IPRenewal NPEmails

From: Daily, John
Sent: Monday, December 17, 2012 8:44 AM
To: Ghosh, Anita
Cc: IPRenewal NPEmails
Subject: Non-proprietary version of NL-12-166 from IPEC

This is a non-proprietary version as per your request.
It contains the cover letter and Attachment 2.
Please review.

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NL-12-166
final-nonProp.pdf

Hearing Identifier: IndianPointUnits2and3NonPublic_EX
Email Number: 3987

Mail Envelope Properties (0046140293E11F408991442DB4FE25CA9DAC7D4D4E)

Subject: Non-proprietary version of NL-12-166 from IPEC
Sent Date: 12/17/2012 8:44:20 AM
Received Date: 12/17/2012 8:44:24 AM
From: Daily, John

Created By: John.Daily@nrc.gov

Recipients:
"IPRenewal NPEmails" <IPRenewal.NPEmails@nrc.gov>
Tracking Status: None
"Ghosh, Anita" <Anita.Ghosh@nrc.gov>
Tracking Status: None

Post Office: HQCLSTR01.nrc.gov

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MESSAGE	316	12/17/2012 8:44:24 AM
NL-12-166 final-nonProp.pdf	62784	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
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Recipients Received:

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Fred Dacimo
Vice President
Operations License Renewal

NL-12-166

November 20, 2012

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

SUBJECT: Reply to Request for Additional Information Regarding the License Renewal Application
Indian Point Nuclear Generating Unit Nos. 2 & 3
Docket Nos. 50-247 and 50-286
License Nos. DPR-26 and DPR-64

REFERENCE: 1. NRC letter, "Request for Additional Information for the Review of the Indian Point Nuclear Generating Units 2 and 3, License Renewal Application, SET 2012-03" dated October 16, 2012

Dear Sir or Madam:

Entergy Nuclear Operations, Inc is providing the additional information requested in Reference 1 pertaining to NRC review of the License Renewal Application (LRA) for Indian Point 2 and Indian Point 3. Proprietary and Non-Proprietary versions of the reply are provided in Attachments 1 and 2, respectively. Attachment 3 provides the background for the response.

Attachments 1 and 3 include information deemed proprietary by an entity that is providing support to Entergy on this RAI response. As such, in Attachment 4, a 10 CFR 2.390 affidavit has been executed by the owner of the information.

There are no new regulatory commitments in this submittal.

If you have any questions, or require additional information, please contact Mr. Robert Walpole at 914-254-6710.

I declare under penalty of perjury that the foregoing is true and correct. Executed on 11-20-12.

Sincerely,

Patrick W. Conway, acting for Fred Dacimo

FRD/rw

Attachment: 1. Reply to NRC Request for Additional Information Regarding the License Renewal Application (Proprietary Reply)

2. Reply to NRC Request for Additional Information Regarding the License Renewal Application (Non-Proprietary Reply)

3. Westinghouse Proprietary Letter LTR-RIDA-12-197

4. Application for Withholding Proprietary Information from Public Disclosure

cc: Mr. William Dean, Regional Administrator, NRC Region I
Mr. Sherwin E. Turk, NRC Office of General Counsel, Special Counsel
Mr. Dave Wrona, NRC Branch Chief, Engineering Review Branch I
Mr. John Daily, NRC Sr. Project Manager, Division of License Renewal
Mr. Douglas Pickett, NRR Senior Project Manager
Ms. Bridget Frymire, New York State Department of Public Service
NRC Resident Inspector's Office
Mr. Francis J. Murray, Jr., President and CEO NYSERDA

ATTACHMENT 2 TO NL-12-166

REPLY TO NRC REQUEST FOR ADDITIONAL INFORMATION

REGARDING THE

LICENSE RENEWAL APPLICATION

(Non-Proprietary Reply)

ENTERGY NUCLEAR OPERATIONS, INC.
INDIAN POINT NUCLEAR GENERATING UNIT NOS. 2 & 3
DOCKET NOS. 50-247 AND 50-286

INDIAN POINT NUCLEAR GENERATING UNIT NOS. 2 AND 3
LICENSE RENEWAL APPLICATION (LRA)
REQUESTS FOR ADDITIONAL INFORMATION (RAI)

RAI 16

Entergy Nuclear Operations, Inc. (Entergy)'s response to Applicant/Licensee Action Item 3 in the Reactor Vessel Internal (RVI) Inspection Plan (Reference 1), indicates that the current Indian Point Unit 2 (IP2) guide tube support pins (split pins) were installed in 1995 and are fabricated from X750 Rev. B material, which has improved resistance to stress corrosion cracking (SCC). Entergy's response further states that it plans to begin preliminary IP2 split pin replacement engineering and walkdowns in 2014 and replace the split pins in 2016. However, no basis was given for these dates. The response to request for additional information (RAI) 8 (Reference 2) indicates, in part, that no inspections are planned for the split pins during the period of extended operation, except that the replacement cold-worked Type 316 pins could potentially be inspected if determined to be necessary based on operating experience. Based on the above, the applicant apparently does not plan any inspections of the currently installed IP2 split pins.

Requested Information:

1. Justify the proposed date for replacement of the IP2 split pins, based on predicted degradation of the split pins, and considering that no inspections will be performed on the currently-installed pins prior to replacement.

2. If (a) the proposed replacement date (2016) cannot be justified without performing inspections; or (b) the currently-installed IP2 split pins are not replaced by the proposed date, provide the date when inspections would need to commence, and the periodicity of these inspections to ensure the intended function(s) of the split pins will be maintained until replacement.

3. Describe the inspection methods to be used for any inspections proposed.

Response to RAI 16

1. The current IP2 split pins were installed in 1995 as a replacement for the original X-750 split pins which exhibited stress corrosion cracking (SCC) of one pin. The replacement split pins were designed, fabricated and installed in accordance with the requirements of Westinghouse Specification [ ]^{a,c} and EPRI NP-7032. These design, fabrication and installation improvements over the previous generation of split pins resulted in lower susceptibility to SCC by lowering the residual stresses, reducing the stress concentration effects, improving surface condition and increasing the material's resistance to stress corrosion cracking (SCC). The following summarizes the improvements made to the replacement pins as well as the operating experience of other Revision B, X-750 split pins:

a) The design improvements included the following.

Split Pin Threads - [ ]^{a,c} no radius specification except as per the ANSI requirements for 0.625-11UNC-2A. The thread engagement on the nut is the same for both the original and the replacement pins.

Split Pin Shank - [

]^{a,c} This change, combined with the slightly smaller shank diameter, reduced the fillet stress [ ]^{a,c}.

Leaves – [ ]^{a,c}

b) The material improvements to resist SCC included the following.

The support pin material was procured to a newer Westinghouse material specification, [ ]^{a,c}, than for the reference plant pin [ ]^{a,c} material specification. The newer specification incorporates all of the requirements in the Rev. B specification and addresses additional EPRI recommendations provided in EPRI report N-7032.

The material certification package indicates that the X-750 material was produced to the HTH condition, which is consistent with the heat treat requirements of [ ]^{a,c}. The HTH condition is a higher temperature (i.e. 1975 ºF - 2050 ºF) heat treatment designed to provide X-750 with improved SCC resistance over earlier heat treatments. A review of the Certified Material Test Reports (CMTRs) confirmed that the solution and precipitation hardening heat treatments meet both specifications. Mechanical, chemical and rising load test requirements were also met based on a review of the CMTRs.

From these evaluations, the material procured for the Indian Point Unit 2 support pins meets the requirements of both material specifications [ ]^{a,c} as well as the improvements provided in EPRI N-7032.

c) Review of operating experience.

A review of the Operating Experience (OE) of the Alloy X-750 Revision B material was also performed to establish the likelihood that IP2 could experience cracking prior to the planned replacement date of 2016.

An analysis was performed to normalize the number of effective full power hours of fourteen plants to the same stress and operating temperature to allow for comparison between IP2 and the other plants with the same Revision B, split pin material. Of these plants, twelve had cracking and separation at the pin shanks (either at the bottom of the shank or near the bottom of the threads) and two had pins with cracked and broken leaves. Therefore, the normalization was separated into these two groups due to the different operating time normalization method.

The operating times were normalized to the Indian Point Unit 2 operating conditions by both temperature and preload stress. The cracking susceptibility (Arrhenius)

equation was used to perform this normalization by multiplying each reference plant support pin operating Effective Full Power Hours (EFPH) by the ratio of this equation derived at the Indian Point Unit 2 conditions to that of each operating plant:

$$t \propto \exp\left[\frac{Q}{RT}\right]\sigma^{-a}$$

where,

t = operating time to crack initiation
[ ]^{b,c}
R = universal gas constant = 0.001986 kcal/(gmole °K)
T = absolute temperature in °K
σ = stress due to preload plus temperature (for the shank region)
[ ]^{b,c}

For the ranges for Q and a, [ ]^{b,c} were found to be most conservative to minimize the operating times normalized to Indian Point Unit 2 conditions. The exponent for the stress is typically closer to 4.0, however, since the shank stress is reduced by the reduced installation torque and typically lower temperature for Indian Point Unit 2, the value of [ ]^{b,c} was used to minimize the benefit gained by the lower stress.

Pin Shank

The shank stress, $\sigma_{\tau,}$ is derived as a function of temperature. This is added to the initial preload stress. The stress as a function of temperature is based on the relative thermal expansion between the Inconel X-750 and Type 304 stainless materials, and the stiffness of the pin shank and surrounding guide tube flange.

$$\sigma_t = \frac{\delta E}{\ell_b} = \frac{\ell_1}{\ell_b}(\alpha_1 - \alpha_2)\Delta T\left(\frac{\overline{K}}{\overline{K} + K_b}\right)E$$

where,

ℓ_1 = bottom flange thickness between pin shoulder and nut
ℓ_b = pin shank length from shoulder to thread engagement
α_1 and α_2 = coefficients of thermal expansion for Type 304 and X-750 respectively
ΔT = temperature change from room temperature to core exit normal operating temperature
$\overline{K}$ = combined axial stiffness of bottom flange and nut
K_b = pin shank axial stiffness
E = X-750 elastic modulus

The installation preload stress is derived using the minimum torque coefficient for two reasons. First, this maximizes the preload force which minimizes the effect of the added temperature stress when ratioed since the Indian Point Unit 2 operating core

exit temperature is typically less than for the reference plants. Secondly, it is likely that the pins that crack and fracture first, which are the ones used for the reference operating times, would have the highest stress. Thus, it is assumed that these pins had a higher preload. [ ]^{a,c}

For each reference plant, the operating times were derived by summing operating intervals which occurred at different core exit temperatures.

The Indian Point core exit temperature was derived from the cycle-specific vessel outlet temperatures from cycle 13 when the pins were installed in 1995 until the proposed removal in 2016. A weighted average based on the effective full power days (EFPD) of each cycle times the temperatures was used for the measured temperatures up through cycle 18 (2008), and then from 2008 until 2016, four more cycles of 680 EFPD based on the highest EFPD per cycle is used times a bounding temperature of 597°F. This averaging results in a vessel outlet temperature of 594.9°F. To convert to core exit temperature, an additional [ ]^{b,c} based on Westinghouse derived core exit and vessel outlet temperatures for Indian Point Unit 2 is added to give [ ]^{b,c}. To provide additional margin, the temperature is increased two more degrees to [ ]^{b,c}.

Based on the above methodology and operating temperature, the following normalized operating times to failure of the support pin shanks result.

Plant	No. of Shank Fractures	EFPH Normalized to Indian Point Unit 2
A*	1	276,100
A	2	299,500
B	6	305,700
C	2	317,400
D	1	242,200
E	2	301,200
F*	1	349,500
F	4	356,500
G	4	376,800
H	5	241,700
K	2	277,300
L	1	270,400
N	1	307,000
O	5	232,900

* Fractured during operation

The average and 2σ standard deviation range from this distribution are:

Average = 296,700 EFPH
2σ range = 199,700 to 393,600 EFPH

The above statistics are derived using the number of fractured shanks as listed. If based on the number of plants with no weighting by the number of fractures per plant,

the average is essentially the same at 296,600 EFPH, but with a slightly smaller 2σ standard deviation, so the above derivation is slightly bounding.

Pin Leaves

As previously mentioned, two plants had only fractures of the pin leaves. These were plants J and M.

To minimize the stress reduction due to the lower pinching interference of the Indian Point Unit 2 pins, the minimum interference is assumed for the reference plants and the maximum interference is assumed for the Indian Point Unit 2 pins. As shown above, this resulted in the same diametrical interference of [ ]^{a,c}. Therefore, the reference plant operating times are normalized using only the effect of temperature. In reality, it is very likely that less interference preload exists. For this derivation, the resulting operating times normalized to Indian Point Unit 2 are:

Plant	No. of Shank Fractures	EFPH Normalized to Indian Point Unit 2
J	5	232,700
M	2	252,100

This gives an average time of 238,200 EFPH. Due to the small number of fractures, no standard deviation was derived.

Comparison to Indian Point Unit 2 Operating Time

The above normalized operating times indicate that the probability of split pin cracking at IP2 due to SCC is extremely low based on the 152,000 EFPH estimated for IP2 between 1995 and the currently scheduled replacement date of March 2016. The lowest number of normalized EFPH before cracking was observed at other plants with Revision B split pin material was 232,700 EFPH which is significantly more than the estimated number of EFPH for IP2.

Conclusion

Based on the results of the above review, it is concluded that the current IP2, X-750 Revision B split pins are acceptable for continued service through the current planned replacement date of 2016. The likelihood of pin cracking prior to 2016 resulting from SCC is low considering the low residual and preload stresses, the improved material's resistance to SCC and the OE of other Revision B split pins. It should be further noted that split pins are not core support structures and although failure of a split pin could result is a loose part it would not be expected to adversely affect the ability of the vessel internals to withstand a design basis transient.

2. a) As discussed above, the current IP2 split pins are acceptable for continued service through the proposed replacement date of 2016 given the design improvements, the improved material resistance to SCC and the operating experience of other plants with Revision B material split pins. Therefore, no split pin inspections are required prior to the 2016 replacement date.

b) The IP2 split pins are scheduled to be replaced during the 2016 refueling outage. If the replacement is not implemented as currently scheduled, Entergy will provide the NRC staff with a detailed inspection plan, including inspection methods, inspection coverage and inspection frequency no later than March 2015.

3. Since no inspections are planned, no details are provided in this response. However, if the replacement is not implemented during the March 2016 refueling outage, Entergy will provide the NRC staff with the inspection methods no later than March 2015.

References

1. Indian Point Energy Center Revised Reactor Vessel Internals Inspection Plan Compliant with MRP-227-A. Attachment 2 to Entergy Letter NL-12-037, Letter from Fred Dacimo to NRC dated February 17, 2012, Subject: License Renewal Application -Revised Reactor Vessel Internals Program and Inspection Plan Compliant with MRP-227 -A, Indian Point Nuclear Generating, Units 2 and 3 Docket Nos. 50-247 and 50-286-License Nos. DPR-26 and DPR-64 (ADAMS Accession No. ML 12060A312).

2. Letter from Fred Dacimo to NRC dated June 14, 2012, Subject: Reply to Request for Additional Information Regarding the License Renewal Application Indian Point Nuclear Generating Unit Nos. 2 &3 Docket Nos. 50-247 and 50-286 License Nos. DPR-26 and DPR-64 (NL-12-089) (ADAMS Accession No. ML 12184A037).