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NUREG-0737, ITEM II.E.4.2(7)AUTOMATIC ISOLATION OF CONTAINMENT PURGE AND VENT VALVES (TAC #44876)

Dear Sir:

This letter responds to the NUREG-0737, Item II.E.4.2(7) requirement that containment purge and vent valves be equipped with a direct radiation actuated isolation signal.

Boston Edison Company (BECo) has performed an evaluation and determined that the Boiling Water Reactor Owner's Group (BWROG) evaluation, as accepted by the NRC, is applicable to Pilgrim Nuclear Power Station (PNPS). BECo's evaluation is attached to this letter.

As a result of this evaluation, BECo concludes PNPS containment purge and vent valves on lines 2 inches in diameter or smaller do not need a direct radiation actuated isolation signal. BECo action on Item II.E.4.2(7) of NUREG-0737 for containment purge and vent valves on lines 2 inches in diameter or smaller is complete.

R. G. Bird

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Attachment: NUREG-0737, Item II.E.4.2(7): Automatic Isolation of Containment Purge and Vent Valves (TAC #44876)

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ATTACHMENT
to BECo Letter No. 88- 053

NUREG-0737, ITEM II.E.4.2(7): AUTOMATIC ISOLATION OF CONTAINMENT PURGE AND VENT VALVES TAC #44876

1.0 SUMMARY

Item II.E.4.2(7) of NUREG-0737 (References 1 and 2), required that containment purge and vent valves close automatically on a high radiation signal. On June 14, 1982, the Boiling Water Reactor Owners Group (BWROG) submitted the results of a generic evaluation of offsite releases of radioactivity from a postulated primary system break through an open containment vent or purge valve (References 3 and 4) stating:

> For both large (24 inch) or small (2 inch) BWR containment purge and vent lines the valves do not need an automatic radiation isolation signal. This is based on a number of conditions, including resultant low dose impact, expected operator actions, sensitive leak detection system alarms and the use of several other plant features to further minimize the event effects.

The NRC accepted part of this generic evaluation in a letter to the BWROG dated May 7, 1986 (Reference 5), stating:

> BWR lines of 2 inches in diameter or smaller need not be provided with a radiation isolation signal, provided that a licensee demonstrates on his docket that the BWROG generic evaluation is applicable to his plant. This demonstration should include an assessment of the ability of the operators to assess and isolate leakages that would not cause other isolation signals.

1.1 The Pilgrim-specific evaluation, based on the BWROG generic approach, establishes the following:

1.1.1 The BWROG generic evaluation of primary containment purge and vent valve isolation applies to the Pilgrim Nuclear Power Station (PNPS).

1.1.2 The offsite dose rates resulting from leak or break flow rates into the primary containment are as low as those implied by the generic evaluation.

1.1.3 The operator can assess and isolate leaks which do not initiate automatic isolation before such leaks adversely affect the public health and safety.

Based on this evaluation, BECo concludes that PNPS purge and vent isolation valves on lines 2 inches in diameter or smaller do not require the addition of an automatic high radiation isolation signal.

1.2 Further evaluation also shows that the subject valves are under strict administrative and operational control providing PNPS with the following safeguards:

1.2.1 Purge and vent valve alignments which provide a pathway out of the containment will be quickly identified to operators by a containment low pressure alarm.

1.2.2 Opening the purge and vent valves requires concurrent operation of the Standby Gas Treatment System (SBGTS). The SBGTS mitigates the radiological impact of a release by filtering it and providing it with an elevated release point.

1.2.3 The purge and vent valves are unlikely to remain open during breaks or leaks involving iodine-spiked reactor coolant. Such events depressurize the primary system, resulting in automatic containment isolation.

1.2.4 Analysis shows that the narrow range of minor leak rates that do not initiate automatic containment isolation will not result in offsite doses beyond NRC/EPA limits.

All of these factors further reduce or eliminate the already low radiological impact cited in the BWROG analysis.

2.0 RESULTS

2.1 The BECo dose calculation model (DORITA) produces results comparable to the BWROG radiation analysis results.

2.2 The PNPS plant parameters fall within the BWROG assumptions and initial conditions.

2.3 The PNPS calculated offsite dose rates are as low as the results of the BWROG calculation and below the NRC/EPA limits.

2.4 The PNPS operators can isolate and assess leaks that do not initiate automatic isolation before such leaks can adversely affect public health and safety.

2.5 PNPS design, operation and administrative controls prevent the inadvertent or unauthorized opening of the normally-closed containment purge and vent valves and the uncontrolled and unmonitored release of containment effluents.

2.6 Additional PNPS plant protection features, such as the Standby Gas Treatment System, further reduce radiological effects.

3.0 CONCLUSION

The BECo evaluation demonstrates automatic isolation of the containment purge and vent valves by a high radiation signal is unnecessary at PNPS.

4.0 CALCULATIONS

BECo performed the PNPS primary containment purge and vent valve calculations in conformance with the instructions issued by the BWROG (Reference 6) and accepted by the NRC. This established the following results:

4.1 The PNPS plant parameters fall within the BWROG assumptions and initial conditions.

The generic analysis, initial conditions and assumptions were used, except for those few parameters where PNPS values were different from those used in the generic calculation.

4.2 The BECo dose calculation model (DORITA) produces comparable results to the BWROG radiation analysis results.

To demonstrate this, a base case analysis was performed which reproduced the BWROG generic evaluation using the same release duration to the environment and the same atmospheric dispersion conditions. The BECo calculation yielded a thyroid dose of approximately 0.0171 Rem. The BWROG generic analysis yielded a thyroid dose of 0.0168 Rem.

4.3 The PNPS calculated dose rates are as low as the results of the approved generic evaluation and below the NRC/EPA limits.

PNPS release rates were evaluated for a drywell vent opening. Analyses of wet well vents of identical size result in significantly less radiological impact due to suppression pool scrubbing effects.

The analysis is based on a reactor coolant pressure boundary leak rate of 5 gpm venting through a 2 inch inside diameter line for a 24 hour period. This is the limiting leak rate that will not result in a high drywell pressure isolation signal with a 2 inch diameter vent path. The 24 hour period is based on existing technical specification surveillance requirements for containment sump monitoring. This case represents the opposite of the BWROG generic evaluation, which assumes a large leak, large vent path and rapid operator action (30 minutes). BECo's model is conservative because it assumes a small, harder to detect, leak and a longer period for operator action.

Radiological analysis using DORITA shows that the expected releases would result in a thyroid dose of approximately 2.82×10^{-2} Rem, and a whole body dose of approximately 1.66×10^{-4} Rem at the site boundary in a 24 hour period. This calculated dose is orders of magnitude less than EPA Protective Action Guide (PAG) Level 1 dose guidelines of 5 Rem thyroid and 1 Rem whole body. Allowing the 2 inch purge and vent valves to remain open for as much as 30 days would result in doses at the site boundary of 1.01×10^{-1} Rem thyroid and 2.27×10^{-4} Rem whole body.

5.0 OPERATION EVALUATIONS

BECo evaluated the ability of the operators to recognize and take necessary actions to prevent, mitigate, or accommodate primary coolant and containment boundary leakages. Based on that evaluation, we conclude:

5.1 PNPS is equipped with instrumentation that detects Reactor Coolant Pressure Boundary (RCPB) leakage into the drywell. There are over 8 leak detection parameters that are continuously monitored and presented to the operator. Recognition of an abnormal RCPB leakage rate will initially result in control room alarms or in conditions observable during normal plant surveillances.

Procedures and instrumentation are provided to guide operators and aid them in the detection and mitigation of RCPB leakage. The procedures also instruct the operator to monitor specific parameters when abnormal conditions, which may or may not result from abnormal RCPB leakage, are indicated. Plant operating procedures specifically instruct the operator to investigate any unexplained drywell or torus atmospheric change. If conditions continue to degrade (e.g., high containment temperature), the operators are guided by Emergency Operating Procedures (EOPs) which require immediate shutdown.

Evaluations were performed that show a high drywell sump level alarm will occur within 14 minutes, assuming a 140 gpm reactor coolant pressure boundary leak rate, and within 10.3 hours for a 5 gpm leak.

5.2 Design and operational constraints minimize the potential for a release of radioactive materials through the purge and vent lines.

The purge and vent valves are remotely controlled from the main control room. Procedures require them to be normally closed except for short periods of time needed to inert, de-inert, or vent the containment for operational reasons. The outlet purge and vent valves are key-locked.

All of these valves are subject to double operator control/alignment sign-offs (NUREG 0737, Item I.C.6). Limiting Conditions of Operation (LCOs) provided in the technical specifications require:

- the containment be inert within 24 hours after placing the reactor mode switch into RUN
- de-inerting cannot commence prior to 24 hours before a shutdown
- oxygen concentration must be maintained below 4% by volume
- a 1.17 psig minimum differential pressure must be maintained between the drywell and torus.

Analysis performed in this evaluation shows the containment low pressure alarms will quickly alert the operator to any improper purge and vent valve opening. The alarms will occur in less than 220 minutes from the vent valve opening. The alarms, when coupled with operational constraints and administrative controls, ensure the valve open time is minimal during reactor operation.

6.0 ADDITIONAL RELEASE EVALUATIONS

BECo evaluated several important PNPS features that were not used in the BWROG and NRC analyses. These features were not used in our dose calculations but would be available and would reduce release rates to the environment during an actual event. Based on these evaluations BECo concludes:

6.1 Releases would be controlled, filtered and discharged at an elevated point because procedures require the Standby Gas Treatment System (SGTS) to be operating when the purge and vent valves are open. If credit were taken for this system being in operation, the calculated dose rates would be reduced by a factor of approximately 100-1000.

6.2 The likelihood of releasing radioactive material through the containment purge and vent valves directly to the environment is minimized at PNPS. Two pathways exist downstream from the purge and vent valves: one through the SGTS to the Main Stack, the other through the Reactor Building Vent Stack. Both these release pathways are monitored and isolated by additional normally closed ventilation system isolation valves.

As a result, a direct and uncontrolled radiological release from the primary containment going only through the containment purge and vent valves is not possible. This is contrary to the conservative assumptions made in the BWROG and NRC analyses, both of which assumed that all releases went directly to the environs through the purge and vent valves without further control, treatment or monitoring.

6.3 The incorporation of iodine spiking considerations for non-depressurization small breaks or leaks is a conservative calculational assumption. Iodine spiking is the direct result of rapid power changes or primary system depressurization. Overpower events will command immediate operator attention and action. Sudden depressurization events would cause automatic high drywell pressure, or low reactor water level containment isolations and the immediate and automatic closure of the purge and vent and valves. Incorporation of this assumption into the BWROG/NRC model would reduce the calculated dose values by a factor of 10-100.

REFERENCES

(1) NUREG-0737, Clarification of TMI Action Plan Requirements, dated October, 1980

(2) NUREG-0660, NRC Action Plan Developed as a Result of the TMI Accident, dated May, 1980

(3) Letter, (#8149) (T. Dente) to NRC (D. Eisenhut), BWROG Evaluation of NUREG-0737 Item II.E.4.2(7), dated: June 29, 1981

(4) Letter, (#8222) (T. Dente) to NRC (D. Eisenhut), Supplement to BWR Owners Group Evaluation of NUREG Item II.E.4.2(7), dated: June 14, 1982

(5) Letter, NRC (R. Bernero) to BWROG (J. Fulton), (NRC Review and Approval of BWROG Evaluation NUREG-0737 Item II.E.4.2(7), dated: May 7, 1986

(6) NSEO-78-0882, GE (J. Schilder) to BWROG Utilities, Instruction For Calculation of Offsite Dose From Limiting Primary System Break Which Does Not Isolate Primary Containment Vent and Purge Valves, dated: June 18, 1982