UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

July 30, 1998

MEMORANDUM TO: Loren R. Plisco, Director
Division of Reactor Projects, RII

FROM: Frederick J. Hebdon, Director
Project Directorate II-3
Division of Reactor Projects I/II
Office of Nuclear Reactor Regulation

SUBJECT: SAFETY ASSESSMENT OF REGION II CONCERNS REGARDING DISCREPANCIES OF CONTAINMENT RADIATION MONITOR SENSITIVITIES AT ST. LUCIE UNITS 1 AND 2, AND TURKEY POINT UNITS 3 AND 4 (TAC NOS. M97286, M97287, M97288, AND M97289)

By memorandum dated November 12, 1996 (TIA 96-019), Region II requested NRR assistance to assess discrepancies between the sensitivities in the containment radiation monitoring system described in the Updated Final Safety Analysis Report and Regulatory Guide 1.45, "Reactor Coolant Pressure Boundary Leakage Detection Systems," at St. Lucie Units 1 and 2, and Turkey Point Units 3 and 4. Attached is the Plant Systems Branch's response to your memorandum. If there are any questions, please contact Kahtan Jabbour at 301-415-1496 or Bill Gleaves at 301-415-1479. This memorandum closes all activities associated with TIA 96-019.

Docket Nos.: 50-335
50-389
50-250
50-251

Attachment: As stated

cc w/att: C. Hehl, RI
G. Grant, RIII
T. Gwynn, RIV

Attachment

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

June 24, 1998

MEMORANDUM TO: Frederick J. Hebdon, Director
Project Directorate II-3
Division of Reactor Projects I/II
Office of Nuclear Reactor Regulation

FROM: Ledyard B. Marsh, Chief
Plant Systems Branch
Division of Systems Safety and Analysis
Office of Nuclear Reactor Regulation

SUBJECT: SAFETY ASSESSMENT OF REGION II CONCERNS (TIA-019) REGARDING DISCREPANCIES OF CONTAINMENT RADIATION MONITOR SENSITIVITIES AT ST. LUCIE UNITS 1 AND 2, AND TURKEY POINT UNITS 3 AND 4 (TAC NOS. M97286, M97287, M97288, and M97289)

By memorandum dated November 12, 1996, Region II requested NRR's assistance to assess discrepancies between the sensitivities in the containment radiation monitoring system described in the Updated Final Safety Analysis Report (UFSAR) and Regulatory Guide (RG) 1.45, "Reactor Coolant Pressure Boundary Leakage Detection Systems," at St. Lucie Units 1 and 2, and Turkey Point Units 3 and 4. Specifically, Region II raised the following question:

> "Does the staff consider the [containment radiation monitoring] system described in the UFSAR consistent with RG 1.45?"

The Plant Systems Branch (SPLB) reviewed documentation concerning the Region's request and has concluded that:

(a) The containment radiation monitoring system described in the St. Lucie Units 1 and 2 UFSAR is not consistent with the recommendations of Regulatory Position C.5 of RG 1.45. However, SPLB discussed the discrepancies with the Materials and Chemical Engineering Branch and determined that the licensee's UFSAR values of 15.1 and 18.1 hours for detecting one gpm of leakage should be acceptable for utilization of "leak-before-break" (LBB) technology at St. Lucie pending completion of generic activities as discussed below. Considering the planned generic activities, the fact that there are other methods for detecting RCS leakage (e.g., the containment sump monitor), and the low safety significance of these sensitivity response time discrepancies, it is recommended that the inspection URI be closed and no further staff action be taken at this time. Once the generic activities are completed, further action may be warranted.

(b) The containment radiation monitoring system described in the Turkey Point Units 3 and 4 UFSAR is not fully consistent with the recommendations of Regulatory Position C.5 of RG 1.45. However, Turkey Point Units 3 and 4 are not required to meet RG 1.45, but only the criteria of Generic Letter (GL) 84-04. Since the sensitivity requirements for the

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Attachment

particulate and gaseous radiation monitors at Turkey Point Units 3 and 4 meet the criteria of GL 84-04, the staff concludes that they are acceptable.

During the review of the discrepancies at St. Lucie Units 1 and 2 and Turkey Point Units 3 and 4, the staff recognized that there are inconsistencies in the primary coolant radioactivity concentration assumptions for the sensitivity response times at various facilities. For example, the percentage of failed fuel assumed was 1.0% at Turkey Point and 0.1% at St. Lucie. The outcome between these percentages can change the sensitivity response time by many hours, which could exceed the one gpm in one hour guidance documented in RG 1.45. Furthermore, in recent years, plants have exhibited better fuel performance and improved chemistry resulting in less primary coolant radioactivity concentrations than was assumed when plants were originally licensed. This reduced primary coolant radioactivity could also lead to additional difficulties in detecting leaks in the RCS by measurement of radioactivity levels.

In addition, the Office of Nuclear Regulatory Research is currently developing a RG for LBB to establish updated regulatory guidance on experience obtained over the past years in the application of LBB technology. Since LBB is related to RG 1.45, as discussed in Section 2.1, NRR staff is supporting RES efforts in developing the LBB RG. Once the new RG is developed, RG 1.45 will be reviewed to determine if updates and clarifications are needed to reflect the updated guidance. During this review, RG 1.45 will also be reviewed to determine if any updates are needed to address inconsistencies in licensees' assumptions regarding primary coolant radioactivity concentrations and reduced primary coolant radioactivity levels. Once this is complete, generic action may be warranted to address the containment radiation monitoring system sensitivity response times.

Our safety assessment of the Region II concerns is attached. We consider our efforts on TAC Nos. M97286, M97287, M97288, and M97289 complete. If future issues arise between the sensitivity response times of containment radiation monitoring systems at other plants and the current regulatory guidance, SPLB will evaluate these issues on a plant-specific basis. If you have any questions, please contact George Hubbard at (301) 415-2870 or Vonna Ordaz at (301) 415-2833.

Attachment: As stated

Docket Nos.: 50-335
50-389
50-250
50-251

DISTRIBUTION: Central File, SPLB R/F, Docket File (4), Plant File (2)
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DATE	6/18/98		6/23/98		6/24/98		6/24/98			

SAFETY ASSESSMENT BY PLANT SYSTEMS BRANCH DIVISION OF SYSTEMS SAFETY AND ANALYSIS OFFICE OF NUCLEAR REACTOR REGULATION REGION II CONCERNS (TIA-019) REGARDING DISCREPANCIES OF THE CONTAINMENT RADIATION MONITORING SYSTEM AT ST. LUCIE UNITS 1 AND 2 AND TURKEY POINT UNITS 3 AND 4 (TAC NOS. M97286, M97287, M97288, and M97289)

1.0 INTRODUCTION

By memorandum dated November 12, 1996, (Ref. 1), Region II requested NRR's assistance to assess discrepancies between the sensitivities in the containment radiation monitoring system described in the Updated Final Safety Analysis Report (UFSAR) and Regulatory Guide (RG) 1.45, "Reactor Coolant Pressure Boundary Leakage Detection Systems," at St. Lucie Units 1 and 2, and Turkey Point Units 3 and 4. Specifically, Region II raised the following question:

> "Does the staff consider the [containment radiation monitoring] system described in the UFSAR consistent with RG 1.45?"

Because of the importance of early leak detection in the prevention of accidents, RG 1.45, in part, establishes the following key regulatory positions with regard to the design and sensitivity of the reactor coolant system (RCS) leakage detection system of which the containment radiation monitoring system is an integrated part:

C.3 At least three separate detection methods should be employed and two of these methods should be (1) sump level and flow monitoring and (2) airborne particulate radioactivity monitoring. The third method may be selected from the following:

a. monitoring of condensate flow rate from air coolers,

b. monitoring of airborne gaseous radioactivity.

C.5. The sensitivity and response time of each leakage detection system described in regulatory position C.3 that is employed for unidentified leakage, should be adequate to detect a leakage rate, or its equivalent, of one gpm in less than one hour.

C.6 The leakage detection systems should be capable of performing their functions following seismic events that do not require plant shutdown. The airborne particulate radioactivity monitoring system should remain functional when subjected to the SSE [safe shutdown earthquake].

Attachment a

RG 1.45 also provides the following guidance:

> "In analyzing the sensitivity of leak detection systems using airborne particulate or gaseous radioactivity, a realistic primary coolant radioactivity concentration assumption should be used. The expected values used in the plant environmental report would be acceptable."

The Plant Systems Branch (SPLB) reviewed available documentation concerning the Region's request and the assessment is summarized below.

2.0 ASSESSMENT

2.1 St. Lucie

By letter dated November 20, 1987, the Combustion Engineering Owners Group (CEOG) submitted topical report CEN-367, "Leak-Before-Break Evaluation of Primary Loop Piping in Combustion Engineering Designed Nuclear Steam Supply Systems," for staff review. CEOG proposed to eliminate the dynamic effects of postulated primary loop pipe ruptures from the design basis[1] for certain Combustion Engineering plants, which includes St. Lucie Units 1 and 2, using "leak-before-break" (LBB) technology. The staff reviewed CEN-367 and found the report acceptable for referencing in license applications to the extent specified and under the limitations delineated in the report and associated NRC safety evaluation (Ref. 2). The safety evaluation defines the basis for acceptance of the report and states that when referencing this CEOG report as a technical basis for applying LBB to primary loop piping, the licensee must demonstrate that RCS leakage detection systems installed at the specific facility are consistent with the guidance described in RG 1.45.

During the process of St. Lucie's license application review, the staff in the original Safety Evaluation Reports for Unit 1, dated November 1974, and for Unit 2, dated October 1981, stated that the RCS leakage detection systems for St. Lucie were in accordance with the guidance described in RG 1.45 and were therefore, acceptable. In addition, the licensee stated in the TS Bases Section 3/4.4.6.1 that these detection systems were consistent with the recommendations of RG 1.45.

Accordingly, by letter dated August 26, 1992, (Ref. 3), the licensee proposed to eliminate the dynamic effects associated with high energy pipe rupture in the RCS piping from the licensing and design bases of St. Lucie, Units 1 and 2, by the application of LBB technology. In the submittal, the licensee stated that in preparation of the proposal, it had reviewed the design of the RCS leakage detection systems and reaffirmed the staff's original conclusion that the RCS leakage detection systems for St. Lucie were in accordance with the guidance described in RG 1.45. The staff reviewed the August 26, 1992, submittal and concluded that since the St. Lucie Units were bounded by the CEOG analyses and the RCS leakage detection systems remained capable of detecting the specified leakage rate as described in RG 1.45, the dynamic effects associated with high energy pipe rupture in the RCS piping could be excluded from the

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[1] As permitted by General Design Criterion 4 (GDC-4), "Environmental and Dynamic Effects Design bases," of Appendix A to 10 CFR 50.

licensing and design bases of St. Lucie (Ref. 4).

During an inspection of the St. Lucie Unit 1 containment radiation monitoring system in 1996, the NRC found discrepancies regarding the systems' sensitivity response time between the UFSAR and the guidance described in RG 1.45. St. Lucie Units 1 and 2 UFSAR states that a 1 gpm reactor coolant boundary leak will cause a 10 percent deviation in the normal readings of various monitoring systems and the time for the containment radiation monitor to reach this deviation is 15.1 hours and 18.1 hours for the noble gas and particulate channels, respectively. Since these response times appeared to contradict the one hour response time documented in Regulatory Position C.5 of RG 1.45 and the above UFSAR statements, the inspector considered these discrepancies to be an Unresolved Item (URI).

Based on SPLB's review, the staff found that the sensitivity response times of the containment radiation monitoring system described in the St. Lucie Units 1 and 2 UFSAR are not consistent with the recommendations of Regulatory Position C.5 of RG 1.45. However, SPLB discussed the discrepancies with the Materials and Chemical Engineering Branch and determined that the licensee's UFSAR values of 15.1 and 18.1 hours for detecting one gpm of leakage should be acceptable for utilization of LBB technology at St. Lucie pending completion of generic activities discussed in Section 3 of this assessment. Considering the planned generic activities, the fact that there are other methods for detecting RCS leakage (e.g., the containment sump monitor), and the low safety significance of these sensitivity response time discrepancies, it is recommended that the inspection URI be closed and no further staff action be taken at this time. Once the generic activities are completed, further action may be warranted.

2.2 Turkey Point

During an inspection at Turkey Point Units 3 and 4 in 1996, the inspector reviewed the licensee's calculations used to determine the setpoints for the containment particulate and gaseous radiation monitors, R-11 and R-12, respectively. The inspector found that with the assumption of 1.0% failed fuel and a one gpm leak, the R-11 monitor would alarm within one hour and the R-12 monitor would alarm within four hours. The inspector questioned the acceptability of these particulate and gaseous radiation monitor setpoints with Regulatory Position C.5 of RG 1.45. Consequently, the inspector considered this issue as an URI.

The staff reviewed Westinghouse topical report, WCAP-9558 (Ref. 5), which was submitted to address asymmetric blowdown loads on the PWR RCS that resulted from a limited number of discrete break locations. The report evaluated the limiting or bounding break locations. Subsequent to the review, the staff issued generic letter (GL) 84-04 (Ref. 6) to inform all PWR utilities of its conclusions. In GL 84-04, the staff stated that an acceptable technical basis had been provided so that the asymmetric blowdown loads resulting from double-ended pipe breaks in main coolant loop piping need not be considered as a design basis for the Westinghouse Owner's Group plants listed in WCAP-9558, which included Turkey Point Units 3 and 4, provided two conditions were satisfied. Only the following condition relates to the design and

operation of RCS leakage detection systems:

> "Leakage detection systems at the facility should be sufficient to provide adequate margin to detect the leakage from the postulated circumferential through wall flaw utilizing the guidance of RG 1.45 with the exemption that the seismic qualification of the airborne particulate radiation monitor is not necessary. At least one leakage detection system with a sensitivity capable of detecting one gpm in four hours[2] must be operable."

Furthermore, the staff stated that other PWR licensees or applicants may also request exemptions on the same basis from the requirements of General Design Criterion 4 (GDC-4) with respect to asymmetric blowdown loads resulting from discrete breaks in the primary main coolant loop, if they can demonstrate the applicability of the modeling and conclusions contained in the referenced reports to their plants or can provide an equivalent fracture mechanics based demonstration of the integrity of the primary main coolant loop in their facilities. Licensees or applicants must justify such exemptions on a plant-by-plant basis. In GL 84-04, the staff also provided guidance on the information needed to support case-by-case exemption requests.

Subsequently, in a memorandum (Ref. 7) to R. Vollmer (Director, Division of Engineering), R. Mattson (Director, Division of Systems Integration) established the guidance regarding the acceptability of RCS leakage detection system sensitivity for PWRs which used LBB technology in the evaluation of asymmetric LOCA loads. The memorandum stated that since RG 1.45 was not published until May 1973, most of the operating PWRs (including Turkey Point Units 3 and 4) listed in WCAP-9558 which were affected by asymmetric LOCA loads were not reviewed against the guidance of RG 1.45. However, the sensitivity guidelines of RG 1.45 (capability to detect a leak of one gpm in one hour) seemed appropriate and the staff recommended their use with a suitable change to the detection time to account for the fact that a constant leak rate[2] was being considered. Therefore, the staff recommended the following variance from RG 1.45 for plants listed in WCAP-9558:

> "At least one system for RCS leak detection should have the capability of detecting a one gpm (unidentified) leak in four hours during normal operating conditions for an exemption with respect to asymmetric loads."

In the licensee's response to GL 84-04, dated November 1, 1988, (Ref. 8), the licensee for Turkey Point stated that the requirements for RCS leakage detection systems as included in plant Technical Specification Section 3.1.3 satisfied the condition above. The staff reviewed the licensee's November 1, 1988, submittal and concurred (Ref. 9) that the leakage detection systems at Turkey Point Units 3 and 4 satisfied the above cited leak detection sensitivity requirements established in GL 84-04, and the dynamic effects of postulated primary loop pipe

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[2] In WCAP-9558, specific leakage from main reactor coolant piping assumed for asymmetric LOCA loads was postulated to remain constant for a long time (days). Therefore, the staff accepted a four hour time period to be used as part of the sensitivity criterion.

ruptures that could be eliminated from the design basis.

Accordingly, by letter dated February 2, 1995, (Ref. 10), the licensee proposed to eliminate the dynamic effects associated with high energy pipe rupture in the reactor coolant system piping from licensing and design bases of Turkey Point Units 3 and 4 by the application of LBB technology. The staff reviewed the licensee's February 2, 1995, submittal and concluded that Turkey Point Units 3 and 4 were bounded by the Westinghouse analyses and the RCS leakage detection systems satisfied the requirements in GL 84-04. Therefore, the staff found the licensee's request to utilize LBB methodology for RCS piping design bases acceptable.

Based on SPLB's review, the staff found that the containment radiation monitoring system described in the Turkey Point Units 3 and 4 UFSAR is not fully consistent with the recommendations of Regulatory Position C.5 of RG 1.45. However, Turkey Point Units 3 and 4 are not required to meet RG 1.45, but only the criteria of GL 84-04. Since the sensitivity requirements for the particulate and gaseous radiation monitors at Turkey Point Units 3 and 4 meet the criteria of GL 84-04, the staff concludes that they are acceptable.

3.0 CONCLUSION

Based on the above discussion, SPLB concludes the following:

(a) The containment radiation monitoring system described in the St. Lucie Units 1 and 2 UFSAR is not consistent with the recommendations of Regulatory Position C.5 of RG 1.45. However, SPLB discussed the discrepancies with the Materials and Chemical Engineering Branch and determined that the licensee's UFSAR values of 15.1 and 18.1 hours for detecting one gpm of leakage should be acceptable for utilization of LBB technology at St. Lucie pending completion of generic activities as discussed below. Considering the planned generic activities, the fact that there are other methods for detecting RCS leakage (e.g., the containment sump monitor), and the low safety significance of these sensitivity response time discrepancies, it is recommended that the inspection URI be closed and no further staff action be taken at this time. Once the generic activities are completed, further action may be warranted.

(b) The containment radiation monitoring system described in the Turkey Point Units 3 and 4 UFSAR is not fully consistent with the recommendations of Regulatory Position C.5 of RG 1.45. However, Turkey Point Units 3 and 4 are not required to meet RG 1.45, but only the criteria of GL 84-04. Since the sensitivity requirements for the particulate and gaseous radiation monitors at Turkey Point Units 3 and 4 meet the criteria of GL 84-04, the staff concludes that they are acceptable.

During the review of the discrepancies at St. Lucie Units 1 and 2 and Turkey Point Units 3 and 4, the staff recognized that there are inconsistencies in the primary coolant radioactivity concentration assumptions for the sensitivity response times at various facilities. For example, the percentage of failed fuel assumed was 1.0% at Turkey Point and 0.1% at St. Lucie. The outcome between these percentages can change the sensitivity response time by many hours, which could exceed the one gpm in one hour guidance documented in RG 1.45. Furthermore, in recent years, plants have exhibited better fuel performance and improved chemistry resulting in less primary coolant radioactivity concentrations than was assumed when plants were originally

licensed. This reduced primary coolant radioactivity could also lead to additional difficulties in detecting leaks in the RCS by measurement of radioactivity levels.

The Office of Nuclear Regulatory Research is currently developing a RG for LBB to establish updated regulatory guidance on experience obtained over the past years in the application of LBB technology. Since LBB is related to RG 1.45, as discussed in Section 2.1, NRR staff is supporting RES efforts in developing the LBB RG. Once the new RG is developed, RG 1.45 will be reviewed to determine if updates and clarifications are needed to reflect the updated guidance. During this review, RG 1.45 will also be reviewed to determine if any updates are needed to address inconsistencies in licensees' assumptions regarding primary coolant radioactivity concentrations and reduced primary coolant radioactivity levels. Once this is complete, generic action may be warranted to address the containment radiation monitoring system sensitivity response times.

If future issues arise between the response times of containment radiation monitoring systems at other plants and the current regulatory guidance, SPLB will evaluate these issues on a plant-specific basis.

REFERENCES:

1. Memorandum to F. Hebdon from E. Merschoff, "Task Interface Agreement (TIA-019) Concerning Discrepancies Between the Containment Radiation Monitoring System Described in the Updated Final Safety Analysis Report (UFSAR) and Regulatory Guide 1.45 at St. Lucie Units 1 and 2, and Turkey Point Units 3 and 4," dated November 12, 1996.

2. Letter from J. Richardson to E. Sterling, "Acceptance for Referencing of Topical Report CEN-367, Leak-Before-Break Evaluation of Primary Coolant Loop Piping in Combustion Engineering Designed Nuclear Steam Supply Systems," dated October 30, 1990.

3. Letter from D. Sager to NRC, "St. Lucie - Application of Leak-Before-Break Technology to Reactor Coolant System Piping," dated August 26, 1992.

4. Letter from J. Norris to J. Goldberg, "St. Lucie - Application of Leak-Before-Break Technology to Reactor Coolant System Piping," dated March 5, 1993.

5. Westinghouse Topical Report, WCAP-9558, Revision 2, "Mechanistic Fracture Evaluation of Reactor Coolant Pipe Containing a Postulated Circumferential Through-wall Crack," dated May 1981.

6. Generic Letter 84-04, "Safety Evaluation of Westinghouse Topical Report Dealing With Elimination of Postulated Pipe Breaks in PWR Primary Main Loops," dated February 1, 1984.

7. Memorandum to R. Vollmer from R. Mattson, "Guidance Regarding Sensitivity for Reactor Coolant Pressure Boundary Leakage Detection Methods for Evaluation of Asymmetric LOCA Loads," dated August 22, 1983.

8. Letter from W. Conway to G. Edison, "Application of Leak Before Break Technology to Primary Coolant System Piping," dated November 1, 1988.

9. Letter from G. Edison to W. Conway, "Turkey Point Units 3 and 4 Generic Letter 84-04, Asymmetric LOCA Loads," dated November 28, 1988.

10. Letter from T. Plunkett to NRC, "Turkey Point Units 3 and 4 Request to Utilize Leak-Before-Break Methodology for Reactor Coolant System Piping," dated February 2, 1995.