January 30, 2002

Mr. Robert J. Barrett
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Indian Point Nuclear Generating Unit No. 3
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SUBJECT: INDIAN POINT NUCLEAR GENERATING UNIT NO. 3 - SUPPLEMENT TO SAFETY EVALUATION RE: LEAKAGE DETECTION SYSTEMS (TAC NO. MB3328)

Dear Mr. Barrett:

In a letter dated October 25, 2001, Entergy Nuclear Operations, Inc. (Entergy) submitted a reconciliation of its technical bases for the reactor coolant system (RCS) leakage detection capability used in the methodology supporting the elimination of large primary loop ruptures as a design basis ("leak-before-break" methodology) for Indian Point Nuclear Generating Unit No. 3 (IP3). On March 10, 1986, the U.S. Nuclear Regulatory Commission (NRC) staff issued a safety evaluation (SE) approving the "leak-before-break" methodology for IP3. In the 1986 SE, the staff noted that the IP3 containment air radioactive particulate monitor and containment air radioactive gas monitor had the capability to detect a 1 gallon per minute change in the RCS leak rate in less than 4 hours. However, based on current fuel performance and the low RCS activity, Entergy has now determined that the IP3 containment air radioactive gas monitor is no longer capable of achieving the sensitivity to leakage specified in the 1986 SE. Since leakage detection sensitivity is a significant factor in demonstrating "leak-before-break" behavior, Entergy provided information in its October 25 letter regarding all of its RCS leakage detection systems at IP3 to confirm that the overall sensitivity of these systems continues to support the bases used in the "leak-before-break" methodology.

As stated in the enclosed supplement to its original 1986 SE, the NRC staff finds that the current leakage detection systems are adequate to support the technical basis for the NRC staff's prior leak-before-break approval.

Sincerely,

/RA/

Patrick D. Milano, Sr. Project Manager, Section 1
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-286

Enclosure: As stated

cc w/encl: See next page

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SUPPLEMENT TO SAFETY EVALUATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REGARDING LEAKAGE DETECTION CAPABILITY

IN ELIMINATION OF LARGE PRIMARY LOOP RUPTURES AS A DESIGN BASIS

INDIAN POINT NUCLEAR GENERATING UNIT NO. 3

ENTERGY NUCLEAR OPERATIONS, INC.

DOCKET NO. 50-286

1.0 INTRODUCTION

By letter dated October 25, 2001 (Reference 1), Entergy Nuclear Operations, Inc. (the licensee), submitted information to reconcile its technical basis for the reactor coolant system (RCS) leakage detection capability related to the criterion used in the methodology to support the elimination of large primary loop ruptures as a design basis ("leak-before-break" methodology) at the Indian Point Nuclear Generating Unit No. 3 (IP3). In a letter dated March 10, 1986 (Reference 2), the U.S. Nuclear Regulatory Commission (NRC) staff issued a safety evaluation (SE) approving the LBB methodology for IP3. In its 1986 SE, the staff noted that the IP3 containment air radioactive particulate monitor and containment air radioactive gas monitor have, "the capability of detecting a one gpm [gallon per minute] change in leak rate in less than four hours." However, based on current fuel performance resulting in low RCS activity levels, Entergy has now determined that the IP3 containment air radioactive gas monitor is no longer capable of achieving the referenced sensitivity. Since leakage detection sensitivity is a significant factor in demonstrating LBB behavior, Entergy provided information in its October 25, 2001, letter regarding all of its RCS leakage detection systems available at IP3 and requested NRC staff confirmation that the sensitivity of the installed IP3 leakage detection systems continues to support the NRC's prior LBB approval.

2.0 REGULATORY REQUIREMENTS AND STAFF POSITIONS

Criterion 4, "Environmental and dynamic effects design bases," of Appendix A, "General Design Criteria," to Part 50 of Title 10 of the *Code of Federal Regulations* (10 CFR Part 50) states that nuclear power plant structures, systems, and components important to safety shall be appropriately protected against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit. However, dynamic effects associated with postulated pipe ruptures may be excluded from the facility design basis when analyses reviewed and approved by the Commission demonstrate that the probability of fluid system piping rupture is extremely low under conditions consistent with the design basis for the piping. Formal, rigorous, LBB evaluations consistent with NRC staff guidance (e.g., NUREG-1061, Volume 3, and draft Standard Review Plan Section 3.6.3) (References 3 and 4) have been accepted by the staff as an acceptable demonstration of this extremely low probability of piping rupture.

In the LBB evaluations, the NRC staff requires the throughwall critical crack size which could lead to pipe rupture under design basis loading conditions and the throughwall leakage crack size which would provide a readily detectable amount of RCS leakage under normal operating conditions be established. The leakage crack size is the length of a throughwall flaw that will produce 10 times the amount of leakage that is expected to be detectable by the facility's RCS leakage detection systems. The factor of 10 multiplier is included as a safety factor to account for uncertainties in the evaluation of two-phase fluid leakage through the postulated crack and uncertainties in the actual capability of the facility's RCS leakage detection system. The evaluation should then demonstrate that an acceptable margin on crack length (usually a factor of 2) exists between the critical and leakage crack sizes.

As such, the leakage crack size for the LBB evaluation is directly affected by the sensitivity of installed facility RCS leakage detection systems. Generally, acceptable LBB evaluations have included the condition that facility RCS leakage detection systems be able to detect 1 gpm of leakage over an established time period. In the case of IP3, the NRC staff's original LBB approval discussed in its March 10, 1986, safety evaluation was based on the licensee's ability to detect 1 gpm of RCS leakage in the course of 4 hours. This capability was related to the sensitivity of the IP3 containment air radioactive particulate monitor and containment air radioactive gas monitor.

3.0 LICENSEE'S DETERMINATION

In the October 26, 2001, letter, the licensee stated that the capability of the IP3 RCS leakage detection systems had been reassessed. Based on improved fuel integrity and lower RCS activity, the licensee concluded that, although the containment air radioactive particulate monitor would continue to be able to detect 1 gpm of RCS leakage in the course of 4 hours, the containment air radioactive gas monitor would detect 1 gpm of RCS leakage in the course of 70 hours. Therefore, the licensee questioned whether the IP3 RCS leakage detection system capability remained consistent with the specific bases cited in the NRC staff's LBB approval.

The licensee concluded that, consistent with the technical requirements for demonstrating LBB behavior, the entire package of RCS leakage detection systems should be considered when reviewing the capability of the IP3 facility to monitor RCS leakage. In general, the licencee noted that the overall integrated method of leak detection at IP3 has remained essentially unchanged since the 1986 NRC SE approving LBB for the facility's main coolant loop. In addition to the IP3 containment air radioactive particulate monitor and containment air radioactive gas monitor, the licensee noted that several other RCS leakage detection systems are available. Table 1 summarizes the licensee's assessment of the current capability of 2 of these other leakage detection systems.

Table 1

RCS Leakage Detection System	Present Assessed Capability[1]
Containment Air Radioactive Particulate Monitor (R-11)	1 gpm within 4 hours
Containment Air Radioactive Gas Monitor (R-12)	1 gpm within 70 hours
Vapor Containment (VC) Sump Monitor	1 gpm within 4 hours
Fan Cooler Unit Condensate Weir Monitor	0.5 to 1 gpm (per weir) with operator action

(1) The assessed capability of each system may be affected by specific plant operating conditions, background levels, etc. The values listed are presented as reasonable, point value, estimates of system performance.

In addition, the licensee noted that a vapor containment (VC) humidity detector, which was discussed in the NRC staff's 1986 LBB SE, is also available as an additional means of measuring overall leakage from water and steam systems inside containment. Further, the licensee stated that VC temperature and pressure monitoring methods may also be used to infer identified leakage inside containment. The licensee provided no specific assessment of the sensitivity level that may be expected from these systems.

In conclusion, the licensee determined that the overall IP3 RCS leakage detection capability remains diverse and reasonably sensitive (i.e., demonstrating an acceptable capability relative to the capability necessary to support assumptions in the original 1986 LBB approval) for RCS leakage detection. Based on this conclusion, the licensee requested that the NRC staff review the specific leakage detection bases cited in the original SE along with the existing leakage detection systems capability at IP3.

4.0 STAFF EVALUATION

The NRC staff has reviewed the information provided by the licensee. The staff has concluded that the licensee has demonstrated that the current IP3 leakage detection system capability is adequate to continue to support the technical bases cited in the NRC's March 10, 1986, SE approving LBB for the IP3 primary coolant loop piping. Additional details regarding the staff's conclusion are provided below.

An appropriate LBB evaluation begins with the evaluation of RCS leakage during normal power operation. The "normal power operation" condition is to be used since LBB approval is based on the philosophy that a subcritical throughwall flaw can be identified during normal power operation and the facility brought to cold shutdown conditions to affect a repair prior to realizing the potential for piping failure under any design basis loading condition. The concept of identifying a leak of a given magnitude (e.g. 1 gpm) in some specified period of time (e.g., 1 hour, 4 hours) ensures that the information necessary to take prompt action to place the facility in a safe condition would be readily available to the licensee's operators.

Based on this integrated assessment of RCS leakage detection capability, a "leakage limit" can then be established consistent with the technical bases and safety factors specified in the staff's guidance on LBB evaluations (e.g., NUREG-1061, Volume 3, and draft Standard Review Plan Section 3.6.3). For LBB evaluations, this leakage limit is taken to be the demonstrated facility leakage detection capability multiplied by a safety factor of 10 to account for uncertainties in the estimation of two-phase leakage through a postulated throughwall pipe flaw and uncertainties in the actual capability of the facility's RCS leakage detection system. Hence, a typical facility RCS leakage detection capability of 1 gpm would result in a 10 gpm leakage limit within the LBB evaluation.

This leakage limit is then related to a specific throughwall crack length which is expected to provide that amount of leakage under normal operating conditions. This relation is calculated through the application of thermal-hydraulic computer codes which model two-phase flow through tight flaws. The “leakage flaw” which meets this leakage limit is then compared in length to the “critical flaw” which would fail the pipe under the most severe design basis loading conditions. In order to adequately demonstrate LBB, the postulated critical flaw must be greater in length than the leakage flaw by an approximate factor of two (or more). Finally, the leakage flaw must be shown to be stable under loads equivalent to or slightly greater than (by a specified safety factor) the limiting design basis loads.

Given the overall evaluation process described above, the NRC staff concludes that it is consistent to permit a licensee to credit or evaluate all available RCS leakage detection systems for the purpose of establishing the facility's leakage detection capability. Reliance only on RCS leakage detection systems that are based on the assessment of containment air activity has not been imposed in prior NRC staff LBB approvals. Frequently, prior NRC staff LBB approvals have been based on licensee utilization of sump level/flow monitoring; containment particulate/gaseous radioactivity monitoring; containment temperature, pressure, and humidity monitoring; and/or containment air cooler condensate flow rate monitoring to establish their leakage detection capability. Therefore, the licensee's request to credit systems other than their containment air radioactive particulate monitor and containment air radioactive gas monitor as part of the RCS leakage detection system reassessment is consistent with the considerations accepted in other NRC staff LBB approvals.

Further, based on the considerations specified in the licensee's submittal, the NRC staff has concluded that an overall IP3 RCS leakage detection system capability for detecting 1 gpm of leakage in an acceptable time frame (relative to the bases of the existing IP3 primary coolant loop LBB assessment) has been established. The two systems (the containment air radioactive particulate monitor and the VC sump monitor) capable of identifying 1 gpm of RCS leakage in the course of 4 hours, coupled with the availability of the supporting systems identified in Section 3.0 of this supplement, is sufficient to justify the use of a 1 gpm capability in the IP3 LBB analysis, even in the event that one of the two systems capable of detecting 1 gpm in the course of 4 hours becomes unavailable. Additional operator actions which may be taken or required by IP3 Technical Specifications (performance of RCS inventory balance or containment atmosphere grab sampling) also serve to further enhance the robustness of the overall IP3 leakage detection capability.

5.0 CONCLUSION

The NRC staff concludes that, based on the information provided in the licensee's October 25, 2001, submittal, the IP3 leakage detection system capability continues to support the technical bases cited in the staff's March 10, 1986, IP3 primary coolant loop LBB safety evaluation. Specifically, the licensee has supported the continued use of a 1 gpm RCS leakage detection capability to determine the length of the leakage size flaw in the facility's licensing basis primary coolant loop LBB evaluation. Therefore, the NRC staff finds that the LBB technology for the IP3 primary coolant loop piping, as described in the original March 10, 1986, SE, and as supplemented in this SE, is acceptable and continues to justify the elimination of large primary loop ruptures as a design basis.

6.0 REFERENCES

1. Letter, R.J. Barrett (Entergy) to U.S. Nuclear Regulatory Commission Document Control Desk, “Reconciliation of the Technical Bases of the IP3 Leak Before Break RCS Leakage Detection Capability Licensing Design Basis Documented in May 1986 Safety Evaluation Report,” October 25, 2001.

2. Letter, S.A. Varga (USNRC) to J.C. Brons (State of New York), “Safety Evaluation by the Office of Nuclear Reactor Regulation Related to Elimination of Large Primary Loop Ruptures as a Design Basis,” March 10, 1986.

3. United States Nuclear Regulatory Commission NUREG-1061, Volume 3, ”Report of the U.S. Nuclear Regulatory Commission Piping Review Committee, Evaluation of Potential for Pipe Breaks,” November 1984.

4. United States Nuclear Regulatory Commission Draft Standard Review Plan Section 3.6.3, “Leak-Before-Break Evaluation Procedures,” published for comment at 52 Federal Register 32626, August 28, 1987.

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Date: January 30, 2002