



**Entergy Nuclear Northeast**  
Indian Point Energy Center  
450 Broadway, GSB  
P.O. Box 249  
Buchanan, NY 10511-0249  
Tel (914) 254-2055

Fred Dacimo  
Vice President  
Operations License Renewal

NL-14-013

January 28, 2014

U.S. Nuclear Regulatory Commission  
Document Control Desk  
11545 Rockville Pike, TWFN-2 F1  
Rockville, MD 20852-2738

SUBJECT: Additional Information Regarding the License Renewal Application –  
Action Item 7 from MRP-227-A  
Indian Point Nuclear Generating Unit Nos. 2 & 3  
Docket Nos. 50-247 and 50-286  
License Nos. DPR-26 and DPR-64

REFERENCES:

1. NRC letter, "Summary of Conference Call held on December 18, 2013, between the U.S. Nuclear Regulatory Commission and Entergy Nuclear Operations, Inc., Concerning Applicant/Licensee Action Item 7 from MRP-227-A" dated January 9, 2014.
2. Entergy letter, NL-13-122, "Reply to Request for Additional Information Regarding the License Renewal Application" dated September 27, 2013.

Dear Sir or Madam:

Entergy Nuclear Operations, Inc is providing, in the enclosure, additional information pertaining to NRC review of the License Renewal Application (LRA) for Indian Point 2 (IP2) and Indian Point 3 (IP3). The additional information is being provided as a follow up to a recent conference call between Entergy and the NRC regarding Action Item 7 from MRP-227-A, as documented in Reference 1. The NRC letter notes that the NRC is considering an alternative approach for cast austenitic stainless steel (CASS) components that may impact Commitment 47. This alternative approach would be based on ferrite content derived from certified material test reports (CMTRs) for CASS components. There are 96 columns with CASS caps in the lower internals assembly of each Indian Point unit. As noted on the call, CMTRs are available for all of the IP3 CASS caps. As documented in the enclosure attached to this letter, Entergy can now confirm that CMTRs are also available for all of the IP2 CASS caps, and that the IP2 and IP3 column caps are of low molybdenum CF8 material. As noted in Reference 2, no special casting processes were designated; thus, it was conservatively assumed that the lower core support column caps were statically cast.

A128  
NRR

There are no new regulatory commitments in this submittal.

I declare under penalty of perjury that the foregoing is true and correct. Executed on  
1/28, 2014.

Sincerely,



FRD/rw

Enclosure: LTR-RIAM-14-2, Revision 0, Attachment 1, "Summary of the Evaluation of Indian Point Units 2 and 3, Lower Internals Assembly, Column Caps – Ferrite Content and Susceptibility to Thermal Embrittlement"

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  
Ms. Kimberly Green, 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

**ENCLOSURE TO NL-14-013**

**LTR-RIAM-14-2, Revision 0, Attachment 1, "Summary of the Evaluation of Indian Point  
Units 2 and 3, Lower Internals Assembly, Column Caps – Ferrite Content and  
Susceptibility to Thermal Embrittlement"**

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

**Attachment 1: Summary of the Evaluation of Indian Point Units 2 and 3, Lower Internals Assembly, Column Caps - Ferrite Content and Susceptibility to Thermal Embrittlement**

## **Summary of the Evaluation of Indian Point Units 2 and 3, Lower Internals Assembly, Column Caps - Ferrite Content and Susceptibility to Thermal Embrittlement**

### **Background and Purpose**

The Reactor Vessel Internals (RVI) Program at Indian Point Units 2 and 3 is based on MRP-227-A (Reference 1) and is the base program that addresses the RVI components that require aging management and it specifies inspection requirements. The Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) Program at Indian Point (IPEC LRA (Reference 2) augments the RVI program by evaluating the potential susceptibility to thermal embrittlement (TE) of plant-specific CASS components.

The delta ferrite content of the CASS component is calculated using Hull's formula (as applied to CASS material in Reference 3) with input of element percentages from the component-specific chemistry from either the material specification or from the certified material test report (CMTR) for the material. The NRC screening criteria for TE (Reference 4, Table 2) is based on chemistry, casting method, and the delta-ferrite content.

This is an evaluation of the susceptibility to TE of the Indian Point Units 2 and 3 CASS column caps. These CASS column caps are part of the support columns in the lower internals assembly. There are 96 columns with CASS caps in the lower internals assembly of each Indian Point Unit. Figure 1 is an illustration of the column with its CASS cap. This Indian Point-specific component, lower internals assembly - column cap, correlates to the MRP-227-A, lower support assembly, lower support column bodies (cast) component.



**Figure 1 Support Column with CASS Cap (cast cap is shown as shaded)**

**Indian Point Unit 2, Lower Internals Assembly Column Cap - Ferrite Content and Thermal Embrittlement Evaluation**

The Indian Point Unit 2 lower internals assembly - column caps were cast from ASTM A296, Grade CF8 material (Reference 5). The elemental percentages from the CMTRs, for the Indian Point Unit 2, CASS column caps, are input into Hull's formula (per Reference 3 guidance) to calculate the delta ferrite content of the CASS material. The Indian Point Unit 2 CMTRs do not list the element percentage for nitrogen; thus, per the guidance of Reference 3, nitrogen is assumed to be 0.04 percent. The CMTRs do not list an elemental percentage for molybdenum. ASTM A296, Grade CF8 did not have a requirement for percent molybdenum and that specification was withdrawn in 1977. The current ASTM A351-13, Grade CF8 chemistry requirements specify a maximum of 0.5 percent molybdenum; thus, this maximum value is input into Hull's formula.

The Westinghouse records show that six different heats of material were used to produce 97 CASS caps that were released for use in the fabrication of the 96 Indian Point Unit 2 columns in the lower internals assembly columns. The records do not show exactly which cast cap, out of the 97, was used on each of the 96 columns. The calculated ferrite contents are listed in Table 1. The maximum ferrite content is 14.6 percent, the minimum is 6.4 percent, and the mean ferrite content is 10.5 percent.

The TE screening of Indian Point Unit 2, CASS column caps is shown in Table 2. The Indian Point Unit 2 column caps are of low molybdenum CF8 material, are assumed static cast, and have maximum ferrite content 14.6 percent which is less than the 20 percent screening level. Therefore, consistent with the NRC criteria of Reference 4, it is concluded that the Indian Point Unit 2 lower internals assembly, column caps are not susceptible to TE.

**Table 1 Indian Point Unit 2 Lower Internals Assembly - Column Caps  
Heat and Ferrite Content**

Supplier Heat Number	Quantity of CASS Caps	Calculated Ferrite Content (Percent)
L14	23	8.1
L25	25	12.4
L35	20	14.6
L54	14	6.4
L60	7	10.3
L217	8	7.8

**Table 2 TE Screening of Indian Point Unit 2 Lower Internals Assembly -  
Column Caps**

Molybdenum Content	Casting Method	Delta Ferrite Level	Susceptibility to TE
Low, 0.5 Maximum	Static	≤ 20%	Not susceptible to TE

**Indian Point Unit 3, Lower Internals Assembly Column Cap - Ferrite Content and Thermal Embrittlement Evaluation**

The Indian Point Unit 3 lower internals assembly - column caps were cast from ASTM A296 Grade CF8 material (Reference 6). The elemental percentages from the CMTRs, for the Indian Point Unit 3, CASS column caps, are input into Hull's formula (per Reference 3 guidance) to calculate the delta ferrite content of the CASS material. The Indian Point Unit 3 CMTRs do not list the element percentage for nitrogen; thus, per the guidance of Reference 3, nitrogen is assumed to be 0.04 percent. The CMTRs typically do not list an elemental percentage for molybdenum. There are isolated cases where the Indian Point Unit 3 records do list the molybdenum percentage, which ranges from 0.14 to 0.36 percent, depending on the material heat. Where the CMTRs do list the molybdenum percentage, the listed value is used in the calculation of ferrite content. ASTM A296, Grade CF8 did not have a requirement for percent molybdenum and the specification was withdrawn in 1977; thus, where the CMTRs do not list molybdenum, the current ASTM A351-13, Grade CF8 chemistry requirement of maximum 0.5 percent molybdenum is input into Hull's formula.

The Westinghouse records show that seven different heats of material were used to produce 97 CASS caps that were released for use in the fabrication of the 96 Indian Point Unit 3 lower internals assembly columns. The records do not show exactly which cast cap, out of the 97, was used on each of the 96 columns. The calculated ferrite contents are listed in Table 3. The maximum ferrite content is 11.8 percent, the minimum is 5.2 percent, and the mean ferrite content is 8.3 percent.

The TE screening of Indian Point Unit 3, CASS column caps is shown in Table 4. The Indian Point Unit 3, column caps are of low molybdenum CF8 material, are assumed static cast, and have maximum ferrite content 11.8 percent which is less than the 20 percent screening level. Therefore, consistent with the NRC criteria of Reference 4, it is concluded that the Indian Point Unit 3 lower internals assembly, column caps are not susceptible to TE.

**Table 3 Indian Point Unit 3 Lower Internals Assembly - Column Caps  
Heat and Ferrite Content**

Supplier Heat Number	Quantity of CASS Caps	Calculated Ferrite Content (Percent)
L335	13	8.9
L347	21	7.7
L353	18	11.8
L355	6	7.9
L364	22	5.2
L370	4	5.3
L373	13	10.0

**Table 4 TE Screening of Indian Point Unit 3 Lower Internals Assembly -  
Column Caps**

Molybdenum Content	Casting Method	Delta Ferrite Level	Susceptibility to TE
Low, 0.5 Maximum	Static	≤ 20%	Not susceptible to TE

**References**

1. *Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A)*. EPRI, Palo Alto, CA: 2011. 1022863.
2. Entergy Letter, NL-12-037, "License Renewal Application – Revised Reactor Vessel Internals Program and Inspection Plan Complaint with MRP-227-A, Indian Point Nuclear Generating Unit Nos. 2 and 3, Docket Nos. 50-247 and 50-286, License Nos. DPR-26 and DPR-64," February 17, 2012.
3. U.S. Nuclear Regulatory Commission NUREG/CR-4513, "Estimation of Fracture Toughness of Cast Stainless Steels During Thermal Aging in LWR Systems," August 1994. (Available NRC ADAMS Accession No. ML052360554).
4. U.S. Nuclear Regulatory Commission License Renewal Issue No. 98-0030, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel Components," May 19, 2000. (Available NRC ADAMS Accession No. ML003717179).
5. Westinghouse Letter IPP-13-44, "Support for Reactor Vessel Internals Aging Management RAI Project Final Response to RAI 11B Items 1, 2 and 3," October 16, 2013.
6. Westinghouse Letter INT-13-51, "Support for Reactor Vessel Internals Aging Management RAI Project Final Response to RAI 11B Items 1, 2 and 3," October 16, 2013.