GREC April 2015 Tertiary Superheater Outlet Header Replacement

Executive Summary

The Gainesville Renewable Energy Center (GREC) was put into operation in late 2013. A possible leak was identified in the penthouse in April of 2014 and the leak in the Tertiary Superheater Outlet Header was confirmed in May. Repairs were performed. After a second leak, it was determined a new header was required. Two other shutdowns were required to make additional repairs until the new header was available for installation.

A detailed Root Cause Analysis (RCA) was undertaken but no single root cause was determined. The new design was decided upon to minimize stresses being imposed during fabrication and installation.

The header was fabricated in Valmet's fabrication facility in Lapua, Finland and air freighted and trucked to the GREC facility.

The original header was made of P91 header material and T23 stubs. The new header was made of P91 and T24. The original header would have been made of this new material but the T24 was not an accepted code case at the time of the original design.

Shutdown Report

April 20, 2015

- New Tertiary outlet header is on site
- Early construction crews starting to arrive on site
    - Detailed discussions on header installation ongoing
    - Going to utilize the 2nd row of risers for the monorail support system
        - This will save the cost of dismantling the penthouse and allow the work overhead for the additional hanger rods (x2) on the tertiary SH element support system

  - Monorail materials to arrive later in the week
- Sunbelt scaffold on site tomorrow for Early monorail scaffold scope

April 21, 2015

- Early Construction on site prepping the monorail for installation

April 22, 2015

- Early flying up monorail materials to 9th floor
- Titan on site for mobilizing
- Titan consolidating all the additional hanger rod materials
- Vacuum pipe arrived on site. To be installed on Thursday
- Consolidating all the quality documents into a central folder

April 23, 2015

- Lifting plan developed with Early and Valmet
- Monorail steel lifted up to 9th floor
- Scaffold for monorail arrived and lifted to 9th floor

April 24, 2015

- Penthouse dismantling will proceed Saturday morning 7am. Vacuum crews are coming in around 5-6pm to complete the clean up of the penthouse.
- Sunbelt scaffold installing the monorail platforms
- Header lifting procedure developed and submitted by Early for review
- Discussing the requirement for a HYDRO with Valmet and local AI.
- Requested the fireside boiler be locked out for Saturday 7am for the penthouse dismantling.

April 25, 2015

- Fireside lockout complete and safe work permit complete.
  - Contractors starting on dismantling the penthouse around 7:45am
  - Vacuum services will be onsite around 5-6pm tonight for final clean out

- Monorail and scaffolding in place for header removal and installation
- Developed the shut down lock out and permit schedule.

Monorail installation inside building

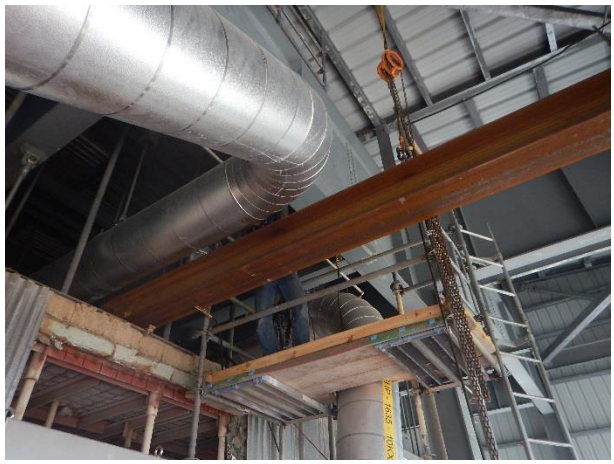
Penthouse dismantling started

- Titan laying out the steel support beams for the two new additional support rods

- Hull (Insulation Vacuum) Arrived on site at @7:00PM – work began at approximately 8:00pm
- Hull completed the vacuum of the penthouse areas at approximately 3:00am.

April 26, 2015

- Early continues to prep and clean weld ends on header
- Early given go ahead to start implementing cut lines for new header
- Titan to install monorail beams into upper furnace today.



Penthouse opening and monorail


Early prepping header tube stub ends

- Started cutting into sidewall and rear wall risers. Boiler not drained. Opening up downcomer drains. More water coming from rear wall risers? Went and investigated issue and found the downcomers have independent drains. All opened up and leaking stopped. We have approx 3-4" water inside the penthouse. Contacted Hull Vacuum services. They will arrive on site around 6pm to start vacuuming water out of penthouse. Early continuing to cut risers and we are targeting to have water vacuumed out for night shift activities.
- Started installing the support beams for the additional hanger rods for the tertiary SH elements
- Hulls arrived on site at approximately 7:00pm, vacuuming started at approximately 8:00pm and was completed at approximately 10:00pm. Small amounts of water is draining back toward the center of the work area. ECI inspected and approved Hulls completed work.
- ECI construction crew started back work in the penthouse area at approximately 10:00pm.
- ECI completed cutting the T23 safe end tubes at approximately 11:45pm. A few tubes on each end have been left uncut until the point of actually removing the header. Hanger rods have been removed. Header is supported by chain falls.


- ECI will prep riser pipes for beveling, prepare tig rigs, and prep additional areas for removal and replacement of the header.

- Early construction is looking at bringing in the crane one day earlier as they are ahead of the demolition schedule

April 27, 2015

- Monorail set into upper risers for taking out header
  - Early cut and machined the P91 header ends
  - Early is cutting back and beveling SH tube stubs (x212)
  - Header is hanging on the external monorail ready for removing tomorrow
- Work continues on addional hangers
- Crane for header lift will arrive tomorrow around 11 am
- Flat bed will arrive at noon to remove header from site.


Old header cut out and hanging on monorail

Night Shift

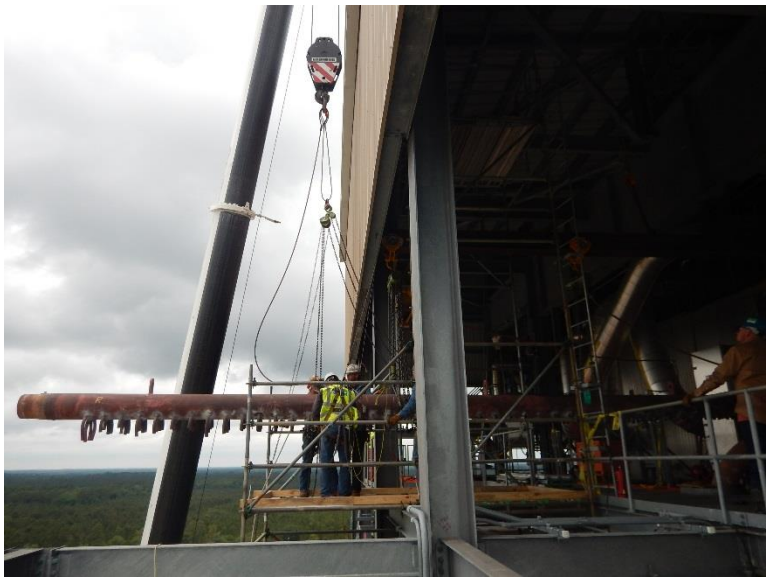
- Early continues to prep lower SH stub ends. Anticipation is that this work will be complete tonight.


Cut line prep completed on night shift

- ECI completed work for this shift at approximately 12:30am.

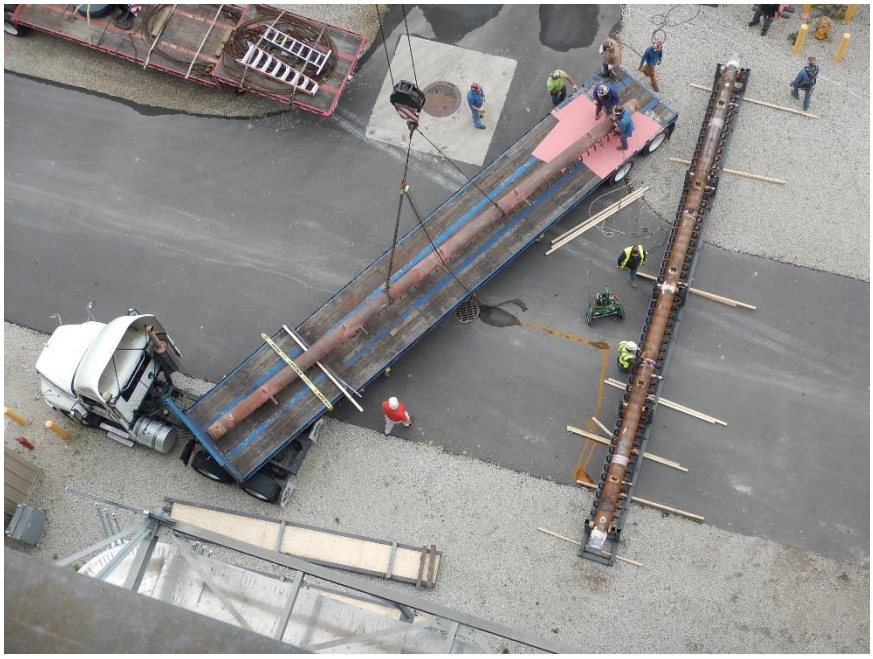
April 28, 2015

- Crane to remove old header arriving at 11am. Lifting safety plan established for the Removal/Replacement of the header.
    - Flat bed trailer coordinated to remove header from site.
- Early going to sound all the new header stub tubes into the header and is prepping to rotate the header for lifting.
- Titan completing the two additional hanger rods today.
- Early lifted the old header our and new header in before 4pm.

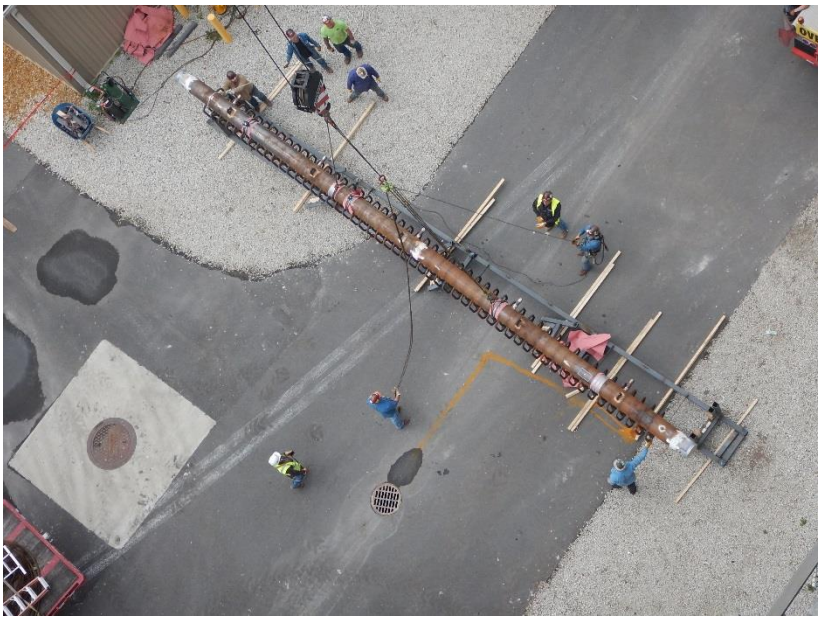


Tertiary header coming out from monorail to crane

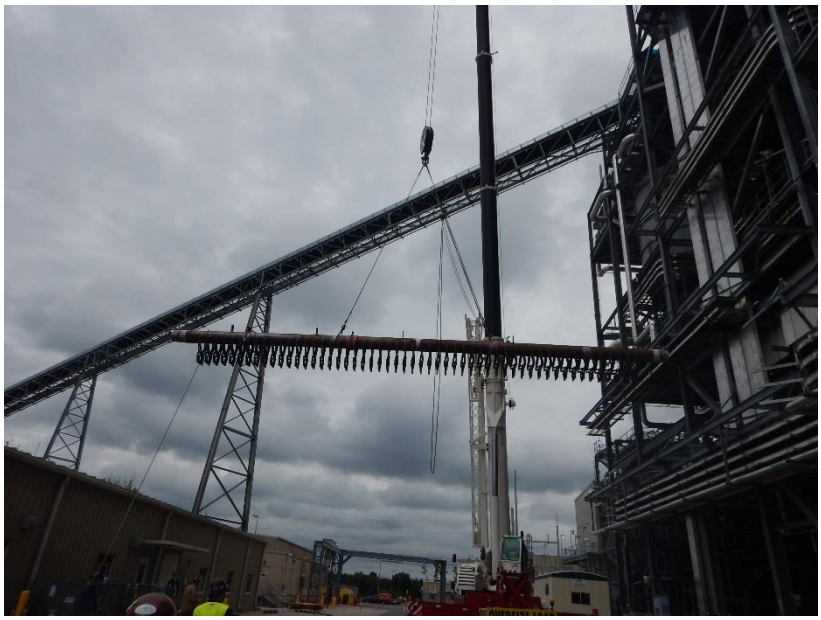
SH tubes prepped and ready for fit up



Old header on flat bed. New header prepped for lifting



New header rigged for lifting



New header in the air

Night Shift

- ECI lowered header into place. Alignments made, tube joints taped off for argon purge. Purge flow verified.

- Rows 1, 53 and finally 31 were root pass welded to kill off header.

- Row 53 tubes were welded out completely and UT Scan performed. No indications noted.
- Rows 1, 2, 3 and 4 (with the exception of the cap pass on tubes 8 and 12) were completed. UT inspection not yet performed. Row 31 was completed, UT inspection not yet performed.
- Alignment and preheat was monitored by ATS technician. Initial alignments do not indicate any tubes outside the ¼" misalignment requirement.
- Monorail system removed.
- After hanger rods are reattached, rigging will be removed.
- Argon purge shut off, day shift will be required to re-purge header.
- ECI completed shift at 3:30am.

April 29, 2015

Titan

- Completed the tertiary outlet hanger termination to the outlet header. There are not ”cold set” as of yet until Early gives the go ahead to tension them up

Early

- Need to flame straighten approx 15-16 tube stubs. Our header team will develop a detailed Flame straightening procedure.
- Superheat will not be on site for the Hydrogen Bake Out until Saturday. For the current bake out the Early crews are using a ”rosebud and cerwool blanket” for the 550F
- Production welding was slower today. 12 welds done
- AI discussed the Hydro requirement and agreed we need to do a hydro to an agreed pressure.

Night Shift

- Discussed with ECI the tubes with misalignment. Directed ECI not to weld these tubes.
- ECI has completed 83 tube welds as of this date.
- ATS has completed UT scan of 35 welds – 1 reject-tube 200, 1 questionable-tube 117 (this weld will be radiographed for confirmation). ATS is approximately 50 welds behind the welding crew.

- Main steam pipe on the right sider of the boiler has been fit-up. A double layer of purge paper was used for the argon purge at both weld joints. Joint is tacked together using T23 materials. Area was preheated, and section placed in top of weld joint and tacked. These will be removed during the welding of the joint.

April 30, 2015

Titan

- Tertiary Outlet hanger rods set
- Additional hanger rods installed and set

- Tertiary Inlet hanger rods set

Early

- Scaffold down for monorail rigging and monorail removed
- Built some wind screens with scaffold around P91 joints
- SH arrived today and equipment set up for preheat and welding. RHS is preheating to start welding
- LHS is being prepped for pre-heat and this will start welding tonight as well
- ATS radiaography crew arriving at site at 2am. We will continue with shear wave until RT crews get to site.
- All hands safety discussion held at site today
- Total of 89 welds complete


Header set and welding in progress

Night Shift

- 131 Tube to Tube welds completed as of end of shift
- 90 Tube to Tube weld UT tested, two rejects requiring repair – Tubes 137 and 138.
- 28 Tube to Tube Welds baked out.

- RT Crew did not show up on site. Will arrive on site today.
- UT technician arrived at midnight and left at 4:30am
- Right and Left side Main Steam lines welded out 30 percent. ATS will radiograph prior to finishing weld to ensure root is sound.

Fit-up and pre-heat


Left Right

- ECI working on 6" riser bevels in preparation for fit-up and welding.

May 1, 2015

Early

- RHS P91 weld joint complete and removed pre heat. Still cooling for RT
- LHS P91 almost capped out. ETA 7pm to remove pre heat and cool down for RT. Should have results for both in the am
- 159 welds complete – no RT done and will start on night shift tonight
- Mock up test done on flame straightening today and will start tomorrow on dayshift

Night Shift

- Riser Tubes fit-up
- 180 Tube to Tube welds completed
- ATS arrived on site at approximately 1:00am, they will RT the RHS and LHS P91 Main Steam welds. If time allows, they will begin RT on the tube to tube welds.
- PWHT not performed on night shift. Radiography not completed.
- 68 Tube to Tube welds have been baked out.
- Tube 147 has an excessive Gap, appears to be approximaely 1". Request Timo review the joint/gap for possible resolution.
- Tube 48 still remains tacked in place. Tacks will be removed just prior to flame straightening.

May 2, 2015

Early

- Early is holding true to their name and appears to be ahead of schedule. Hydro is likely Tuesday or Wednesday this coming week. This is pending after RT is complete on butt welds
- Starting to cut the attemperator inspection nozzle holes for installation
- Both P91 outlet weld joints passed RT. Wrapped and PWHT started.
- The belleville washers will have to be reset after the P91 outlet spring hanger rods are installed.


PWHT P91 joints on both sides

Night Shift

- Work continues on tube to tube welds.
- Two riser pipe welds remain to complete all welds.
- Main Steam left and right off PWHT.
- ATS arrived on-site, will radiograph Main Steam left and right.
- After Main Steam is radiographed, crew will begin RT on the tube to tube connections.
- Approximately 11 connections remain to be flame straightened.
- A total of 24 tube to tube welds remain to complete, this includes tubes which must be flame straightened.
- 60 Tubes remain to be baked out prior to RT.
- Requested sponge log from ECI. Documentation will be delivered to Valmet on night shift.
- Documentation for Welder Log will be updated tonight.

May 3, 2015

Night Shift

- Remaining three tube to tube connections flame straightened.

- Early Construction completed welding of tube to tube connections.
- Early Construction completed welding of attemperator nozzles.
- ATS on site peforming RT of the tube to tube connection.
- ATS performed magnetic particle testing on the remainder attemperator nozzles. No indications noted.
- Early Construction left site at approxinmately 1:00am.

May 4, 2015

Early

- Valmet provided a variance on the RT and we will use PT and Shear Wave UT for the remainder of the welds joints.
- We will advance the hydro schedule to Wednesday evening and likely start up the unit on Friday.
- Working on developing the hydro procedure and pressure increase diagram.
- Repaired two reject welds and will RT again tonight.

Night Shift

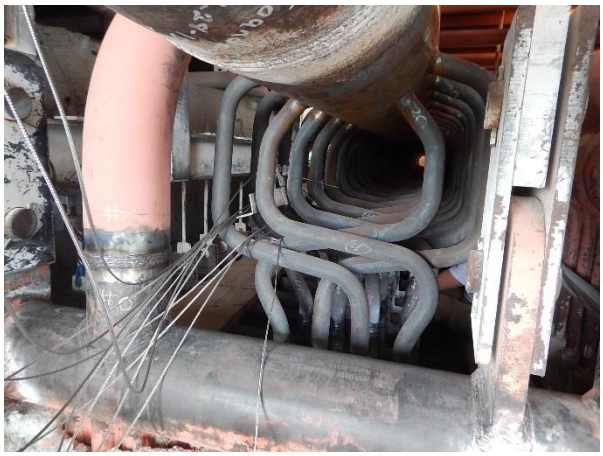
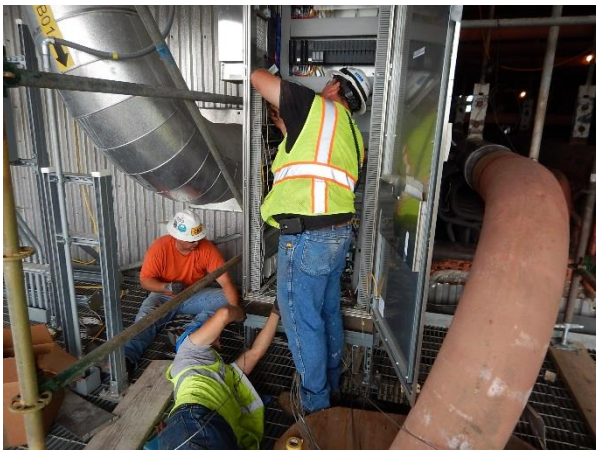
- ATS performed radiography on two repairs. One repair failed radiography for lack of fusion – T-37 - in the ”B” portion of the shot.
- Four additional tracer shots were made. All four tracer shots were found acceptable.
- Verify hanger rods have been tightened prior to hyrdo. – Titan
- ATS will perform UT test on remaining 77 tube to tube welds.

May 5, 2015

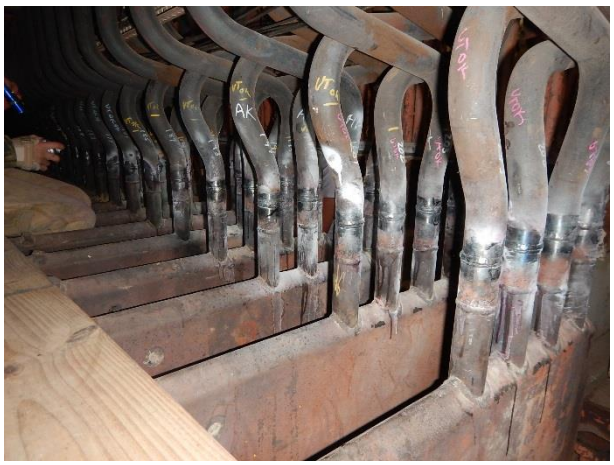
- Plan is to hydrostatic test the unit to 1.5x MAWP. Procedure developed and will be reviewed with Ops group today.
- **Outstanding work for tertiary header**
    1. Penthouse framing – ready for insulation.

2. Couple of weld cap pick ups on tertiary header. All other butt welds are complete.
3. Thermocouples (x 12) terminated to tube clamps and then into junction box and tested. Need NAES ICE techs to complete.
4. Insulation on penthouse frame staged for tomorrow
5. Insulation on tertiary outlet headers staged for tomorrow
6. Insulation on tertiary outlet and primary II outlet header inside penthouse. Will be scheduled for Thursday morning



Installing Teriary SH TC's




Tertiary SH butt welds and PT UT NDE


Night Shift May 5, 2015

- ATS was asked to Shear Wave the risers for informational purposes only, and five indications were noted.
  - We will confirm with Digitial RT
  - DRT confirmed four indications, in three riser welds, working from the left side, Riser numbers 1, 5 and 7, front welds (closest to steam drum).
  - Riser 1 is identified as 1649, Riser 5 is identified as 1651 and Riser 7 is identified as 1652. Clearly marked on Riser, and RT Film is identified as such.

- Early welders will be in on day shift 5/6/15 at approximately 6:30am to make repairs on the riser welds.
- Applied Technical Services RT technicians will be on-site at 8:00am to perform DRT on the repaired welds.
- Confirmed with Titan, hanger rods have been tighted appropriately.
- Insulation and Penthouse assembly ongoing this morning.

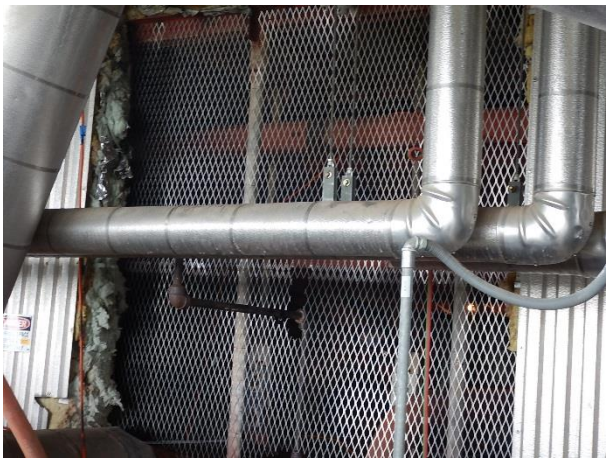
May 6, 2015

Titan

- Tertiary SH TC's check out complete and good continuity with graphics on DCS.

Early and Penthouse work

- Insulators working on the following: but leaving the welds and inspection nozzles exposed
  - Penthouse Frame and insulation on both sides
  - Tertiary SH outlets
- They will come back in tomorrow morning to complete the remainder of the work.
  - Tertiary SH and Primary SH internal insulation
  - The areas left off for the hydro above
- Early welders working on the repairs and should be complete around noon.
- NAES is installing the hydro plugs on all 3 safety valves and will be complete around noon as well.
- NAES Ops crew will manage the hydro. Valmet will perform the hydro inspection.




PH side framing on and starting insulation

Installing hydro plugs on safety valves

Night Shift

Boiler was pressurized to 380psig, A visual inspection of the Tertiary Outlet Header was performed. No indication of leaking. Inspection of the gauge was made at the steam drum. The pressure had dropped to 100psig.

- Hydro Checklist was completed (in areas where it was able to be completed).
- Early Construction and Thompson will return to site at approximately 5:30am to initiate pressurizing the boiler.
- At approximately 2am, the temperature at the steam drum was 108F. The gauge on the steam drum had dropped to 0psig.
- Day shift will pressurize the boiler to 1945psig and hold until the AI arrives.
- Early Construction arrived back on site at approximately 5:00am
- Thompson arrived back on site at approximately 5:15am

May 7, 2015

- **Boiler hydro complete (to NOP x 1.5 = 2385psi) and AI signed off**

Titan & Early

- Insulation crews in for PH reassemble, attemperator nozzles and Tertiary outlet lines.
- Completed at 3pm
- They required some cladding to complete one outlet header
- Early and Titan packing and cleaning up

Tertiary and Primary SH reinsulated

May 8, 2015

- **Fires in boiler at 800am. SA pressure was too high. Lowered to 7.7" H_2O and lit off.**
- **Tested system and everything handed back to operations group at 1130am.**
- **Unit on line at 1130pm and Overspeed trip engaged on turbine for testing. Unit on Automatic Generator Control at 130am May 9, 2015. 2-3 days ahead of schedule!!!!!**

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