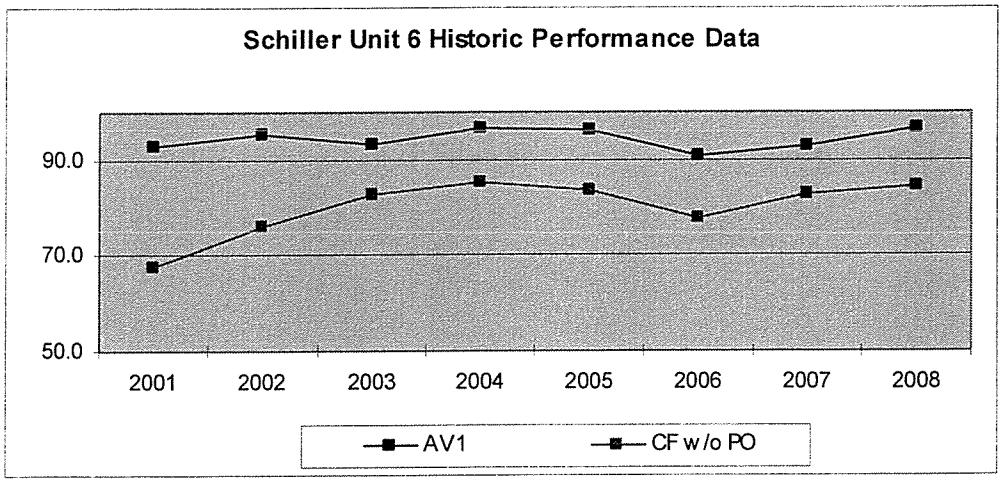



# Fossil Plant Graphs – Planned Outages Omitted






# Fossil Plant Graphs – Planned Outages Omitted