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Docket No. 50-293

Mr. William D. Harrington
Senior Vice President, Nuclear
Boston Edison Company
800 Boylston Street
Boston, Massachusetts 02199

Dear Mr. Harrington:

SUBJECT: NUREG-0737, ITEM II.B.3,
POST-ACCIDENT SAMPLING

Re: Pilgrim Nuclear Power Station

We have completed our review of your submittals of June 9, 1983; August 9, 1984; and May 30, 1985, concerning the post-accident sampling system (PASS) at the Pilgrim Nuclear Power Station. As a result of this review, we find that ten of the eleven criteria in Item II.B.3 of NUREG-0737 have been met and that your procedure for estimating core damage is acceptable on an interim basis.

On June 17, 1985, Mr. Kahler of your staff informed us by telephone that a more complete procedure for estimating core damage will be provided by September 20, 1985 for our review.

Enclosed is a copy of our Safety Evaluation of your submittals.

Sincerely,

Original signed by MGrotenhuis for/

Domenic B. Vassallo, Chief
Operating Reactors Branch #2
Division of Licensing

Enclosure:
As stated

cc w/enclosure:
See next page

DL:ORB#2	DL:ORB#2	DL:ORB#2
SNorris:ajs	PLeech	DVassallo
06/27/85	06/27/85	06/ /85

Mr. William D. Harrington
Boston Edison Company
Pilgrim Nuclear Power Station

cc:

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

POST-ACCIDENT SAMPLING SYSTEM (NUREG-0737, ITEM II.B.3)

BOSTON EDISON COMPANY

PILGRIM NUCLEAR POWER STATION, UNIT 1

DOCKET NO. 50-293

1.0 INTRODUCTION

Subsequent to the TMI-2 incident, the need was recognized for an improved post-accident sampling system (PASS) to determine the extent of core degradation following a severe reactor accident. Criteria for an acceptable sampling and analysis system are specified in NUREG-0737, Item II.B.3. The system should have the capability to obtain and quantitatively analyze reactor coolant and containment atmosphere samples without radiation exposure to any individual exceeding 5 rem to the whole body or 75 rem to the extremities (General Design Criteria (GDC) 19) during and following an accident in which there is core degradation. Materials to be analyzed and quantified include certain radionuclides that are indicators of severity of core damage (e.g., noble gases, isotopes of iodine and cesium, and nonvolatile isotopes), hydrogen in the containment atmosphere and total dissolved gases or hydrogen, boron, and chloride in reactor coolant samples.

To comply with NUREG-0737, Item II.B.3, Boston Edison Company (the licensee) must (1) review and modify his sampling, chemical analysis, and radionuclide determination capabilities as necessary and (2) provide the staff with information pertaining to system design, analytical capabilities and procedures in sufficient detail to demonstrate that the criteria are met.

2.0 EVALUATION

By letters dated June 9, 1983, August 9, 1984 and May 30, 1985, the licensee provided information on the post-accident sampling system at Pilgrim Station, as follows:

Criterion (1):

> The licensee shall have the capability to promptly obtain reactor coolant samples and containment atmosphere samples. The combined time allotted for sampling and analysis should be three hours or less from the time a decision is made to take a sample.

The licensee has provided sampling and analysis capability to promptly obtain and analyze reactor coolant, suppression pool (from residual heat removal (RHR) loop) containment sump, and containment atmosphere samples within

three hours from the time a decision is made to take a sample. During loss of off-site power, alternate power sources are available for both gas and liquid sampling systems that can be energized in sufficient time to meet the three hour sampling and analysis time limit. We find that these provisions meet Criterion (1) and are, therefore, acceptable.

Criterion (2):

> The licensee shall establish an onsite radiological and chemical analysis capability to provide, within the three-hour time frame established above, quantification of the following:
>
> a) Certain radionuclides in the reactor coolant and containment atmosphere that may be indicators of the degree of core damage (e.g., noble gases, iodines and cesiums, and nonvolatile isotopes);
>
> b) hydrogen levels in the containment atmosphere;
>
> c) dissolved gases (e.g., H_2), chloride (time allotted for analysis subject to discussion below), and boron concentration of liquids;
>
> d) alternatively, have in-line monitoring capabilities to perform all or part of the above analyses.

The PASS provides grab sample capability for pH, chloride, boron, radionuclide analysis and dissolved hydrogen and oxygen in the reactor coolant, and grab samples and/or in-line monitoring of hydrogen oxygen and gamma spectrum in the containment atmosphere. The PASS provides the capability to collect diluted or undiluted liquid reactor coolant and gaseous grab samples.

The licensee has provided a core damage estimation procedure based on reactor coolant and containment atmosphere radionuclides and two other plant parameters. This is acceptable as an interim procedure. The licensee has committed to provide a final core damage estimation procedure by September 20, 1985. The final procedure should include information the from BWR Owners Group procedure which will provide a more realistic core damage estimate. We find that the licensee partially meets Criterion (2).

Criterion (3):

> Reactor coolant and containment atmosphere sampling during post-accident conditions shall not require an isolated auxiliary system (e.g., the letdown system, reactor water cleanup system) to be placed in operation in order to use the sampling system.

Reactor coolant and containment atmosphere sampling during post-accident conditions does not require an isolated auxiliary system to be placed in operation in order to perform the sampling function. The PASS valves which

are not accessible after an accident are environmentally qualified for the conditions in which they need to operate. These provisions meet Criterion (3) and are, therefore, acceptable.

Criterion (4):

> Pressurized reactor coolant samples are not required if the licensee can quantify the amount of dissolved gases with unpressurized reactor coolant samples. The measurement of either total dissolved gases or H_2 gas in reactor coolant samples is considered adequate. Measuring the O_2 concentration is recommended, but is not mandatory.

Pressurized reactor coolant samples are cooled and degassed to obtain representative total dissolved gas samples at the PASS sampling station. The hydrogen and oxygen concentrations are measured by gas chromatography. Dissolved oxygen concentrations of less than 0.1 ppm can be verified by measurement of a dissolved hydrogen residual of greater than 10 cc/kg. Alternately, dissolved oxygen can be obtained by gas chromatography. We have determined that these provisions meet Criterion (4) of Item II.B.3 in NUREG-0737, and are, therefore, acceptable.

Criterion (5):

> The time for a chloride analysis to be performed is dependent upon two factors: (a) if the plant's coolant water is seawater or brackish water and (b) if there is only a single barrier between primary containment systems and the cooling water. Under both of the above conditions the applicant shall provide for a chloride analysis within 24 hours of the sample being taken. For all other cases, the applicant shall provide for the analysis to be completed within four days. The chloride analysis does not have to be done on-site.

Chloride analysis is performed on a diluted sample within 96 hours of sampling by using an ion chromatograph. Chloride analysis accuracy by this technique is less than 0.1 ppm. An undiluted sample will also be obtained and stored on-site for analysis within 30 days. These provisions meet Criterion (5) and are, therefore, acceptable.

Criterion (6):

> The design basis for plant equipment for reactor coolant and containment atmosphere sampling and analysis must assume that it is possible to obtain and analyze a sample without radiation exposures to any individual exceeding the criteria of GDC 19 (Appendix A, 10 CFR Part 50) (i.e., 5 rem whole body, 75 rem extremities). (Note that the design and operational review criterion was changed from the operational limits of 10 CFR Part 20 (NUREG-0578) to the GDC 19 criterion (October 30, 1979 letter from H.R. Denton to all licensees).

The licensee has performed a time-person-motion study to ensure that operator exposure while obtaining, transporting, and analyzing a PASS sample is within the acceptable limits. This operator exposure includes entering and exiting the sample panel area, operating sample panel manual valves, positioning the grab sample into the shielded transfer casks, transporting casks and performing sample analyses. PASS personnel radiation exposures from reactor coolant and containment atmosphere sampling and analysis are within 5 rem whole body and 75 rem extremities, which meet the requirements of GDC 19 and Criterion (6) and are, therefore, acceptable.

Criterion (7):

> The analysis of primary coolant samples for boron is required for PWRs. (Note that Rev. 2 of Regulatory Guide 1.97 specifies the need for primary coolant boron analysis capability at BWR plants).

A diluted grab sample of the reactor coolant will be analyzed for boron by plasma spectrometry or spectrophotometry in the range of 0 to 1000 ppm with an accuracy of ±10%. This provision meets the recommendations of Regulatory Guide 1.97, Rev. 2 and Criterion (7) and is, therefore, acceptable.

Criterion (8):

> If in-line monitoring is used for any sampling and analytical capability specified herein, the licensee shall provide backup sampling through grab samples, and shall demonstrate the capability of analyzing the samples. Established planning for analysis at off-site facilities is acceptable. Equipment provided for backup sampling shall be capable of providing at least one sample per week until the accident condition no longer exists.

In-line monitoring is used to determine containment atmosphere hydrogen and oxygen levels. These are redundant safety related systems required by Item II.F.1.6 of NUREG-0737, and, therefore, it is acceptable not to have backup grab sample capability. Radionuclide analysis, dissolved hydrogen and oxygen, pH, conductivity, and boron are obtained on grab samples of reactor coolant. The PASS can obtain both diluted and undiluted samples. We find these provisions meet Criterion (8) and are, therefore, acceptable.

Criterion (9):

> The licensee's radiological and chemical sample analysis capability shall include provisions to:
>
> a) Identify and quantify isotopes of the nuclide categories discussed above to levels corresponding to the source term given in Regulatory Guides 1.3 or 1.4 and 1.7. Where necessary and practicable, the ability to dilute samples to provide capability for measurement and reduction of personnel exposure should be provided. Sensitivity of on-site liquid sample analysis

capability should be such as to permit measurement of nuclide concentration in the range from approximately 1 μCi to 10 Ci/g.

b) Restrict background levels of radiation in the radiological and chemical analysis facility from sources such that the sample analysis will provide results with an acceptably small error (approximately a factor of 2). This can be accomplished through the use of sufficient shielding around samples and outside sources, and by the use of a ventilation system design which will control the presence of airborne radioactivity.

The radionuclides in both the primary coolant and the containment atmosphere will be identified and quantified. Provisions are available for obtaining diluted reactor coolant samples to minimize personnel exposure. The PASS can perform radioisotopes analyses at the levels corresponding to the source term given in Regulatory Guides 1.3, Rev. 2, and 1.7. Radiation background levels will be restricted by shielding. Ventilated radiological and chemical analysis facilities are provided to obtain results with an acceptably small error (approximately a factor of 2). We find these provisions meet Criterion (9) and are, therefore, acceptable.

Criterion (10):

Accuracy, range, and sensitivity shall be adequate to provide pertinent data to the operator in order to describe radiological and chemical status of the reactor coolant systems.

The accuracy, range, and sensitivity of the PASS instruments and analytical procedures are consistent with the recommendations of Regulatory Guide 1.97, Rev. 3, and July 27, 1983 clarifications of NUREG-0737, Item II.B.3, Post-Accident Sampling Capability. Therefore, they are adequate for describing the radiological and chemical status of the reactor coolant. The analytical methods and instrumentation were selected for their ability to operate in the post-accident sampling environment. The licensee has not provided standard test matrix testing information on similar equipment; however, the standard test matrix and radiation effect evaluation indicated no interference in the PASS analyses. Technician refamiliarization training will occur at least every 6 months. The equipment and procedures used in the PASS will be tested or calibrated to maintain a high level of reliability. We determined that these provisions meet Criterion (10) of Item II.B.3 in NUREG-0737 and are, therefore, acceptable.

Criterion (11):

In the design of the post-accident sampling and analysis capability, consideration should be given to the following items:

a) Provisions should be made for purging sample lines, for reducing plateout in sample lines, for minimizing sample loss or distortion, for preventing blockage of sample lines by loose material in the

reactor coolant system (RCS) or containment, for appropriate disposal of the samples, and for flow restrictions to limit reactor coolant loss from a rupture of the sample line. The post-accident reactor coolant and containment atmosphere samples should be representative of the reactor coolant in the core area and the containment atmosphere following a transient or accident. The sample lines should be as short as possible to minimize the volume of fluid to be taken from containment. The residues of sample collection should be returned to containment or to a closed system.

b) The ventilation exhaust from the sampling station should be filtered with charcoal adsorbers and high-efficiency particulate air (HEPA) filters.

The licensee has addressed provisions for purging and recirculation back to containment to ensure that samples are representative, and for flow restrictions and/or isolation valves to limit reactor coolant loss from a rupture of the sample line. To limit iodine plateout, the containment atmosphere sample line is heat traced. The post-accident sampling stations are ventilated by the standby gas treatment system which contains charcoal adsorbers and HEPA filters. The post-accident reactor coolant and the containment atmosphere samples will be representative of the reactor coolant and the containment atmosphere respectively. We determined that these provisions meet Criterion (11) of Item II.B.3 of NUREG-0737, and are, therefore, acceptable.

3.0 CONCLUSION

On the basis of our evaluation, we conclude that the post-accident sampling system at Pilgrim Station meets ten of the eleven criteria in Item II.B.3 in NUREG-0737. The procedure for estimating reactor core damage is acceptable on an interim basis. The licensee has committed to providing a plant specific procedure for estimating the extent of core damage based on the BWR Owners Group Procedure.

Principal Contributor: Frank Witt

Dated: July 1, 1985