

Public Meeting on Baffle-Former Bolt Degradation

Rockville, MD

July 13, 2017

NRC Inspections of Baffle-Former Bolt Examination and Repair



Jeff Poehler

Senior Materials Engineer

NRR/DE/EVIB

U.S. Nuclear Regulatory Commission

11555 Rockville Pike, Rockville, MD 20852

+1-301-415-8353

Jeffrey.Poehler@nrc.gov

NRC Recent Inspections Involving Baffle-Former Bolts

- NRC performed inspections of baffle-former bolt examination and replacement activities at the following plants:
 - Indian Point, Unit 2 (April-May 2016) – R-I
 - Salem, Unit 1 (June 2016) – R-I
 - D.C. Cook, Unit 2 (October-November 2016) R-III
 - Indian Point, Unit 3 (March 2017) R-I
 - Salem, Unit 2 (April 2017) R-I*
 - Diablo Canyon, Unit 1 (May 2017) R-IV*

* Salem, Unit 2, and Diablo Canyon, Unit 1 inspection reports are not issued yet

Baffle-Former Bolts Examination Results for Tier 1a Plants

Plant	EFPY@ Date of UT Exam	Date of UT Exam	No. of visually failed bolts	No. of bolts with UT indications	No. of bolts that could not be UT examined	Total No. of Potentially Degraded Bolts	No. of Bolts Replaced
Indian Point, Unit 2	31.1	March 2016	31	182	14	227	278
Salem, Unit 1	27	May 2016	38	135	16	192	189
D.C. Cook, Unit 2	26.7	October 2016	0	170	9	179	201
Indian Point, Unit 3	28.6	March 2017	0	256	3	259	270
Salem, Unit 2	25.4	April 2017	0	9	0	9	129
Diablo Canyon, Unit 1	27	May 2017	0	1	0	1	61

Indian Point, Unit 2

- In-depth review of technical analysis and corrective actions related to baffle-former bolt degradation
 - Bolt pattern analysis was acceptable
 - Margin for future bolt degradation sufficient
 - Licensee corrective action to examine bolts again next RFO
- No findings related to:
 - UT examination procedure
 - Replacement of degraded bolts
- Green non-cited violation issued for failure to perform an operability evaluation for IP3
 - Licensee later completed operability evaluation that the NRC found acceptable
 - NRC later withdrew the violation after challenge by licensee, further internal review

Salem, Unit 1

- In-depth review of technical analysis and corrective actions related to baffle-former bolt degradation
 - Bolt pattern analysis was acceptable
 - Margin for future bolt degradation sufficient
 - Licensee corrective action to examine bolts again next refueling outage
- No findings related to:
 - UT examination procedure
 - Replacement of degraded bolts
- Green non-cited violation issued for failure to perform an operability evaluation for Salem, Unit 2
 - Licensee completed operability evaluation after the NRC exit
 - NRC later withdrew the violation after challenge by licensee, further internal review
- NRC opened an unresolved issue related to the root cause evaluation to determine if a performance deficiency exists

D. C. Cook, Unit 2

- In-depth review of technical analysis and corrective actions related to baffle-former bolt degradation
 - Bolt pattern analysis
 - Noted that 6 replacement bolts installed in 2010 were among the degraded baffle-former bolts, and 5 degraded edge bolts
 - Reviewed assessments of cause of edge bolt and replacement bolt degradation
 - Metallurgical lab testing of replacement baffle-former bolts
 - Operability determination
- No findings related to:
 - UT examination procedure
 - Replacement of degraded bolts
 - Operability

D. C. Cook, Unit 2

- Annual Follow-Up on Selected Issues
 - Looked at 2010 baffle-former bolt degradation and corrective actions
- Determined that licensee actions to address bolt degradation in 2010 were appropriate
 - VT of D.C. Cook, Unit 1 baffle-former bolts in 2010 found no degradation; therefore, scheduling UT in 2017 was acceptable, and consistent with industry guidance
 - Leaving two vacant bolt locations was reasonable given the extent of bolt degradation known at the time
 - Degraded replacement bolts contributed to fuel fretting at vacant locations
 - Could not predict this would happen because extent of degradation of original bolts was not known without UT
 - UT for D.C. Cook, Unit 2 bolt design not available in 2010
- No findings

Indian Point, Unit 3

- Inspectors observed remote UT of the baffle-former bolts and VT of the baffle-former assembly, including baffle-edge bolts
- Inspectors verified that:
 - UT results were dispositioned in accordance with Entergy's procedure and corrective actions were in accordance with NRC requirements.
 - Entergy's actions were in-progress to replace all of the potentially degraded BFBs prior to restart.
- The inspectors did not identify any deviations from MRP-227-A and noted that Entergy's planned re-examination of original BFBs next refueling outage was in advance of the program required frequency.

Diablo Canyon, Unit 1

- Inspectors observed remote UT examinations and replacement activities of the baffle-former bolts, and verified that examination procedures and personnel were qualified.
- Inspectors did not identify any deviations from MRP-227-A,
- Noted that Diablo Canyon plans no additional UT inspections of either unit prior to planned shutdown at end of current operating license because:
 - Unit 2 is a Tier 3 plant (converted upflow, accelerated baseline inspections not required)
 - Expected end of license of both units is essentially 35 EFPY.
- The inspectors reviewed the bolt pattern analysis that identified the location of the 60 bolts that were preemptively replaced.

Salem, Unit 2

- Inspectors reviewed UT,VT, and corrective actions related to baffle-former bolts
- No issues preventing plant restart
- Inspection report to be issued mid-August 2017

Observations from Inspections

- Large fraction of bolts with UT indications retain significant load-bearing capacity, based on the high removal torque values and relatively large fraction of bolts removed intact
- Minimal degraded bolts missed by UT, based on small number of “green” bolts that break when removed

Conclusions

- Regional inspections of baffle-former bolt examination, evaluation and replacement activities have provided valuable insights into these activities.
- Licensees are following the industry guidance for baffle-former bolts examinations.
- Licensees are taking appropriate corrective actions to provide reasonable assurance of safe operation, such as:
 - Replacement of all degraded bolts plus additional margin bolts
 - Scheduling follow-up examinations next refueling outage
 - Lab analysis of bolts to support root cause evaluation
 - Analytical evaluation of bolting patterns.