



August 1, 2016  
NMP2L2620

ATTN: Document Control Desk  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

Nine Mile Point Nuclear Station, Unit 2  
Renewed Facility Operating License No. NPF-69  
Docket No. 50-410

Subject: Submittal of Post Extended Power Uprate Steam Dryer Inspection Results and Long-term Steam Dryer Inspection Plan in accordance with Operating License Conditions 2.C.(20)(f), 2.C.(20)(g) and 2.C.(20)(h)

- References:
- (1) Letter from R. V. Guzman (NRC) to K. Langdon (NMPNS), dated December 22, 2011, Nine Mile Point Nuclear Station, Unit No. 2 – Issuance of Amendment RE: Extended Power Uprate (TAC No. ME1476)
  - (2) Letter from P. M. Swift to the Document Control Desk (NRC), dated July 28, 2014, Submittal of Post Extended Power Uprate Steam Dryer Inspection Results in Accordance with Operating License Condition 2.C.(20)(f) and 2.C.(20)(g)
  - (3) Email from B. Vaidya (NRC) to T. Darling (NMPNS), dated August 13, 2014, Request for Additional Information, Nine Mile Point Unit 2, Submittal of Post Extended Power Uprate Steam Dryer Inspection Results in Accordance with Operating License Condition 2.C.(20)(f) and 2.C.(20)(g)
  - (4) Letter from P. Swift (NMPNS) to Document Control Desk (NRC), dated October 3, 2014, Response to Request for Additional Information - Nine Mile Point Unit 2, Submittal of Post Extended Power Uprate Steam Dryer Inspection Results in Accordance with Operating License Condition 2.C.(20)(f) and 2.C.(20)(g)
  - (5) Letter from B. Mozafari (NRC) to P. Orphanos (NMPNS), dated August 5, 2015, Nine Mile Point Nuclear Station, Unit 2 - Request for Additional Information Regarding Post Extended Power Uprate Steam Dryer Inspection Results
  - (6) Letter from A. Sterio (NMPNS) to Document Control Desk (NRC) dated October 8, 2015, Response to Request for Additional Information - Nine Mile Point Nuclear Station, Unit 2 - Request for Additional Information Regarding Post Extended Power Uprate Steam Dryer Inspection Results
  - (7) NRC Audit dated February 18, 2016, to determine the validity and applicability of the new loading component that was used in the NMP2 steam dryer stress analysis.
  - (8) Letter from A. Sterio (NMPNS) to Document Control Desk (NRC) dated May 4, 2016, Response to Questions Raised during NRC Audit of the

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- Response to Request for Additional Information Regarding Post Extended Power Uprate Steam Dryer Inspection Results
- (9) Letter from B. Mozafari (NRC) to B. Hanson (Exelon), dated June 24, 2016, Nine Mile Point Nuclear Station, Unit 2 - Summary Report of Audit Regarding the Steam Dryer Inspection Report Results (CAC No. MF4559).

By letter dated December 22, 2011 (Reference 1), the NRC issued Amendment No. 140 to Renewed Facility Operating License No. NPF-69 for Nine Mile Point Nuclear Station, Unit 2 (NMP2). The amendment authorized an increase in the maximum steady-state reactor core power level for NMP2 to 3,988 megawatts thermal (MWth). This letter provides the steam dryer inspection results in accordance with the following NMP2 license conditions associated with the issuance of Amendment No. 140:

License Condition 2.C.(20)(f) - *"During the first two scheduled refueling outages after reaching 120 percent OLTP conditions, a visual inspection shall be conducted of all accessible, susceptible locations of the steam dryer in accordance with BWRVIP-139 inspection guidelines. In addition, a visual inspection of all accessible welds that were analyzed using embedded models shall be conducted. In addition, a visual inspection of the existing indications in the upper support ring, the drain channel to skirt weld, the tie bar-to-hood weld heat affected zone, and vertical support plates shall be conducted."*

License Condition 2.C.(20)(g) - *"The results of the visual inspections of the steam dryer shall be reported to the NRC staff within 90 days following startup from the respective refueling outage."* The inspection results for the second RFO post EPU required by the license conditions above are summarized attachment (1) to this letter.

Please note that per the License Condition 2.C.(20)(f), this is the last submittal for the Steam Dryer Inspection.

The inspection results for the first refueling outage (RFO) post Extended Power Uprate (EPU) required by the license conditions above were provided to the NRC on July 28, 2014 (Reference 2). In Reference 3, the NRC submitted a Request for Additional Information (RAI) regarding the results of the steam dryer inspections documented in Reference 2. Nine Mile Point Nuclear Station (NMPNS) provided a response to the RAIs in Reference 4. In Reference 5, the NRC requested additional information regarding the results of the steam dryer inspections documented in Reference 2. NMPNS provided a response to the RAIs in Reference 6. On February 18, 2016 (Reference 7), the NRC performed an audit to determine the validity and applicability of the new loading component that was used in the NMP2 steam dryer stress analysis. In Reference 8, NMPNS provided the information requested during the NRC audit conducted in February 2016. In Reference 9, the NRC summarized the results of the February 2016 audit, and the subsequent RAI responses provided, and completed the assessment of the first refueling outage steam dryer inspection results. The assessment does include two open items from the review of the first refueling outage steam dryer inspection results, which are being reviewed along with the second refueling outage steam dryer inspection results. Section 4.0 of attachment (1) provides information to support resolution of the two open items.

The long-term steam dryer inspection plan in attachment (2) is submitted in accordance with the following NMP2 license condition:

License Condition 2.C.(20)(h) - *"At the end of the second refueling outage, following the implementation of the EPU, the licensee shall submit a long-term steam dryer inspection plan based on industry operating experience along with the baseline inspection results for NRC review and approval."*

There are no regulatory commitments contained in this letter.

Should you have any questions regarding the information in this submittal, please contact Dennis Moore, Site Regulatory Assurance Manager, at (315) 349-5219.

Sincerely,



Robert E. Kreider Jr.  
Plant Manager, Nine Mile Point Nuclear Station  
Exelon Generation Company, LLC

ADS/KJK

Attachments: (1) Steam Dryer Inspection Results - Second RFO Post EPU (N2R15)  
(2) Long-Term Steam Dryer Inspection Plan

cc: Regional Administrator, Region I, USNRC  
Project Manager, USNRC  
Resident Inspector, USNRC

**Attachment (1)**

Steam Dryer Inspection Results - Second RFO Post EPU (N2R15)

## Steam Dryer Inspection Results - Second RFO Post EPU (N2R15)

### 1.0 Purpose

This report provides the results of the visual inspections of the steam dryer as required by the Nine Mile Point Unit 2 Renewed Facility Operating License No. NPF-69 (Reference 1) License Conditions 2.C.(20)(f) and 2.C.(20)(g) as issued by Amendment No. 140 (Reference 2).

### 2.0 Inspection Summary

The required steam dryer inspections were completed during Refuel Outage N2R15, which concluded on May 5, 2016. The full steam dryer inspection results are documented in the GEH Refuel Outage Inspection report (Reference 3) and in the associated IDDEAL video database. The steam dryer inspection included a total of 329 locations. In summary the inspections included;

- 100 horizontal and vertical welds
  - 36 Tie Bars
  - 24 Cam/Nut and Washer tack welds
  - 40 Hood Support Welds
  - 9 Bank Reinforcement Bank welds
  - 4 hood reinforcement bank welds
  - 8 closure plate reinforcement welds
  - 8 reinforcement strip welds
  - 8 mass plate welds
  - 12 drain channel and pipe welds
  - 6 perforated plate welds
  - 44 lifting rod welds
  - 16 high stress areas
  - 6 upper support ring exams (100% circumference)
  - 2 lower guide
  - 1 manway cover weld
  - 4 impingement areas
- The scope also included inspection of the center closure plate stiffener bracket installed during Refuel Outage N2R14.

### 3.0 Inspection Results

The inspections show no cracking associated with the locations analyzed with the embedded models, no cracking associated the BWRVIP-139 inspections, no change in the intergranular stress corrosion cracking (IGSCC) associated with support ring locations, no new cracking, and no change in the drain channel to skirt weld locations.

Section 2.2.6.1.1 of the Safety Evaluation Report (SER) for Reference 2 discusses existing steam dryer cracking flaw evaluations. The SER section discusses the IGSCC flaw evaluations for the upper ring, the tie bars and the steam dryer hood support vertical cracks. The SER accepted the flaw evaluation basis which concluded that EPU conditions would not create

## Steam Dryer Inspection Results - Second RFO Post EPU (N2R15)

sufficient alternating stress to cause fatigue crack growth of the existing IGSCC cracks and that the existing hood support plate vertical weld cracks would remain bounded by the flaw evaluation without repair.

The flaw assessment for the hood support vertical cracks concluded that these fatigue cracks would not grow vertically longer than 2 to 3 inches under EPU service condition and therefore repair of these locations was not required for EPU service. The 2014 inspection showed all the existing cracking remains bounded by the flaw evaluations noted in the SER assessment. The 2016 inspection showed no discernable change of the pre-existing cracking associated with the steam dryer hood support vertical cracks which is consistent with the flaw evaluations and no new crack indications were identified associated with these components.

The EPU steam dryer modifications included installation of eight mass plates in 2012: four 10 lb. plates installed on the middle section of the inner hoods, four 15 lb. plates on the middle section of the middle hoods. Each plate is attached with an upper and lower 3/16" fillet weld. In 2014 a fabrication related indication was identified and a stop drill repair implemented. The inspections of the eight mass plates showed no relevant indications and confirmed the stop drill repair was effective with no discernable change.

The previously identified tie bar to hood IGSCC locations and the steam dryer support ring IGSCC locations showed no evidence of fatigue crack growth. The inspection scope included all 36 tie bar locations last inspected in 2014. The 2016 inspection of the tie bar shows the IGSCC cracking remains essentially unchanged and remains bounded by the previous flaw evaluations.

In the 2012 pre-EPU outage, NMP2 installed additional redundant tack welds to both the cam nuts and the lifting lug to add additional margin. The 2014 inspection showed no new cracking in the repaired cam nut tack weld locations. The 2014 100% re-baseline identified one new location with a cam nut tack weld crack. For this location the anti-rotation function was not degraded as redundant tack welds exist and adequate engagement exists to prevent rotation. The 2014 100% baseline identified two of the lifting lugs with tack weld cracks. These cracks were found in similar locations to the pre-EPU baseline cracking. The anti-rotation function was not degraded based on adequate integrity of the weld / interference and redundancy of the tack welds. The 2016 inspection shows no discernable change for the cam nut anti-rotation tack welds from 2014. The 2016 inspections show no new lifting rod lug tack weld cracks and concluded the tack weld cracking remains essentially unchanged from the 2014 baseline. The 2016 lifting lug tack weld included improved EVT-1 quality which showed apparent change from 2014; however, review of the 2014 inspection video was able to show the condition remained essentially unchanged from the 2014 baseline.

The 2016 inspection scope included two previously repaired guide channel skirt locations. The repairs were performed in 2012. The 2016 inspections show the repairs remained effective with no discernable change from the 2012 baseline. The repair at one location stopped after surface preparation concluded the indication had been removed. The 2016 inspection shows portions of the indication that were evident in 2012 were visible in 2016. The comparison between the

## Steam Dryer Inspection Results - Second RFO Post EPU (N2R15)

2016 indication and the pre-repair 2012 baseline shows no discernable change in the length or other characteristics. The evaluation concluded that the indication is stable and the location is not considered an active crack.

### 4.0 Acoustic Circuit Model Vendor Non-Conformance

In October 2013, Continuum Dynamics Inc. (CDI) issued a preliminary notice of investigation into an issue associated with the CDI Acoustic Circuit Model (ACM) version 4.1 used to assess the NMP2 acoustic loads on the steam dryer. CDI determined that the software used for the NMP2 steam dryer evaluation was run with an option activated that was not consistent with the ACM computer software used to define the ACM 4.1 benchmark bias and uncertainties. The resolution of NC-0343 was evaluated in the NMPNS corrective action program (CR-2013-008411). The corrected ACM load definition is documented in CDI Report No. 14-09P (Reference 4) and the stress re-evaluation is documented in CDI Report No. 14-08P (Reference 5). These reports were submitted for NRC review and approval in October 2014.

Based on NRC review of the CDI Report No. 14-08P, NRC staff requested NMP2 assess the alternating stress ratio (SR-a) without the Velocity Induced loading (VIL) applied in CDI Report 14-08P. CDI Report TN 16-03P (Reference 6) provided the steam dryer stress analysis results without VIL considered. The results show all steam dryer locations have SR-a greater than the licensing basis ASME code minimum ratio of 1.0. The TN 16-03 table 2 identifies the location specific SR-a below the NRC recommended ratio of 2.0. The 2016 steam dryer inspections included all the locations identified in TN 16-03P table 2.

Based on review of Appendix C of Report 14-09P, Rev. 1, (Reference 4) the NRC requested NMP2 check the accuracy of the plots / pressure loading as they appear lower than expected. Appendix C of Report 14-09P, Rev. 1, shows predicted pressure loading spectra at various locations on the hoods of the NMP2 steam dryer, where pressure loading is lower than the peak load on the outer bank hoods, shown in Figure 4.6 of this report. Three checks have been performed regarding the loads presented in appendix C:

- 1) A comparison between a representative measured outer bank hood pressure loading on the Quad Cities Unit 2 (QC2) dryer and the computed pressure loading at a similar location on the NMP2 outer bank hood at a similar main steam line Mach number. The conclusion is that the loading definition for NMP2 is consistent with the load measured on the QC2 dryer.
- 2) An independent check of the design record file of the calculation supporting the load definition was completed and no errors or inconsistencies were found in the analysis.
- 3) The loads were compared to a similar size plant and dryer evaluated with the CDI ACM model and the pressure loading spectra considered to be in the same order of magnitude.

## 5.0 Second Post EPU steam Dryer Inspection Results Conclusion

The inspections completed during N2R14 and N2R15 have not identified any EPU related service induced cracking. The NMP2 steam dryer remains qualified for EPU service conditions.

The NMP2 resolution of NC-0343 included installing a center plate stiffener modification and updating the stress analysis as documented in CDI Report 14-08P. This resolution demonstrated that all steam dryer locations have an SR-a above the recommended ratio of 2.0. The NRC review of CDI Report 14-08P requested NMP2 define the limiting SR-a without consideration for the Velocity Induced Loading effects. NMP2 provided TN 16-03P for NRC review which defines all steam dryer locations with SR-a below 2.0 without VIL. The 2016 inspections verified no service induced fatigue cracking exists at these locations after 4 years of EPU service. The qualitative review of the fatigue usage for the locations with SR-a below 2.0 when discounting the VIL mechanism shows the minimum number of fatigue cycles experienced at NMP2 post EPU is greater than  $10^9$  cycles and as such the inspections are considered sufficient basis to conclude the SR-a will remain above the required SR-a ASME code margins.

## 6.0 References

1. Nine Mile Point Unit 2 Renewed Facility Operating License No. NPF-69
2. Letter from R. Guzman (NRC) to K. Langdon (NMPNS), "Nine Mile Point Nuclear Station, Unit No. 2 - Issuance of Amendment RE: Extended Power Uprate (TAC NO. ME1476)," dated December 22, 2011
3. In-Vessel Visual Inspection (IVVI) of Reactor Pressure Vessel Internals, Nine Mile Point Generating Station - Unit 2 (NMP2R15) 2016 Spring Outage, GEH Final Report Summary Number GEH-RPT-N2R15-321565-KG1-IVVI, dated April 30, 2016
4. CDI Report No. 14-09P, "Acoustic and Low Frequency Hydrodynamic Loads at 115% CLTP Target Power Level on Nine Mile Point Unit 2 Steam Dryer to 250 Hz Using ACM 4.1R"
5. CDI Report No. 14-08P, "Stress Re-Evaluation of Nine Mile Point Unit 2 Steam Dryer at 115% CLTP"
6. CDI Report TN 16-03P, "Nine Mile Point Steam Dryer Inspection Recommendations Based on Flow-Induced Vibratory Stresses"



Attachment (2)

Long-Term Steam Dryer Inspection Plan

## Long-Term Steam Dryer Inspection Plan

The results of the two successive steam dryer inspections have not revealed any new unacceptable flaws or unacceptable flaw growth that is due to fatigue. This satisfies the license condition requirements defined in license condition 2.C.(20) which state that these conditions shall expire upon satisfaction of the requirements in paragraphs (f) and (g), provided that a visual inspection of the steam dryer does not reveal any new unacceptable flaw(s) or unacceptable flaw growth that is due to fatigue.

Based on these results, the NMP2 long term inspection frequency plan is to revert to the BWRVIP-139 inspection protocol using the second post EPU inspection as the baseline inspection as defined by BWRVIP-139. All the EPU related modifications and post EPU inspection requirements defined in license condition 2.C.(20) will be considered as high stress locations as defined by BWRVIP-139 for the NMP2 curved hood steam dryer and inspected accordingly to the BWRVIP requirements. Consistent with BWRVIP-139 inspection requirements, all crack indications will be inspected until it is determined that the crack is stable by at least two successive inspections. The plan is to complete a third post EPU inspection of all crack locations that also have an SR-a below 2.0 without considerations for VIL prior to considering these locations as stable.

The final NMP2 stress report established that NMP2 meets the recommended margin of 2.0 for all steam dryer locations. NMP2 considers this a realistic assessment of the actual margins. When the Velocity Induced Loading is not considered, the minimum margin remains above the licensing basis ASME code required margin; but at several locations the minimum alternating stress margin is below the recommended margin of 2.0. For these specific nodal locations, the long term inspection plan will include inspection of these specific locations in the third post EPU refueling outage. Review of the actual fatigue usage for these locations will be performed to determine inspection frequency beyond the third post EPU inspection for these locations. Supplemental validation of the NMP2 Velocity Induced Loading is under review and may be submitted to reconcile the actual fatigue usage margin for the NMP2 steam dryer under EPU steam flow conditions.

Consistent with BWRVIP-139 requirements, NMP2 monitoring of the reactor Moisture Carryover (MCO) is trended on a monthly basis and compared to the post EPU baseline that has been established based on monitoring from 2012 through 2016. The NMP2 post EPU MCO baseline performance shows MCO is in the .01 to .03 wt % range with variations based on reactor core exposure / control rod pattern variations and cycle specific core design factors. This MCO performance is considered excellent (NMP2 design MCO is less than 0.1 wt % for EPU conditions and less than .25 wt % for MELLLA+ conditions) and is actually below the pre-EPU baseline. This performance is anticipated as the EPU core has less radial peaking than the pre-EPU core designs. Consistent with BWRVIP-139 requirements, NMP2 procedures require more frequent monitoring if the MCO trend is outside the normal operating band or other reactor parameters, such as reactor water level deviations, indicate a potential steam dryer bypass flow path.