

**ATTACHMENT WHS – 2**

**PSNH FOSSIL AND HYDRO STATION  
OUTAGE REPORTS**

# PSNH

## FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2007-01 (SR5- 01)

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

**Dates:** January 2 – January 13, 2007

**Duration:** 11.15 days

**Immediate Cause:**

The Unit came off-line due to a master fuel trip caused by low furnace bed average temperature.

**Discussion/Remedy:**

On December 30, 2006, prior to the outage, one of the two wood feeders experienced a drive chain failure, causing the unit to operate on only one wood feeder. The start-up burner was lit to maintain furnace temperatures. The chain was replaced and the second feeder was put back in service. Over the next couple of days, some of the bed thermocouples began to experience low temperatures. In addition, about one day prior to the outage, the bed ash drain line plugged which prevented any ash from flowing out of the furnace. This pluggage could not be cleared while on-line. This ultimately caused the average bed material temperature to lower to a point to cause a master fuel trip, which resulted in the unit coming off-line.

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 removed one of the six cyclone covers. To supplement the station's mechanical crew, management called in a contractor to perform the boiler work. The contractor's boilermaker crews worked on the six cyclones for the next nine days. The inspection of the cyclones determined that the vortex finders on Cyclones 1 and 5 had broken off the mounting ring flange to which they had been welded and had fallen to the bottom of the cyclones. In addition, the same welds on Cyclones 2, 3, 4, and 6 were cracked and appeared to be ready to fall. There was also a significant amount of ash accumulation both in the boiler and in the cyclones.

This observation suggested that the bed ash accumulation, referred to as agglomeration, had apparently restricted primary air flow resulting in a loss of fluidization, which is also

referred to as slumping the bed. This, in turn, resulted in bed cooling, more agglomeration, and ultimately the master fuel trip.

Working two shifts, it took the vacuum contractor over two days to remove all of the ash and to allow access for further inspection and repair. To expedite the work schedule, vortex finders on Cyclones 2, 3, and 6 were repaired in the cyclones, while vortex finders on Cyclones 1, 4, and 5 were removed and repaired on the adjacent deck.

The vortex finders on Cyclones 2, 3, 4, and 6 were removed and repaired. The ring flanges on all six cyclones were removed and all weld areas were reground. Two of the rings were sent out to a metal shop to be straightened. While those rings were at the shop, the contractor welded the remaining four rings onto the vortex finders and reinstalled them back into the cyclones. When the other rings returned from the shop, they were welded onto the vortex finders and reinstalled in the cyclones. All covers were installed on the cyclones. The doors were bricked up and closed. The unit was then returned to operations to be put into service.

A number of other corrective and preventative maintenance activities were completed during the outage, including the following:

- Repacked economizer hopper expansion joint.
- Repacked backpass hopper expansion joint.
- Removed and cleaned riser urea nozzles.
- Completed Wood Yard systems inspections and repairs.
- Tested bed temperature probes.
- Inspected and cleared DP lines pluggage.

## PSNH

# FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2007-02 (MK2-01)

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

**Dates:** February 9 – February 13, 2007

**Duration:** 3.68 days

**Immediate Cause:**

The unit was removed from service as a result of excessive water usage.

**Discussion/Remedy:**

Unit 2 was removed from service due to excessive water usage indicating a tube leak. Immediately upon shutdown, station personnel commenced a boiler inspection. Before entering the lower furnace for the inspection, ash build-up on the overhead tubes was removed in order to ensure the safety of the workers. Staging was then erected to provide access to the superheater pendants. The staging consisted of four levels of planking installed between the superheater's intermediate and inlet pendants spanning the 36-foot length of the boiler. The access provided by the staging enabled workers to search for the leak in the secondary superheater inlet pendant. The leak was located on an exterior tube at elevation 330'. The tube failed 3.5 feet below the roof tubes. The failed tube was bent and severed.

Once the leak was located, scaffolding was suspended from the penthouse area in order to gain access to the leading edge tubes of the secondary superheater inlet pendant. The scaffolding provided a safe working space from which workers could remove and replace the failed tube. It enabled them to perform non-destructive examination of other tubes in the affected area as well as other tubes that were in the soot blowing lanes.

The repair required that the secondary superheater alignment castings on the inlet pendant first be removed. Working from the scaffolding and the penthouse, workers removed and replaced the failed tube. They also removed and repaired adjacent tubes that were impacted by the severed tube. A total of 64 feet of tube that included two new lower bends and required six welds was removed and replaced. A black-light inspection was performed on the six welds to confirm that they met code requirements. The inlet pendant sections were then realigned and the alignment castings re-installed. The staging and the suspended scaffolding were removed and a boiler pressure test was conducted on the waterside tubes. The boiler and cyclone doors were closed and the unit was turned over to operations.

The station took advantage of the shutdown and the staging to make other repairs to the boiler that did not extend the startup critical path. These included water tube leaks in 2B, 2C and 2F cyclones, a leak above G cyclone on the firebox rear wall, and a leak on a drain coupling in the tempering duct.

The tube failure that caused the shutdown, located near the top of the inlet pendant at elevation 330' was the first one to occur in this area. Prior failures were on the bottom of the leading edge tubes around elevation 322'. During the 2006 annual overhaul, the station conducted ultrasonic testing (UT) of the secondary superheater tubes. The readings indicated that coal ash corrosion was present throughout the inlet bank. As a result, some tubes in the lower loops were pad welded and shielded during that outage.

The most practical way of identifying and addressing all tubes in the superheater inlet pendants at risk of developing a leak due to wall thinning by the coal ash is to replace the entire bank of 23 pendants. This is because coal ash corrosion can cause significant wall thinning in one isolated location on a single tube while leaving the rest of the tube and adjacent tubes intact. Visual inspection and non-destructive examination techniques cannot cover one hundred percent of the tubes and UT is not completely reliable for tubes encrusted with coal ash. Replacement of the secondary superheater inlet pendant bank was therefore scheduled for the spring 2008 annual overhaul. Extensive turbine work had already been scheduled for this outage thereby allowing sufficient time to replace the tube bank without impacting the existing critical path for the outage. In the interim, in order to minimize the risk of tube failure before replacement of the bank, enhanced inspections were made during the spring 2007 annual overhaul. This included realignment of the secondary superheater inlet pendants, visual inspections and non-destructive examinations.

A number of other corrective and preventative maintenance activities were completed during the outage, including the following:

- Completed preventative maintenance on 2A and 2B gas recirculation fans.
- Cleaned and inspected the heat exchangers.
- Completed preventative maintenance and repairs as necessary on the slag tank equipment.
- Inspected all primary and secondary air dampers.
- Cleaned forced draft fan preheat coils.
- Completed preventative maintenance on 2A and 2B FD fans and associated equipment.
- Cleaned all coal feeder motors.
- Repaired 14 rappers in the original precipitator.
- Tested SCR by-pass damper.
- Adjusted packing on Daca valve on the turbine oil system.
- Brush cleaned both sides of the condenser.
- Vacuumed various boiler areas as necessary.
- Performed a complete boiler inspection.

- Cleaned boiler nose, SSH and VRSH pendants of ash.
- Repaired casing leaks.
- Repaired 2B, 2C, and 2F cyclone leaks.
- Repaired wall tube leak above G cyclone in the fire box.

# PSNH

## FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2007-03 (SR5-05)

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

**Dates:** February 9 – February 16, 2007

**Duration:** 6.84 days

**Immediate Cause:**

The unit came off-line due to a master fuel trip caused by a loss of furnace temperature.

**Discussion/Remedy:**

During a 4-to-5-day period prior to the unit being taken off-line, load reductions had been necessary as a result of erratic furnace bed temperatures. The apparent cause was the loss of wood feed on one side of the furnace on February 4. Low furnace temperatures caused a crust to develop on the bed resulting in a master fuel trip of the boiler. The residual heat of the boiler was sufficient to supply steam to the turbine for a period of time, so the unit was kept on-line.

During that time, station personnel attempted to break up the crust by reducing load and wood feed rate while using the gas-operated start-up boiler (SUB) to continue to heat the bed material. Bed temperatures, however, remained low and on February 9, there were indications that Cyclone 5 was plugged. To avoid possible damage that additional cyclone pluggage could cause, it was decided to take the unit off-line.

With the unit off-line, the boiler was vented and drained while the forced draft and induced draft fans were left on to cool the boiler and allow access for inspection and repair. Initial inspection found Cyclones 1, 2, and 6 relatively clear of pluggage while Cyclones 4 and 5 were plugged with ash. The cyclones were vacuumed and inspected. The inspection found that, in Cyclone 3, the structural member normally connected to the bottom of the vortex finder had become detached and fallen through the downcomer to the bottom of the cyclone.

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, which took a number of days. 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.

At this point, operators then transferred replacement bed material into the boiler and the SUB was ignited to initially heat-up the unit. During the start-up process, Cyclone 5 became plugged. The fires were put out, the bed sand was removed and the boiler cooled. The vacuum contractor then unplugged Cyclone 5's downcomer leg. The other five cyclones were also re-inspected and found to be clear. Replacement sand was added and the unit was then re-started without incident.

A number of other corrective and preventative maintenance activities were completed during the outage, including the following:

- Completed wood yard systems inspections and repairs.
- Replaced Dwyer DP gauge/switches for Wood Silo #1 Dust Collector.
- Cleaned, inspected and repaired as necessary a variety of valves.
- Installed instrument air isolation valves for cyclone flowrators.

# PSNH

## FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2007-04 (MK1-01)

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

**Dates:** March 22 – March 26, 2007

**Duration:** 3.54 days

**Immediate Cause:**

The unit was removed from service to perform planned preventative maintenance after operating continuously through the winter period.

**Discussion/Remedy:**

The preventative maintenance outage ended over 107 days of continuous operation that spanned the entire winter period. This was the ninth-longest continuous run in the unit's 47-year history. Several considerations led to management's decision to shutdown for a planned preventative outage at this time. First, the long run built up a large number of priority backlog items that required a shutdown for completion. Second, Unit 2 was scheduled for an overhaul in April. A shutdown at this time, allowing completion of a significant portion of the maintenance backlog, would increase confidence in the ability of Unit 1 to operate through what would be a five-week Unit 2 outage and on into the summer peak period. Finally, the outage could be conducted in a relatively low-demand period.

During the outage, a complete inspection of the boiler was conducted. It included steamside and waterside tubes as well as 1A and 1B air heaters. Water washing of 1A and 1B air heaters and replacement of the lower circumferential seals governed the outage's critical path. All bottom circumferential seals on both air heaters and a portion of the upper seals were replaced. The cold end baskets were inspected and did not need to be replaced. One boiler water tube leak in the firebox was identified and repaired. Both condensers were brush cleaned.

In parallel, a sizable amount of backlog and priority backlog maintenance was completed. This included extensive inspection and maintenance of both Boiler Feed Pumps. A valve contractor was also brought in to re-pack, rebuild and repair a number of valves. In all, over one hundred backlog jobs were completed.

Other outage maintenance activities including the following:

- Cleaned 1A & 1B primary fan coils.
- Cleaned ammonia injection nozzles.
- Inspected original electrostatic precipitator.
- Replaced a number of collector ring brushes.
- Cleaned cooling water heat exchanger.
- Brush cleaned condenser.
- Vacuumed a number of boiler areas including the SCR, precipitator and associated ducts.
- Performed a complete boiler inspection.
- Repaired leaks on 1B and 1C cyclone cooling jackets.
- Replaced 1A and 1B precipitator inlet duct expansion joints.
- Removed, repaired casing, and replaced lagging and insulation to access and inspect the precipitator inlet ducts.

# PSNH

## **FOSSIL STATION OUTAGE REPORT**

**Outage Report No.:** OR-2007-05 (SR4-03)

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

**Dates:** March 26 – March 30, 2007

**Duration:** 4.36 days

**Immediate Cause:**

The unit was taken offline due to excessive water caused by a superheater tube leak.

**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 was filled and the leak was located in the superheater on the eighth tube back from the west on the first pendant off of the south wall at Elevation 75'. The boiler inspection indicated that the screen tubes were not plugged and that the ash build-up was minimal. Vacuuming was conducted in the kicker baffle and super heater hopper areas.

Two crews were established to begin repairs to the leaks. It was apparent that the leak was caused by ash erosion. A section of the steel wall on the south side was removed for access and the repair was made by pad welding the leaking tube. Upon completion of welding, a boiler hydro was performed to look for additional leaks. During the fill a second leak was found in the superheater section. The leak was small and on an old pad weld. The tube pendants were spread to get to the tube. A pad weld repair was completed. The boiler was filled and the hydro continued to check for additional leaks. Another small leak was located in the furnace area in the middle of the south wall at Elevation 40'. A sky climber was required to access this leak. Once it was pad welded, the boiler was filled, a hydro conducted and no leaks found. Pins to hold the tiles were installed in the superheater and kicker baffle. The refractory vender reinstalled all tile and made one poured seal in the kicker baffle. Poundable refractory was used to seal up the hole on the south wall on Elevation 75'. The boiler skin was reinstalled after the hole was filled with refractory. All boiler doors were closed and boiler was turned over to operations to be placed in service.

A number of other corrective and preventative maintenance activities were completed during the outage, including the following:

- Replaced the collector brushes.
- Inspected the precipitator inlet duct.
- Checked and tested the main transformer high side bushings.
- Cleaned and inspected the main fuel oil shut off valve.

# PSNH

## FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2007-06 (SR6-05)

**Station/Unit:** Schiller Unit No. 6

**Dates:** April 29 – May 7, 2007

**Duration:** 7.47 days

**Immediate Cause:**

Unit 6 was taken off-line when excessive water leakage indicated a tube leak.

**Discussion/Remedy:**

The boiler was depressurized, cooled, drained and isolated for repairs. During the initial inspection by station personnel, wet refractory at the bottom of the drum indicated leakage at the tube-to-drum sheet rolls. The boilermaker contractor was notified and requested to mobilize manpower and equipment.

To identify the leakage location, the boiler was filled to the steam drum and tiles were removed from the roof of the kicker baffle for access to the bottom of the drum. After completion of the fill, the boiler was drained and the steam drum was opened and cooled.

The steam drum internals were removed and boilermakers re-rolled 24 tubes in the drum. The drum was closed and the boiler was filled for a hydro. With the fill, there were no apparent leaks in the generation tube rolls. However, a small pinhole leak was discovered in a generation tube weld above Elevation 65' on the first row from the east. The boiler was drained to below the generation tube leak. The refractory contractor removed boiler tiles to allow access to the leaking tube. The leak was repaired and the steam drum internals were reinstalled.

With the leak repaired, the fill was continued and the hydro performed. The hydro identified a number of additional generation tube roll leaks. The boiler was drained and the steam drum and mud drum were opened and cooled. All steam drum internals were then removed.

A representative from EASCO tool, the manufacturer of the tube rolling equipment, was brought on site to ensure that the tube rolling equipment was functioning properly, that the rolling dies were correct, and that the tube rolling process was correct. Once this was confirmed, all 240 generation tubes were rolled twice. The inside diameters of the tubes were then measured to ensure that the rolls were correct.

The steam and mud drums were closed and the boiler was filled for another hydro. The hydro identified multiple leaks in the screen and roof tube rolls. Four rows of screen tubes were rolled and the boiler was filled and a successful hydro finally achieved. With all the leak repairs complete, the boiler was drained and the steam drum and mud drum were opened and cooled. The internal parts were reinstalled into the steam drum. The refractory contractor reinstalled the boiler tiles, the mud and steam drums were cleaned and closed and the unit was returned to operations to be placed in service.

A number of other corrective and preventative maintenance activities were completed during the outage, including the following:

- Completed inspection and repairs as necessary on the ID fan damper, ID fan, and associated equipment.
- Replace steam root valve between 10<sup>th</sup> and 18<sup>th</sup> stage feedwater heaters.

# PSNH

## FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2007-07 (MK2-05)

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

**Dates:** May 29- June 1, 2007

**Duration:** 3.09 days

**Immediate Cause:**

The unit was removed from service as a result of excessive water usage due to an economizer tube leak.

**Discussion/Remedy:**

Upon shutdown, once the boiler was cool and safe to enter, a boiler inspection was conducted. Station personnel identified the cause of the excessive water usage to be leaks in the economizer. The leaks were in the three top tubes of the 21<sup>st</sup> and the three top tubes in the 22<sup>nd</sup> tube elements, about three feet from the west wall. Prior to repair, the surrounding tubes in the area were visually inspected and the wall thicknesses were checked through ultrasonic testing (UT). The inspection and testing determined that a weld (dating back to initial installation) in the top tube of the 21<sup>st</sup> element had eroded as a result of coal ash corrosion. This leak caused subsequent damage to the two 21<sup>st</sup> element tubes below it as well as to the top three tubes of the 22<sup>nd</sup> element. As a result of the failure, other tubes in the area that might have been impacted were visually and non-destructively examined.

Three of the identified leaks were repaired by cutting out three-foot sections of tube and installing Dutchmen and three were repaired with pad welds. Three other small leaks were found during the inspection of the boiler and repaired with pad welds. Two other tubes with indications of washout were also repaired.

After all the leaks were repaired, a boiler pressure check was performed. Upon successful completion of this test, the boiler doors were closed and the boiler was turned over to operations.

The economizer elements are original equipment and were about 40 years old at the time of these tube failures. Recognizing the potential for leakage because of their age and susceptibility to coal ash corrosion, the station conducted extensive visual inspection and UT during the 2006 annual spring overhaul as well as the 2007 spring overhaul that was completed the month before this outage. During the overhauls, the boilermakers completed corrective and preventive maintenance on the economizer that included pad

welding of thin-walled tubes, tube replacement (Dutchmen), alignment strap and tube hanger repair, additional tube shielding, and header protection baffle repair. Coal ash corrosion, however, can cause significant wall thinning in one isolated location on a single tube while leaving the rest of the tube and adjacent tubes intact. In addition, visual inspection and non-destructive examination techniques cannot cover one hundred percent of the tubes and UT is not completely reliable for tubes encrusted with coal ash. This area will continue to be monitored as part of the overall boiler inspection program. No additional leaks have occurred in this area.

A number of other corrective and preventative maintenance activities were completed during the outage, including the following:

- Replaced shaft seals on 2A and 2B gas recirculation fan.
- Inspected and cleaned flyash line to boiler on the SCR supplemental precipitator system.
- Inspected cyclone stress-trol hangers.
- Inspected limestone additive system.
- Checked programs and limit switches on the SCR inlet dampers.
- Inspected and cleaned both sides of the condenser (east and west water boxes).
- Performed a complete boiler inspection.

# PSNH

## FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2007-08 (MK1-02)

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

**Dates:** June 22 - June 25, 2007

**Duration:** 2.42 days

**Immediate Cause:**

The unit was removed from service to perform planned preventative maintenance and to prepare the unit to run reliably through the peak summer period.

**Discussion/Remedy:**

This preventative maintenance shutdown ended an 89-day run. A complete boiler inspection was completed and did not reveal any boiler water tube leaks. The water washing of 1A and 1B air heaters governed the outage's critical path. During the outage, an inspection was conducted of both sets of circumferential seals in air heaters 1A and 1B. The lower seals that were replaced during the March outage, as well as the upper seals, were determined to be in good condition. The cold end baskets were also inspected and did not need replacement. The condenser was inspected and the brushed clean along with the cooling water heat exchanger. The SCR was prepared for summer operation.

In parallel, a sizable amount of backlog and priority backlog maintenance was completed. Other maintenance work activities done during the outage include the following:

- Opened A, B, and C cyclone doors.
- Cleaned and repaired slag rodder port.
- Welded hardfacing on 1-A and 1-C cyclone door coal chutes.
- Changed the oil in 1-A and 1-B forced draft fan inboard and outboard motor bearings.
- Inspected and cleaned A, B, and C blast gates.
- Inspected and cleaned A, B, and C coal feeders.
- Inspected and cleaned 1A and 1B primary fan coils.
- Greased 1A and 1B forced draft fan inlet and outlet dampers.
- Greased and tested 1A and 1B forced draft fan preheater coil drip return pumps.
- Inspected all components, greased crusher, and adjusted chain on slag tank.
- Cleaned ammonia injection nozzles.
- Repaired casing leak below SCR inlet damper (south).
- Inspected original electrostatic precipitator.

# PSNH

## FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2007-09 (SR5-17)

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

**Dates:** June 22 – June 29, 2007

**Duration:** 6.67 days

**Immediate Cause:**

Planned maintenance outage.

**Discussion/Remedy:**

This maintenance outage was coordinated with ISO to complete a number of boiler items that had been identified over a six to eight week period. The new boiler had experienced periodic high cyclone temperature excursions as well as air and fuel swings which were limiting the firing capability and often causing a reduction in boiler steam output. PSNH, working with the boiler manufacturer, Alstom, developed and carried out a systematic approach to resolving the operational constraints with the unit on-line. The adjustments made some improvements; however, several outage activities were still necessary to improve the performance of the unit. To complete the required off-line activities, maintenance outage was planned for June 22, late Friday afternoon.

The outage activities included work on the primary air system, cleaning the tuyeres, replacing the bed material, and cleaning and inspecting the cyclones. More specifically, the outage focused on the primary air system constraints that were impacting operations. This included stroking the forced draft, induced draft, secondary air, and dilution dampers; inspection of the FD fan silencer and ductwork, furnace and in-bed tubes, the ID fan, and the tuyeres and inlet plenum. The airflow limitation was determined to be the result of a significant amount of debris build-up on the inlet side of the tuyeres that reduced the amount of airflow to the furnace. This, in turn, resulted in agglomeration of the furnace bed and a reduction in fluidization, leading to lower furnace temperatures and reductions in steam output.

The tuyeres were cleaned and all bed material was removed and replaced. The cyclones were also inspected and cleaned. No other issues associated with the operational problems experienced prior to the outage were identified during the outage inspections.

During the outage, numerous other corrective and maintenance activities were completed, including the following:

- Worked on cyclone water spray system.
- Performed calibration check condenser leg temperature East & West indication loops.
- The air slide stone were replaced on both the economizer and backpass ash removal systems.
- Replaced 22 feet of ash removal pipe along the west wall of the baghouse.
- Replaced leaking elbow and reworked piping on the cooling water make-up line.
- Changed oil and repacked all (4) stuffing boxes.
- Stroked FD Fan dampers.
- Stroked Dilution Air dampers.
- Stroked SUB Pilot dampers.
- Inspected, cleaned and repaired cyclone thermocouples.
- Completed preventative maintenance on the ID Fan.
- Completed preventative maintenance on both FD Fans.
- Completed turbine tin-work installation.
- The wood yard outage included routine preventive maintenance and inspection items as well as corrective maintenance.
- Weld repaired #1 and #2 wood feeder pantlegs.
- Installed hinges on cyclone side of #2 wood silo screw feeder pantlegs, both sides.

# PSNH

## FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2007-10 (SR5-19)

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

**Dates:** September 3 – September 8, 2007

**Duration:** 4.89 days

**Immediate Cause:**

The unit was taken off line due to furnace bed agglomeration.

**Discussion/Remedy:**

The unit was removed from service due to an agglomeration formed on the bed material. The station had been monitoring high circulating water discharge temperatures for a couple of weeks. To improve the water discharge temperature, a water box cleaning was planned. During a water box cleaning, one half of the condenser is isolated which requires steam flow and load to be reduced. The steam flow is reduced during this activity to match a load of 15-20 MW. As load is reduced, the operator must both reduce fuel input and remove bed sand from the boiler. While bringing the plant through this transition, the operator also monitors differential pressure (DP) across the bed in order to ensure that the appropriate temperature for the plant condition is maintained. Cleaning one-half of the water boxes at a time is not uncommon at Schiller Station, but brand new to its application to the wood boiler and its very different operational characteristics.

On September 2 at 2000, the operator began to drop load for the purpose of cleaning the water boxes. As the operator reduced load, the bed DP increased which, in turn, allowed the average bed temp to drop to about 1225F, below the minimum operating value of 1350F. To correct this, the operator lit off the startup gas burner (SUB). This resulted in the boiler airflow to swing. At this point, the condenser cleaning had been completed so the operator also increased the wood feed rate. These actions caused the bed temperature to fluctuate quickly between about 1600F and 1250F during a one-half-hour period. The boiler was stabilized but the operator observed cyclone temperature excursions and significant variations of bed temperatures that suggested bed material problems. Attempts continued for the next several hours to correct the problem utilizing the SUB and varying air flows. Ultimately, the decision was made to take the unit off-line.

With the unit off-line, the boiler was vented and drained while the forced draft and induced draft fans were left on to cool the boiler and allow access for inspection and repair. Two crews were quickly established to work the day and the night shift. Upon inspection, an excess of bed material was found in the furnace despite the operator's

attempts to reduce it during the previous night's power reduction. Most of the excess bed material was piled up on the west side. The estimated amount of material in the furnace was 100 tons. The bed material was relatively soft, but had enough agglomeration to prevent it from being removed with the bed material removal system. It, therefore, had to be manually vacuumed from the tuyere area. This took four days. In parallel, the vacuum crews also cleared out the cyclone dip legs that were plugged and forced air through the tuyeres to make sure they were not plugged. The boiler doors were bricked and closed and the unit was turned over to operations to be put into service.

During the outage a number of other corrective and preventative maintenance activities were completed, including the following:

- Repacked 18<sup>th</sup> stage bleeder check.
- Changed flange gasket on feed water flow orifice.
- Cleaned and repaired bed ash piping equipment in various locations.

# PSNH

## FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2007-11 (MK1-03)

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

**Dates:** September 20 – September 24, 2007

**Duration:** 3.39 days

**Immediate Cause:**

The unit was removed from service to perform planned preventative maintenance after operating continuously through the summer period.

**Discussion/Remedy:**

The preventative maintenance outage ended an 81-day run through the peak summer period. During the outage, a complete boiler inspection was conducted as well as a thorough inspection of 1A and 1B air heaters and associated equipment. Water washing of 1A and 1B air heaters governed the outage's critical path. An inspection was conducted of both sets of circumferential seals in air heaters 1A and 1B. All of the bottom circumferential seals on both units and a portion of the upper seals were replaced. The cold end baskets were inspected and did not need to be replaced.

One boiler water tube leak in the firebox was identified and repaired. The condenser was inspected and brushed cleaned along with the cooling water heat exchanger.

In parallel, a sizable amount of backlog and priority backlog maintenance was completed. Other work items completed during the outage, apart from those items discussed above, include the following:

- Opened A, B, and C cyclone doors.
- Inspected the five butterfly dampers in the dilution air lines to each ammonia injection nozzle.
- Opened both boiler steam drum doors, tightened some acorn nuts, and closed doors.
- Washed out trough on the slag tank.
- Cleaned the cooling water heat exchanger.
- Inspected inboard bearing and replaced outboard bearing on 1B forced draft fan motor.
- Removed insulation and the old material from the intakes of the fan coils.
- Inspected and cleaned 1A and 1B primary fan coils.
- Greased 1A and 1B forced draft fan inlet and outlet dampers.

- Inspected all components, rebuilt gate, greased crusher, and adjusted chain on slag tank.
- Cleaned ammonia injection nozzles.
- Inspected 1A and 1B air preheater steam cleaning devices.
- Repaired screen tube # 29 from south to north.
- Repaired tube leak in C cyclone on the knee bends.
- Pad welded A and C cyclone doors.
- Sealed the north drain valve plug on OCB G-1.
- Inspected original electrostatic precipitator.
- Replaced all collector ring brushes.
- Tested dampers on 1A forced draft fan outlet damper drive.
- Vacuumed the SCR inlet, breech room, north economizer shelf, precipitator penthouse, firebox, bullnose, demineralizers, and precipitator hopper room.
- Water washed 1A and 1B air preheaters.

## PSNH

# FOSSIL STATION OUTAGE REPORT

**Outage Report No.:** OR-2007-12 (MK2-07)

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

**Dates:** September 24 – October 4

**Duration:** 10.2 days (4.69 days MO, 5.92 days extension)

**Immediate Cause:**

The unit was removed from service to perform planned preventative maintenance and the outage was extended as a result of a feedwater flow nozzle failure.

**Discussion/Remedy:**

Unit No. 2 was removed from service on September 24 to perform planned preventative maintenance after operating for 113 continuous days through the summer peak load period. This was the fifth-longest run in the 39-year history of Unit No. 2. The maintenance outage was initiated at this time to take advantage of the relatively low-demand period and to address maintenance items that had built up and during the long run and which required a shutdown for completion

During the shutdown, the station completed work on many priority backlog items including a boiler inspection. The boiler inspection identified sixteen water tube leaks that were repaired during the outage. During start-up from the outage on September 28, operators observed that feedwater flow indications were not consistent with other plant parameters. As a result, the unit was shut down for investigation. Boroscope examination discovered that the feedwater flow nozzle had become detached. The feedwater flow nozzle is a nozzle-shaped pipe, welded inside the feedwater line, which measures the amount of feedwater delivered by the boiler feed pump to the boiler. The nozzle was welded to the pipe during initial installation.

The repair required that a large section of pipe (14 feet long with 1.5-inch wall thickness) be cut out the feedwater line. The detached flow nozzle and the length of pipe were hauled to the machine shop where the flow nozzle was repaired and re-welded to the inside of the pipe. The repaired nozzle, now attached to the feedwater line section, was then shipped to Alden Laboratories for calibration. When it was returned to Merrimack Station, the ends of the pipe had to be weld-prepped and the pipe welded back into place. Once the welding was complete, the joints were radiographically inspected and stress

relieved. After a natural cool down of the piping the unit was ready for start-up. In parallel with this repair, a spare flow nozzle was ordered, and a new one was manufactured by our machine shop, as part of a contingency plan. As a result of this incident, a program to inspect and replace other flow nozzles throughout the system was implemented.

A number of other corrective and preventative maintenance activities were completed during the outage, including the following:

- Opened and closed all 7 cyclone doors.
- Completed preventative maintenance on 2A gas recirculation fan.
- Checked 2A and 2B forced draft fan for balance.
- Tested and operated SCR bypass damper guillotine.
- Installed new primary superheat bypass valve (PCV-7B 202B)
- Disassembled, inspected, and cleaned the turbine auxiliary governor.
- Cleaned 2A and 2B slag tank troughs.
- Inspected and replaced gate, piston, cylinder, guide rails and associated internals on slag tank.
- Inspected 201 valves
- Performed troubleshooting exercise on 202A and 202B primary superheat bypass valves, seated and stroked.
- Inspected the old and new electrostatic precipitator.
- Performed generator rotor grounding brushes inspection
- Upgraded controllers in the supplemental precipitator.
- Inspected and brush cleaned both sides of the condenser (east and west water boxes).
- Brush cleaned the cooling water heat exchanger.
- Performed a complete boiler inspection.
- Repaired leak in 2C cyclone radial burner cooling water jacket.
- Repaired a variety of casing leaks

## **PSNH Hydro Outages – T&D Issues - 2007**

### 1 (A) – Canaan – 1/6/2007 15:52

DIR: n/a

Trouble Report: 159534

A tree fell on the distribution circuit 355X7 from outside the trim zone on Jordan Hill Rd. The 10T fuse at the tap off the 355 line cleared the fault in the same time frame as the generator tripped off line. There were no breaker operations on the distribution system. This will be further reviewed by Distribution Protection and Control.

### 2 (B) – Garvins – 2/28/2007 12:13

DIR: 07-22-28-01

Trouble Report: 163314

The 3320 breaker at Garvins Substation failed and the unit tripped off line at the same time due to the resulting disturbance. This will be further reviewed by Distribution Protection and Control.

### 2 (A) – Hooksett – 2/28/2007 12:13

DIR: 07-22-28-01

Trouble Report: 163314

The 3320 breaker at Garvins Substation failed and the unit tripped off line at the same time due to the resulting disturbance. The feed to Hooksett Hydro was lost for nine minutes until loadbreak switch 355J2 was closed via radio control by ESCC.

### 4 (B) – Canaan – 3/23/2007 00:19

DIR: 07-03-23-01

Trouble Report: 182488

Lightning caused a pole fire at pole 21½ on circuit 355X at 23:23 on 3/22/2007. In order to allow the local fire department to put out the fire it was required to drop the line from the 0355 breaker at Lost Nation. This action caused an outage to Canaan Hydro. This will be further reviewed.

### 5 (A) – Ayers – 3/31/2007 17:28

DIR: 07-03-31-01

Trouble Report: 164719

Tree fell on the 3114 Line at pole 70/35 Old Bristol Rd, New Hampton. The trouble was isolated by a current limiting fuse at pole 30/55 after one trip and reclose of the 3114 breaker at Pemigewasset Substation. The unit tripped off line at the same time due to the resulting disturbance. This will be further reviewed by Distribution Protection and Control.

6a (A) – Jackman – 4/5/2007 00:44

DIR: 07-04-05-24

Trouble Report: 165213

A limb fell due to heavy snow and ice onto circuit 3140 at pole 77. The 3140 breaker tripped and reclosed twice and the voltage sensing switch 3140J3 opened to isolate the fault. The unit tripped off line at the same time due to the resulting disturbance. This will be further reviewed by Distribution Protection and Control.

6b (B) – Jackman – 4/5/2007 02:40

DIR: 07-04-05-24

Trouble Report: 165327

A limb fell due to heavy snow and ice onto circuit 3140 at pole 70. The 3140 breaker tripped and reclosed twice and the voltage sensing switch 3140J3 opened to isolate the fault. The unit tripped off line at the same time due to the resulting disturbance. This will be further reviewed by Distribution Protection and Control.

6c (B) – Hooksett – 4/5/2007 03:12

DIR: 07-04-05-17

Trouble Report: 167284

The cutouts for distribution tap 335FX2 flashed over during a heavy snow and ice storm. This caused operations of 332 breaker at Garvins and 335 breaker at Rimmon. The feed to Hooksett Hydro was lost until faults were cleared and switching was completed to restore service.

6c (C) – Jackman – 4/5/2007 03:12

DIR: 07-04-05-26

Trouble Report: (various) 166271, 165822, 171252

There were numerous line faults and breaker operations resulting from heavy wet snow and ice accumulation in PSNH service territory. As a result, limbs and trees contacted lines in numerous locations. While specific operations cannot be identified at the same time as the trip, it is felt that the unit tripped off line due to the resulting disturbance(s).

6d (D) – Jackman – 4/5/2007 05:30

DIR: 07-04-05-24

Trouble Report: (various)

There were numerous line faults and breaker operations resulting from heavy wet snow and ice accumulation in PSNH service territory. As a result, limbs and trees contacted lines in numerous locations. While specific operations cannot be identified at the same time as the trip, it is felt that the unit tripped off line due to the resulting disturbance(s).

6e (F) – Jackman – 4/5/2007 06:32

DIR: 07-04-05-24

Trouble Report: (various)

There were numerous line faults and breaker operations resulting from heavy wet snow and ice accumulation in PSNH service territory. As a result, limbs and trees contacted lines in numerous locations. While specific operations cannot be identified at the same time as the trip, it is felt that the unit tripped off line due to the resulting disturbance(s).

6f (G) – Jackman – 4/5/2007 08:50

DIR: 07-04-05-13

Trouble Report: 165808

There were numerous line faults and breaker operations resulting from heavy wet snow and ice accumulation in PSNH service territory. As a result, limbs and trees contacted lines in numerous locations. While specific operations cannot be identified at the same time as the trip, it is felt that the unit tripped off line due to the resulting disturbance(s).

7 (D&C) – Amoskeag – 4/11/2007 06:00

DIR: 07-04-11-01

Trouble Report: 170243, 170817

Cutouts at the 312FX2 tap flashed over due to an animal contact, causing breaker 312 at Eddy Substation tripped and reclosed twice. The fault was isolated by voltage sensing switch J8712. The unit tripped off line at the same time due to the resulting disturbance. This will be further reviewed by Distribution Protection and Control.

8 (D) – Garvins – 4/16/2007 07:48

DIR: 07-04-16-16

Trouble Report: momentary

A momentary fault on the 374 line occurred at 07:47 due to an unknown cause during ice, sleet and snow conditions. This caused breaker 374 to trip and reclose once. The unit tripped off line at the same time due to the resulting disturbance. This will be further reviewed by Distribution Protection and Control.

9a (C) – Canaan – 4/16/2007 10:01

DIR: 07-04-16-02

Trouble Report: \*

There were numerous line faults and breaker operations resulting from heavy wet snow and ice accumulation in PSNH service territory. As a result, limbs and trees contacted lines in numerous locations. While specific operations on the 355 line cannot be identified at the same time as the trip, it is felt that the unit tripped off line due to the resulting disturbance(s).

9b (D) – Canaan – 4/16/2007 13:30

DIR: 07-04-16-02

Trouble Report: 168515, 169248

There were numerous line faults and breaker operations resulting from heavy wet snow and ice accumulation in PSNH service territory. As a result, limbs and trees contacted lines in numerous locations. While specific operations on the 355 line cannot be identified at the same time as the trip, it is felt that the unit tripped off line due to the resulting disturbance(s). The unit was left off line due to the storm activity on the distribution system.

10 (E) – Canaan – 4/21/2007 17:54

DIR: n/a

Trouble Report: \*

PSNH service territory was experiencing high winds and rain. It is believed that distribution line oil circuit recloser OCR 355 tripped and reclosed causing momentary loss of voltage to the unit. This prompted a signal from the hydro to ESCC indicating that the unit tripped off line.

11 (F) – Canaan – 5/11/2007 18:31

DIR: n/a

Trouble Report: \*

PSNH service territory was experiencing a thunder storm. It is believed that distribution line oil circuit recloser OCR 355 tripped and reclosed causing momentary loss of voltage to the unit. This prompted a signal from the hydro to ESCC indicating that the unit tripped off line.

12 (K) – Eastman – 5/31/2007 20:26

DIR: 07-05-31-01

Trouble Report: 172867

PSNH was experiencing lightning in the area. Breaker 337 at Webster Substation tripped, reclosed, and tripped to lockout causing an outage to Eastman. At the same time, unit G2 at Eastman tripped.

13 (H) – Jackman – 6/02/2007 17:11

DIR: n/a

Trouble Report: \*

PSNH was experiencing lightning in the area. There may have been momentary faults which caused recloser operations however no permanent outages occurred at this time and there were no breaker operations at the same time as the trip. It is felt that the unit tripped off line due to the resulting disturbance(s).

14 (L) – Eastman – 6/05/2007 13:17

DIR: n/a

Trouble Report: \*

PSNH was experiencing lightning in the area. Also, the Eastman unit had a hydraulic failure. The cause of the generator trip is under investigation.

15 (I) – Jackman – 6/11/2007 17:20

DIR: 07-06-11-02

Trouble Report: 173888

PSNH was experiencing lightning in the area. A trouble occurred at pole 3140/83 which damaged a pole top insulator. This failure caused breaker 3140 to trip and reclose twice which allowed voltage sensing switch 3140J3 to open, isolating the fault. The unit tripped at the same time. This will be further reviewed by Distribution Protection and Control.

16a (O) – Eastman – 7/15/2007 14:39

DIR: n/a

Trouble Report: 176355

PSNH experienced lightning in the area. As a result there may have been momentary outages near this time. While specific operations cannot be identified at the same time as the trip, it is felt that the unit tripped off line due to the resulting disturbance(s).

16b (C) – Hooksett – 7/15/2007 16:46

DIR: 07-07-15-07

Trouble Report: momentary

PSNH experienced lightning in the area. The 3320 breaker at Garvins and the 335 Breaker at Rimmon both tripped and reclosed as a result of a temporary fault. This momentary loss of voltage caused the unit to trip at the same time.

17 (H) – Canaan – 8/25/2007 10:26

DIR: 07-08-25-07

Trouble Report: 178988

PSNH experienced a thunder storm in the area. Insulators broke off from a cross arm due to wind at pole 355/512, causing the 0355 breaker to trip and reclose twice. This momentary loss of voltage caused the unit to trip at the same time. Crews were dispatched and the 355J10 was opened to repair the problem.

18 (G) – White Lake – 8/25/2007 20:45

DIR: 07-08-25-08

Trouble Report: \*

There were numerous line faults and breaker operations resulting from lightning in the area. As a result, there were numerous breaker operations causing associated voltage disturbances. A CT-1 Lockout Alarm was received from the station by ESCC. It was checked and reset. The unit was not running at the time.

20 (I) – Canaan – 9/27/2007 15:42

DIR: 07-09-27-01

Trouble Report: momentary

PSNH experienced lightning in the area. At 15:42 breaker 0355 at Lost Nation Substation tripped and reclosed. This temporary loss of voltage tripped the unit.

26b (N) – Jackman – 11/30/2007 09:14

DIR: n/a

Trouble Report: n/a

The unit tripped off line during switching from TB33 over to the Mobile S/S for planned work. There is no 69TT switch to disable a relay protection scheme. It would have been necessary to lift some wires in order to disable this relay system which normally trips the unit when transformer breaker TB33 is opened. However, these wires were not lifted and, therefore, the relay scheme was not disabled prior to taking TB33 out of service.

\* Additional Supporting documentation being pursued