February 4, 2003

Mr. Michael R. Kansler
Senior Vice President and
Chief Operating Officer
Entergy Nuclear Operations, Inc.
440 Hamilton Avenue
White Plains, NY 10601

SUBJECT: RELIEF REQUEST NO. RR 3-28 REGARDING RISK-INFORMED INSERVICE INSPECTION PROGRAM, INDIAN POINT NUCLEAR GENERATING UNIT NO. 3 (TAC NO. MB4637)

Dear Mr. Kansler:

By letter dated February 5, 2002, Entergy Nuclear Operations, Inc. (ENO) submitted proposed Relief Request No. RR 3-28 to use the Risk-Informed Inservice Inspection (RI-ISI) Program as an alternative to the requirements in Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) for Indian Point Nuclear Generating Unit No. 3 (IP3). The proposed alternative would be applied to Class 1, Item Category B-F and B-J welds.

The U.S. Nuclear Regulatory Commission (NRC) staff has completed its review of the proposed relief request. The results are provided in the enclosed safety evaluation.

The RI-ISI program for IP3 was developed in accordance with NRC-approved Electric Power Research Institute Topical Report TR-112657, Revision B-A, using the Nuclear Energy Institute template methodology. The results of our review indicate that ENO's proposed RI-ISI program is an acceptable alternative to the requirements of the ASME Code Section XI for inservice inspection (ISI). Therefore, Relief Request No. RR 3-28 is authorized pursuant to 10 CFR 50.55a(a)(3)(i) on the basis that the alternative provides an acceptable level of quality and safety. The relief request is authorized through the end of the third ISI 10-year interval for IP3.

If you should have any questions, please do not hesitate to call Mr. Patrick Milano, Senior Project Manager, at 301-415-1457.

Sincerely,

/RA/

Richard J. Laufer, Chief, Section 1
Project Directorate 1
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-286

Enclosure: Safety Evaluation

cc w/encl: See next page

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Indian Point Nuclear Generating Unit No. 3

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST NO. RR 3-28 REGARDING

RISK-INFORMED INSERVICE INSPECTION PROGRAM

ENTERGY NUCLEAR OPERATIONS, INC.

INDIAN POINT NUCLEAR GENERATING UNIT NO. 3

DOCKET NUMBER 50-286

1.0 INTRODUCTION

By letter dated February 5, 2002 (Reference 1), as supplemented by letters dated October 1, 2002 (Reference 2) and January 10, 2003 (Reference 3), Entergy Nuclear Operations, Inc. (Entergy or the licensee) proposed a risk-informed inservice inspection (RI-ISI) program as an alternative to a portion of its current inservice inspection (ISI) program for Indian Point Nuclear Generating Unit No. 3 (IP3). The scope of the RI-ISI program would be limited only to the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Class 1 piping, Item Categories B-F and B-J welds.

The licensee's RI-ISI program was developed in accordance with the methodology contained in the Electric Power Research Institute (EPRI) Report TR-112657, Revision B-A (Reference 4), which was previously reviewed and approved by the U.S. Nuclear Regulatory Commission (NRC) in a safety evaluation dated October 28, 1999. The licensee proposed the RI-ISI program as an alternative to the requirements in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," pursuant to Section 50.55a(a)(3)(i) of Title 10 of the *Code of Federal Regulations* (10 CFR). The licensee requested the alternative for the third 10-year ISI interval at IP3.

2.0 BACKGROUND

2.1 Applicable Requirements

10 CFR 50.55a(g) requires that ISI of the ASME Code Class 1, 2, and 3 components be performed in accordance with Section XI of the ASME Code, (hereinafter called Code) and applicable addenda, except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). The regulation 10 CFR 50.55a(a)(3) states, in part, that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if the licensee demonstrates that the proposed alternatives would provide an acceptable level of quality and safety, or if the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) must meet the requirements set forth in the Code, to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that ISI of components conducted during the first 10-year interval and subsequent intervals comply with the requirements in the latest edition and addenda of the Code incorporated by reference in 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. IP3 is currently in the first period of its third ISI interval. The IP3 third 10-year ISI interval began on July 21, 2000. The applicable edition of the ASME Code, Section XI, for IP3 is the 1989 Edition with no Addenda.

2.2 Summary of Proposed Approach

The licensee has proposed to use an RI-ISI program for ASME Class 1 piping, Examination Categories B-F and B-J welds, as an alternative to the ASME Code, Section XI requirements. The Code requires, in part, that for each successive 10-year ISI interval, 100% of Category B-F welds and 25% of Category B-J welds for the Code Class 1 non-exempt piping be selected for volumetric and/or surface examination, based on existing stress analyses and cumulative usage factors.

In its application, the licensee followed the NRC-approved RI-ISI process and methodology delineated in EPRI TR-112657, Revision B-A. By assessing piping failure potential and piping failure consequences, and performing probabilistic risk assessment (PRA) and safety significance ranking of piping segments, the number of inspection locations is significantly reduced. However, the program retains the fundamental requirements of the Code, such as inspection methods, acceptance guidelines, pressure testing, corrective measures, documentation requirements and quality control requirements. Thus, ISI program requirements of other non-related portions of the ASME Code, Section XI are unaffected.

The licensee stated that no augmented programs were affected by the RI-ISI application on Class 1 piping at IP3.

The implementation of an RI-ISI program for piping should be initiated at the start of a plant's 10-year ISI interval consistent with the requirements of the ASME Code and Addenda committed to by the licensee in accordance with 10 CFR 50.55a. However, the implementation may begin at any point in an existing interval as long as the examinations are scheduled and distributed consistent with the ASME Code requirements (e.g., the minimum examinations completed at the end of the three inspection periods under ASME Code Program B should be 16 percent, 50 percent, and 100 percent, respectively, and the maximum examinations credited at the end of the respective periods should be 34 percent, 67 percent, and 100 percent).

It is also the NRC staff's view that the inspections for the RI-ISI program and the balance of the ISI program should be on the same interval start and end dates. This can be accomplished by either implementing the RI-ISI program at the beginning of the interval or merging the RI-ISI program into the ISI program for the balance of the inspections if the RI-ISI program is to begin during an existing ISI interval. One reason for this view is that it eliminates the problem of having different Codes of record for the RI-ISI program and for the balance of the ISI program. A potential problem with using two different interval start dates and hence two different Codes

of record would be having two sets of repair/replacement rules depending upon which program identified the need for repair (e.g., a weld inspection versus a pressure test).

According to the information provided in Reference 1, IP3 is currently in the first period of its third ISI interval. As such, 100% of the required RI-ISI program inspections will be completed in the third interval. The examinations will be performed during the interval such that the period examination percentage requirements of ASME Section XI, paragraph IWB-2412 will be met.

3.0 EVALUATION

Pursuant to 10 CFR 50.55a(a)(3), the staff has reviewed and evaluated the licensee's proposed RI-ISI program, including those portions related to the applicable methodology and processes contained in TR-112657, based on guidance and acceptance criteria provided in NRC Regulatory Guides (RGs) 1.174 (Reference 5) and 1.178 (Reference 6) and in Standard Review Plan (SRP) Chapter 3.9.8 (Reference 7).

3.1 Proposed Changes to the ISI Program

The scope of the licensee's proposed RI-ISI program is limited to ASME Class 1 piping welds for the following Examination Categories: B-F for pressure retaining dissimilar metal welds in vessel nozzles and B-J for pressure retaining welds in piping. The licensee proposed to use the RI-ISI program as an alternative to the existing ISI requirements of the ASME Code, Section XI. A general description of the proposed changes to the ISI program is provided in Sections 3 and 5 of the licensee's February 5, 2002, application.

During the course of its review, the staff verified that the proposed RI-ISI program is consistent with the guidelines contained in EPRI TR-112657, which states that industry and plant-specific piping failure information, if any, is to be utilized to identify piping degradation mechanisms and failure modes, and consequence evaluations are to be performed using probabilistic risk assessments to establish piping segment safety ranking for determining new inspection locations. Thus, the staff concludes that the licensee's application of the EPRI TR-112657 approach is an acceptable alternative to the current IP3 piping ISI requirements with regard to the number, locations, and methods of inspections, and provides an acceptable level of quality and safety pursuant to 10 CFR 50.55a(a)(3).

3.2 Engineering Analysis

In accordance with the guidance provided in RGs 1.174 and 1.178, an engineering analysis of the proposed changes is required using a combination of traditional engineering analysis and supporting insights from the PRA. The licensee elaborated as to how the engineering analyses conducted for the IP3 RI-ISI program ensure that the proposed changes are consistent with the principles of defense-in-depth. This is accomplished by evaluating a location's susceptibility to a particular degradation mechanism and then performing an independent assessment of the consequence of a failure at that location. No changes to the evaluation of design-basis accidents in the final safety analysis report are being made by the RI-ISI process. Therefore, sufficient safety margins will be maintained.

The licensee's RI-ISI program at IP3 is limited to ASME Class 1 piping welds. The licensee stated in its submittal that other non-related portions of the ASME Code will be unaffected by

this program. Piping systems defined by the scope of the RI-ISI program were divided into piping segments. Pipe segments are defined as lengths of pipe whose failure leads to similar consequences and are exposed to the same degradation mechanisms. That is, some lengths of pipe whose failure would lead to the same consequences may be split into two or more segments when two or more regions are exposed to different degradation mechanisms. The submittal states that failure potential categories were generated utilizing industry failure history, plant-specific failure history, and other relevant information using the guidance provided in EPRI TR-112657. The degradation mechanisms identified in the submittal include thermal fatigue including thermal stratification, cycling and striping and thermal transients, and intergranular stress-corrosion cracking.

3.3 Probabilistic Risk Assessment (PRA)

As stated in its submittal, the licensee used the Individual Plant Examination (IPE) model Revision 0, dated June 1994, to evaluate the consequences of pipe rupture for the RI-ISI assessment. The staff evaluation report (SER) of the IPE, dated December 11, 1995, concluded that Revision 0 of the IP3 IPE satisfied the intent of Generic Letter 88-20, "Individual Plant Examination for Severe Accident Vulnerabilities." The staff's SER did not report any significant weaknesses or deficiencies found during the review of IP3. The current PRA is Revision 1 to the IPE dated June 2001. The Revision 1 model underwent the Westinghouse Owners Group peer certification review. The licensee stated that there were no significant findings identified during the peer review that would impact the RI-ISI consequence evaluation. Results from the updated PRA Revision 1 were used to confirm that the consequence evaluation developed to support the RI-ISI submittal using the Revision 0 model were current. The core damage frequency and large early release frequency for the Revision 1 model is 1.35E-5/year and 5.86E-7/year, respectively.

The staff did not review the IPE analysis to assess the accuracy of the quantitative estimates. The staff recognizes that the quantitative results of the IPE are used as order of magnitude estimates for several risk and reliability parameters used to support the assignment of segments into three broad consequence categories. Inaccuracies in the models or in assumptions large enough to invalidate the broad categorizations developed to support RI-ISI should have been identified during the staff's review of the IPE and by the licensee's model update control program. Minor errors or inappropriate assumptions will affect only the consequence categorization of a few segments and will not invalidate the general results or conclusions. The staff finds the quality of the licensee's PRA sufficient to support the proposed RI-ISI program.

The degradation category and the consequence category were combined according to the approved methodology described in the EPRI TR-112657 to categorize the risk significance of each segment. The risk significance of each segment is used to determine the number of weld inspections required in each segment.

As required by Section 3.7 of the EPRI TR-112657, the licensee evaluated the change in risk expected from replacing the current ISI program with the RI-ISI program. The licensee performed a qualitative evaluation of the change in risk. The RI-ISI program inspects 18 more locations in the population of welds placed in the high risk category than the ASME Section XI program inspected in the same population. The RI-ISI program will inspect 9 fewer locations in the population of welds placed in the medium risk locations than the ASME Section XI program

inspected in the same population. Conservatively neglecting that the decrease in risk from adding an inspection in a high risk weld is larger than the increase in risk from discontinuing an inspection at a medium risk weld, the net increase of nine additional weld inspections in the high and medium risk weld population indicates that there is a reduction in risk associated with the implementation of the proposed RI-ISI program. As discussed in the EPRI TR-112657, discontinued inspections in the low risk significant population contribute negligibly to the change in risk and are not included in the change in risk estimate.

The staff finds the licensee's process to evaluate and bound the potential change in risk reasonable because it accounts for the change in the number and location of elements inspected, and incorporates the difference in risk between the different locations. Therefore, the staff concludes that the implementation of the RI-ISI program as described in the licensee's application will have a small impact on risk consistent with the guidelines of RG 1.174.

3.4 Integrated Decisionmaking

As described in the licensee's submittal, an integrated approach is utilized in defining the proposed RI-ISI program by considering in concert the traditional engineering analysis, risk evaluation, and the implementation and performance monitoring of piping under the program. This is consistent with the guidelines of RG 1.178.

The selection of pipe segments to be inspected using the results of the risk category rankings and other operational considerations is described in Section 3.5 of the submittal. Table 3.5 of the submittal provides the number of locations and inspections by risk category for the various IP3 systems. Table 5-2 provides a table comparing the number of inspections required under the existing ASME Section XI ISI program with the alternative RI-ISI program. The risk impact analysis results for each system are provided in Table 3.6-1. The licensee used the methodology described in EPRI TR-112657 to guide the selection of examination elements within high and medium risk ranked piping segments. The EPRI TR-112657 report describes targeted examination volumes (typically associated with welds) and methods of examination based on the type(s) of degradation expected. The staff has reviewed these guidelines and has determined that, if implemented as described, the RI-ISI examinations should result in improved detection of service-related degradations over those currently required by ASME Code, Section XI.

The staff finds that the location selection process is acceptable since it is consistent with the process approved for EPRI TR-112657, takes into account defense-in-depth, and includes consideration of degradation mechanisms in addition to those covered by augmented inspection programs.

Chapter 4 of EPRI TR-112657 provides guidelines for the areas and/or volumes to be inspected as well as the examination method, acceptance standard, and evaluation standard for each degradation mechanism. Based on review of the cited portion of the EPRI report, the staff concludes that the examination methods for the proposed RI-ISI program are appropriate since they are selected based on specific degradation mechanisms, pipe sizes, and materials of concern.

3.5 Implementation and Monitoring

Implementation and performance monitoring strategies require careful consideration by the licensee and are addressed in Element 3 of RG 1.178 and SRP 3.9.8. The objective of Element 3 is to assess the performance of the affected piping systems under the proposed RI-ISI program by implementing monitoring strategies that confirm the assumptions and analyses used in the development of the RI-ISI program. To approve an alternative pursuant to 10 CFR 50.55a(a)(3)(i), implementation of the RI-ISI program, including inspection scope, examination methods, and methods of evaluation of examination results, must provide an acceptable level of quality and safety.

The licensee stated that upon approval of the RI-ISI program, procedures that comply with the EPRI TR-112657 guidelines will be prepared to implement and monitor the RI-ISI program. The licensee confirmed that the applicable portions of the ASME Code, such as inspection methods, acceptance guidelines, pressure testing, corrective measures, documentation requirements, and quality control requirements would be retained.

The licensee stated in Section 4 of the submittal that the RI-ISI program is a living program and its implementation will require feedback of new relevant information to ensure the appropriate identification of safety significant piping locations. The licensee states (Reference 2) that the RI-ISI program, as a minimum, will be reviewed and adjusted on an ASME period basis. In addition, significant changes may require more frequent adjustment as directed by NRC bulletin or generic letter requirements, or by industry and plant-specific feedback.

The licensee's submittal (References 1 and 2) presented the criteria for engineering evaluation and additional examinations if unacceptable flaws or relevant conditions are found during examinations. The submittal stated that the evaluation will include whether other elements in the segment or segments are subject to the same root cause conditions. Additional examinations will be performed on these elements up to a number equivalent to the number of elements required to be inspected on the segment or segments initially. The licensee also stated that elements selected for additional examinations will be selected based on the root cause or damage mechanism and will include high risk significant elements, as well as medium risk significant elements (if needed), to reach the number of elements required to be inspected on the segment or segments during the current outage. The licensee provided clarifying information in its letter dated January 10, 2003, on the time frame for sample expansions. The licensee stated that all R-A category welds will be treated as Class 1, and will follow the provisions of the 1989 ASME Code, Section XI, IWB-2430(b), with regards to the second sample expansion. The staff finds this acceptable since the additional examinations, if required, will be performed during the outage that the indications or relevant conditions are identified.

The proposed periodic reporting requirements meet existing ASME Code requirements and applicable regulations and, therefore, are considered acceptable. The staff finds that the proposed process for RI-ISI program updates meets the guidelines of RG 1.174 which provide that risk-informed applications should include performance monitoring and feedback provisions; therefore, the licensee's proposed process for program updates is acceptable.

4.0 CONCLUSIONS

In accordance with 10 CFR 50.55a(a)(3)(i), proposed alternatives to regulatory requirements may be used when authorized by the NRC when the applicant demonstrates that the alternative provides an acceptable level of quality and safety. In this case, the licensee's proposed alternative is to use the risk-informed process described in the NRC-approved EPRI TR-112657. As discussed in Section 3.0 above, the staff concludes that the licensee's proposed RI-ISI program, as described in its submittal, will provide an acceptable level of quality and safety pursuant to 10 CFR 50.55a(a)(3)(i) with regard to the number of inspections, locations of inspections, and methods of inspections.

The staff finds that the results of the different elements of the engineering analysis are considered in an integrated decision-making process. The impact of the proposed change in the ISI program is founded on the adequacy of the engineering analysis and acceptable change in plant risk in accordance with RG 1.174 and 1.178 guidelines.

The IP3 methodology also considers implementation and performance monitoring strategies. Inspection strategies ensure that failure mechanisms of concern have been addressed and there is adequate assurance of detecting damage before structural integrity is affected. The risk significance of piping segments is taken into account in defining the inspection scope for the RI-ISI program.

System pressure tests and visual examination of piping structural elements will continue to be performed on all Class 1, 2, and 3 systems in accordance with the ASME Code Section XI program. The RI-ISI program applies the same performance measurement strategies as existing ASME Code requirements and, in addition, increases the inspection volumes at weld locations that are exposed to thermal fatigue.

The IP3 methodology provides for conducting an engineering analysis of the proposed changes using a combination of engineering analysis with supporting insights from a PRA. Defense-in-depth and quality are not degraded in that the methodology provides reasonable confidence that any reduction in existing inspections will not lead to degraded piping performance when compared to existing performance levels. Inspections are focused on locations with active degradation mechanisms as well as selected locations that monitor the performance of system piping.

On the basis of its review of the licensee's proposed RI-ISI program, the NRC staff concludes that the program is an acceptable alternative to the current ISI program, which is based on ASME Code, Section XI, requirements for Class 1 welds. Therefore, the licensee's proposed alternative is authorized pursuant to 10 CFR 50.55a(a)(3)(i) on the basis that the alternative provides an acceptable level of quality and safety. This safety evaluation authorizes application of the proposed RI-ISI program for the third 10-year ISI interval at IP3.

5.0 REFERENCES

1. Entergy letter, Michael R. Kansler to NRC, dated February 5, 2002, "Relief Request RR 3-28, Risk-Informed Inservice Inspection Program," enclosing "Indian Point Nuclear Generating Unit No. 3 Risk-Informed Inservice Inspection Program, Rev. 0."

2. Entergy letter, Michael R. Kansler to NRC, dated October 1, 2002, “Response to Request for Additional Information Regarding Relief Request RR 3-28 for Risk-Informed Inservice Inspection.”

3. Entergy letter, Michael P. Gallagher to NRC, dated January 10, 2003, “Response to Request for Additional Information Regarding Relief Request RR 3-28 for Risk-Informed Inservice Inspection.”

4. EPRI Technical Report TR-112657, Revision B-A, “Revised Risk-Informed Inservice Inspection Evaluation Procedure,” January 2000.

5. NRC Regulatory Guide 1.174, “An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis,” July 1998.

6. NRC Regulatory Guide 1.178, “An Approach for Plant-Specific Risk-Informed Decision Making: Inservice Inspection of Piping,” September 1998.

7. NRC NUREG-0800, Chapter 3.9.8, “Standard Review Plan for Trial Use for the Review of Risk-Informed Inservice Inspection of Piping,” September 1998.

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Date: February 4, 2003