Progress Energy

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February 7, 2006

SERIAL: BSEP 06-0020
TSC-2005-05

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

Subject: Brunswick Steam Electric Plant, Unit Nos. 1 and 2
Docket Nos. 50-325 and 50-324/License Nos. DPR-71 and DPR-62
Response to Request for Additional Information
Revised Main Steam Isolation Valve Leakage Limit
(NRC TAC Nos. MC8106 and MC8107)

Reference: Letter from Cornelius J. Gannon to the U. S. Nuclear Regulatory Commission (Serial: BSEP 05-0102), "Request for License Amendment - Revised Main Steam Isolation Valve Leakage Limit," dated August 11, 2005 (ML052310224)

Ladies and Gentlemen:

On August 11, 2005, Carolina Power & Light Company, now doing business as Progress Energy Carolinas, Inc., requested a revision to the Technical Specifications (TSs) for the Brunswick Steam Electric Plant (BSEP), Units 1 and 2. The proposed change revises Surveillance Requirement 3.6.1.3.9 with respect to the allowed leakage rate through each Main Steam Isolation Valve (MSIV). To support the MSIV leakage rate change, additional automatic initiation functions for the Control Room Emergency Ventilation (CREV) system were also included in TS 3.3.7.1, "Control Room Emergency Ventilation (CREV) System Instrumentation."

On January 18, 2006, the NRC provided an electronic request for additional information (RAI) concerning the calculation of control room doses associated with the proposed change to the MSIV leakage rate. The response to this RAI is enclosed.

No regulatory commitments are contained in this letter. Please refer any questions regarding this submittal to Mr. Edward T. O'Neil, Manager - Support Services, at (910) 457-3512.

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I declare, under penalty of perjury, that the foregoing is true and correct. Executed on February 7, 2006.

Sincerely,

James Scarola

MAT/mat

Enclosure:

Response to Request for Additional Information cc:

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Response to Request for Additional Information

Background

On August 11, 2005, Carolina Power & Light Company, now doing business as Progress Energy Carolinas, Inc., requested a revision to the Technical Specifications (TSs) for the Brunswick Steam Electric Plant (BSEP), Units 1 and 2. The proposed change revises Surveillance Requirement 3.6.1.3.9 with respect to the allowed leakage rate through each Main Steam Isolation Valve (MSIV). To support the MSIV leakage rate change, additional automatic initiation functions for the Control Room Emergency Ventilation (CREV) system were also included in TS 3.3.7.1, "Control Room Emergency Ventilation (CREV) System Instrumentation."

On January 18, 2006, the NRC provided an electronic request for additional information (RAI) concerning the calculation of Control Room (CR) doses associated with the proposed change to the MSIV leakage rate. The response to this RAI follows.

NRC Question 1

The BSEP Main Steam Line deposition model takes credit for organic iodine deposition. Due to the uncertainties in the overall modeling of main steam line deposition and the particular uncertainties regarding the behavior of organic iodine the NRC staff has not accepted credit for organic iodine deposition in MSLs. Provide the technical justification for crediting the removal of organic iodine in the MSL deposition model.

Response to NRC Question 1

Crediting or not crediting the removal of organic iodine in the MSL deposition model has a small impact on calculated onsite or offsite doses. The organic iodine contribution to the total deposited iodine species in the MSL model is a very small value. This was confirmed by a series of sensitivity case analyses performed to examine the impacts on dose consequence for the MSL leak path resulting from questions contained in this RAI. Table 1 provides a summary of the sensitivity case anslyses performed in response to questions contained in this RAI. This table shows that the most limiting location of the original submittal, the BSEP CR, would experience an increase of 0.03 Rem with no credit for organic iodine removal. This increase is bounded by other conservatisms discussed in the responses to NRC Questions 2 and 4.

NRC Question 2

BSEP's use of the MSL aerosol deposition methodology from AEB-98-03, "Assessment of Radiological Consequences for the Perry Pilot Plant Application Using the Revised (NUREG-1465) Source Term," may be non-conservative. Please address the following concerns:

a. The calculated aerosol iodine removal efficiencies show a slight increase after 24 hours after which they remain constant for the duration of the evaluation. The NRC staff would expect the removal efficiencies to decrease over time because most of the easily deposited aerosols will have already been deposited in previous time periods. Justify the change in the aerosol size distribution over time due to deposition according to your aerosol deposition model.

b. It appears that the same pipe area was used in the determination of removal efficiencies for all species of iodine and that the entire internal pipe circumference was multiplied by the horizontal pipe segment length to determine the settling area. While this approach is appropriate for elemental iodine deposition, the projected surface area (calculated as the internal diameter times the horizontal length) should be used for aerosol deposition. Explain the basis for the calculation of the effective surface area for application in aerosol deposition.

Response to NRC Question 2

Item a

The aerosol size distribution is implicit from applying the AEB-98-03 50th percentile deposition velocity in a single, well-mixed volume model. In the BSEP modeling, a step reduction of drywell pressure is imposed at 24 hours elapsed event time in accordance with Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors." This reduces the MSIV leak flow driving force and slows the flow rate through the model's volume representing the main steam line (MSL) system. The lower flow rate increases the MSL volume residence time, allowing for greater total deposition to occur and thus the increased iodine removal efficiency (i.e., see Equations 3 and 4 of Appendix A to AEB-98-03).

In telephone conference on January 25, 2006, the NRC clarified this question, stating that what was being requested is BSEP's interpretation of expected aerosol size distribution behavior over time versus that assumed by the AEB-98-03 model. The AEB-98-03 model is intended to be conservative in estimating total deposition based on a deposition velocity statistically determined from drywell expected distributions of aerosol density, diameter, and shape factors. Since the BSEP MSL aerosol deposition model is a lumped, single-volume, there is no aerosol size distribution behavior impact on the model itself. The deposition volume's outlet flow empties directly into the condenser and not into other pipe deposition volumes; with deposition rates based on the first volume's exit conditions. Thus, this single-volume model does not permit simulation of deposition-induced changes to the initial aerosol size distribution as a function of time for a unit volume of aerosol that transits through the model. Simulation of the physical changes to the aerosol constituents would require a multi-volume model to account for time-dependent changes to control volume characteristics (i.e., loss of mass, redistribution of remaining particles, etc.). However, it is expected that a mechanistic multi-compartment pipe deposition model would yield higher deposition rates as the downstream volumes remove additional aerosol particles not deposited in upstream volumes. The model, therefore, does not account for the affect of time-dependent aerosol mass depletion through the MSL leakage path, the affect of pipe bends, condensation, or other non-uniformities that stimulate additional droplet growth and enhance aerosol deposition. Ultimately, it is expected that, in a multi-compartment deposition model, a more dilute aerosol, consisting of only the smallest particles, enters the condenser volume; making the AEP-98-03 model conservative with respect to expected aerosol size distribution behavior.

Thus, the dose consequence predicted from the lumped, single-volume BSEP MSL iodine aerosol pipe deposition model is expected to be greater than that from a multi-compartment aerosol depletion model that accounts for all or most of the aerosol depletion mechanisms.

Item b

Revising the MSL deposition area of this leakage path for aerosol deposition from one based on the circumference and path length to the diameter and path length has only a minor impact on calculated doses. As shown in Table 1, Sensitivity Case 1, the contribution to CR dose from MSIV leakage via the primary pathway results in an increase from 2.94 Rem to 2.95 Rem as a result of this change.

However, in reviewing the model design data, it is noted that the submitted analysis uses a BSEP model that only credits the free volume of one low-pressure turbine (LPT) and its associated condenser shell (i.e., BSEP Calculation No. BNP-RAD-007, Rev. 1A, Section 6.25.5.7). The calculation states an assumption of no credit for communication between the two condenser shells as the basis for the calculated volume. In reality, there is no restriction on crediting the free volume of both LPTs and the whole condenser since they are highly interconnected. This effectively doubles the condenser holdup and deposition volume compared to the value used in the RADTRAD analysis for evaluating increased MSIV leakage. If this conservatism were removed, the contribution from MSIV leakage via the primary pathway to the CR dose, accounting for the revised aerosol deposition area, drops to 1.81 Rem (i.e., Table 1, Sensitivity Case 2). Therefore, the conservatism associated with the assumed free volume of only one LPT more than accounts for the surface area used for aerosol deposition.

<u>NRC Question 3</u>

The report on which the elemental iodine deposition rate was based ("MSIV Leakage Iodine Transport Analysis," J. E. Cline, August 20, 1990) also includes resuspension and conversion. State whether you considered the effect of resuspension and conversion on the elemental iodine deposition rate.

<u>Response to NRC Question 3</u>

Iodine resuspension was not considered in the model. As noted from the temperature dependent formulations in the Cline paper, this impact is very minor. However, the conservatisms addressed in response to NRC Questions 2b, 4a, and 4b, are significant and far out-weigh the affect of iodine re-evolution/resuspension.

NRC Question 4

Address these further considerations with respect to the modeling of main steam line deposition:

a. Whether wall temperature used in elemental iodine deposition modeling account for the decay heat of the deposited material in the pipe. Explain how this additional source of heat would effect the assumed deposition.

b. Describe the effect of the decay heat from deposited material in the main steam piping with respect to iodine re-evolution.

Response to NRC Question 4

In a submittal dated August 19, 2005 (i.e, ADAMS Ascension Number ML052430196), the Clinton Nuclear Station demonstrated that the impact of decay heat from deposited iodine species is approximately equal to an 80-watt incandescent light bulb, or about 266 BTU/hr. This value was based on a 100 scfh leakage flow rate, 100 percent of the iodine species in the leakage flow assumed to be deposited, and the iodine activity of the Clinton source term in curies converted to watts. By comparison, Clinton has a license rated thermal power (RTP) of 3,473 megawatts and each BSEP unit has a RTP of 2,923 megawatts. Since the source term is directly proportional to core power, the estimated decay heat for the same leak rate in the BSEP model would be about that of a 67-watt bulb. Additionally, there are significant conservatisms in the MSL thermal profile model for BSEP which more than offset the any impact of decay heat from deposited iodine species.

One conservatism is the constant 135 degrees F ambient temperature assumed for the MSL cool down calculation model. This is a reasonable assumption for approximately half of the MSL piping which is located in the MSL tunnel, a volume which is enclosed by thick concrete walls which limit the rate of natural heat loss. However, the remaining piping is located in the large condenser bay room. The expected peak temperature in this area is approximately 104 degrees F. Building heat loss as a result of leakage through ventilation ductwork and other openings, and by conduction/convection, would cool the building after the cessation of power generation (i.e., which would remove most of the heat sources in the building). Thus, the building will cool to a temperature much closer to the ambient conditions (i.e., the BSEP site design peak external mean temperature is 93 degrees F) within hours of the postulated event with a consequent impact of depressing the MSL temperature profile.

In addition, the MSL cool down calculation model assumes complete insulation of the MSL piping. In reality, the MSL insulation has many penetrations that connect directly to the piping but are not credited as heat losses for calculating the thermal profile. These include branch piping, valve yokes and uninsulated structural pipe supports that act to dissipate heat directly to the surrounding atmosphere. For example, the combined natural convection and radiation heat transfer coefficient for a 3-inch diameter horizontal cylinder with a 100 degrees F mean temperature differential (i.e., $T_s - T_a$) is 1.8 BTU/hr-ft^2/degree F. This is representative of pipe support material. Conservatively assuming only 100 degrees F effective temperature difference between ambient temperature and temperature of the support material, a 1.4 ft^2 surface, or about 9.50 inches of cylinder length, is sufficient dissipate up to a 266 BTU/hr impact of decay heat from deposited iodine. This represents only a small fraction of the total support structures and attachments combined surface area. Thus, the heat gain to the piping from deposited iodine decay is greatly exceeded by the heat dissipated through the BSEP MSL piping attachments.

Based on the above, the affect of any decay heat on pipe inner surface temperature due to iodine decay energy absorption is insignificant to the evaluation of iodine deposition and, also to any re-suspension/re-evolution of deposited iodine.

Table 1			
Sensitivity Cases	Dose – Rem (TEDE)		
	EAB	LPZ	CR
Current Analysis Baseline dose contribution from MSIV leakage via the primary pathway	0.861	3.42	2.94
Sensitivity Case 1 Modified pipe deposition area and removal efficiencies for aerosols (i.e., NRC Question 2b)	0.866	3.42	2.95
Sensitivity Case 2 Modified pipe deposition area and removal efficiencies for aerosols, increased condenser volume (i.e., 59,958 ft^2) and modified condenser aerosol and elemental removal efficiencies (i.e., NRC Question 2b plus condenser volume conservatism)	0.485	1.91	1.81
Sensitivity Case 3 Modified pipe deposition area and removal efficiencies for aerosols, increased condenser volume, modified condenser aerosol and elemental removal efficiencies, and turn-off organic iodine removal (i.e., NRC Questions 1 and 2b plus condenser volume conservatism)	0.487	1.92	1.84
Sensitivity Case 4 Modified pipe deposition area and removal efficiencies for aerosols, increased condenser volume, modified condenser aerosol and elemental removal efficiencies, and turn-off aerosol iodine removal at 24 hours (i.e., NRC Questions 2a and 2b plus condenser volume conservatism)	0.485	1.91	1.81
Sensitivity Case 5 Modified pipe deposition area and removal efficiencies for aerosols, increased condenser volume, modified condenser aerosol and elemental removal efficiencies, turn-off organic iodine removal, and turn-off aerosol iodine removal at 24 hours (i.e., NRC Questions 1, 2a, and 2b plus condenser volume conservatism)	0.487	1.92	1.84