VERMONT YANKEE
NUCLEAR POWER CORPORATION

RD 5, Box 169, Ferry Road, Brattleboro, VT 05301

REPLY TO:
ENGINEERING OFFICE
1671 WORCESTER ROAD
FRAMINGHAM, MASSACHUSETTS 01701
TELEPHONE 617-872-8100

May 4, 1984
FVY 84-43

United States Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Office of Nuclear Reactor Regulation
Mr. Domenic B. Vassallo, Chief
Operating Reactors Branch No. 2
Division of Licensing

References:
(a) License No. DPR-28 (Docket No. 50-271)
(b) Letter, USNRC to VYNPC, NVY 82-159, dated September 30, 1982
(c) Letter, USNRC to VYNPC, NVY 84-52, dated March 19, 1984
(d) Letter, VYNPC to USNRC, FVY 81-169, dated November 25, 1981
(e) Letter, VYNPC to USNRC, FVY 81-171, dated November 25, 1981

Subject: NUREG-0737, Item II.B.3, Post-Accident Sampling System

Dear Sir:

By Reference (b) you requested additional information to support your post-implementation review of the Post-Accident Sampling System at our facility. The purpose of this letter is to provide you with the requested information. Each of the eleven NUREG-0737, Item II.B.3 criteria is addressed.

We trust that this information is acceptable; however, should you desire additional information, please contact us.

Very truly yours,

J B Sinclair

J. B. Sinclair
Licensing Engineer

JBS/kg

Enclosure

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ENCLOSURE 1

Vermont Yankee Response to

Request for Additional Information

NUREG-0737, Item II.B.3

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.

RESPONSE: (1)

Vermont Yankee has the capability to obtain reactor coolant samples and containment atmosphere samples, and to perform the required analyses within the three (3) hours allotted time frame.

The sample valves associated with the Reactor Coolant System are operated locally at the sample panel. These valves are powered from an emergency supply source.

The hydrogen analyzer sample pumps provide the motive force for establishing flow in the containment sample lines. The sample pumps associated with the Teledyne analyzers are powered from an emergency power source.

CRITERION: (2)

The licensee shall establish an on-site 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), boron concentration of liquids.

(d) Alternatively, have in-line monitoring capabilities to perform all or part of the above analyses.

RESPONSE: (2)

Post-accident sample radioisotopic analysis would be performed in the normal radiochemistry Counting Room, conditions permitting. This room is adjacent to the Chemistry Laboratory. This facility is normally equipped with two Ge(Li) detectors (with efficiencies up to 20%) connected to

two Canberra 8100 multichannel analyzers (MCA). (Two units are physically in the Counting Room.) The 8100 MCA is capable of collecting a spectrum from the detectors. In turn, the MCA is supported by a Digital PDP-11/05 computer, with two available terminals. The Canberra Spectran-III computer program is utilized for isotopic analysis. If required, background subtractions can be performed manually.

As described above, samples can be collected and transported to the laboratory area in shielded containers. Approach and entry into the lab would be monitored for habitability. Monitoring would continue once entry has been made.

Should any significant core damage have occurred, additional dilution of the sample would be required. The degree and methods by which this will be accomplished are described in response to Question 9. The criterion to which samples should be diluted is established at a system dead time of less than 20%.

Because of the nature of the quick-disconnect connectors on the containment atmosphere sample bombs, special handling is required to extract a sample from the bomb. A syringe with a needle is inserted from the bottom of the shield to permit sampling from the bomb. Any of these sample preparation operations would be accomplished inside of a hood in the lab adjacent to the Counting Room. As much as possible, samples would be left inside of their transport container, and remote handles and/or tongs used with the work being done behind a temporary shield wall. Once processed, excess samples not required for the analysis will be placed behind shielding. After it is determined these samples are no longer required, they will be subsequently moved to a more remote area.

In the event that the radiochemistry Counting Room is not habitable, various other options exist for an on-site analysis.

A portable Ge(Li) system, the Canberra Series 10, has the internal circuitry required to enable it to process data from a single Ge(Li) detector as a stand-alone unit. This unit and its supported Ge(Li) could be moved to a more habitable area to permit counting. Finally, if the Counting Room is uninhabitable to a degree that removal of this equipment is impractical, the counting equipment in the Environmental Laboratory mobile van could be used once that unit arrives on-site. This would be reserved as a last option; however, saving that unit for lower activity analytic work (e.g., environmental sample analysis).

As indicated above, the primary method of hydrogen analysis of the containment atmosphere would be with either of the two in-line hydrogen analyzers. If a backup analysis on a grab sample is required, it would be done by gas chromatography. This same method would be used for analysis of the reactor coolant stripped gas sample.

Chemical analysis of the reactor coolant sample for boron and chloride would be done on a degassed sample, then processed and diluted in the post-accident sampling panel. Each of these analyses would be done by wet chemistry procedures in the lab. Boron would be analyzed by the mannitol sodium hydroxide titration or plasma emission spectrometry and

chloride by mercuric nitrate titration or ion chromatography. The ability to analyze for either of these species would be tempered largely by the radioisotopic inventory in the coolant and the time after shutdown when the analysis is desired. The degree of accuracy by which either of these analyses can be performed is directly proportional to the volume of coolant analyzed. These analyses would be done behind a temporary shield wall or at the respective instrument locations. Our position with respect to short-term post-accident chloride sampling and analysis is discussed in Reference (e).

Calculations are available to equate analytic results back to reactor coolant concentrations. All radiological results, however, would be transmitted to the Yankee Nuclear Services Division, in Framingham, Massachusetts, for detailed analysis and assessment.

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 (RWCUS)] to be placed in operation in order to use the Sampling System.

RESPONSE: (3)

Neither the reactor coolant nor Containment Atmosphere Sampling Systems require an isolated Auxiliary System to be placed in-service for the purpose of sampling.

A. RCS Sampling

In the case of the Reactor Coolant Sampling System, samples can be supplied to the panel directly from each of two recirculation loops. The sample return lines provide a return flow path to the torus (See FSAR Figure 10.20-1).

The system interface valves include both manually-operated and remotely-operated valves. All manually-operated valves required for system alignment are equipped with accessible handwheel reach-rod extensions which are located on a wall adjacent to the sampling panel.

Operation of containment isolation valves is not required for sampling. Reactor coolant sampling valves are solenoid-controlled, air-operated valves which can be cycled from the control panel. Environmental qualification of the electrical equipment associated with these valves is addressed in the plant program for IE Bulletin 79-01.

B. Containment Atmosphere Sampling

The Containment Atmosphere Sampling System draws gas samples from the primary containment and returns the sample purge flow to the torus. Inside containment, both of these lines are open-ended to the containment atmosphere (see Sketch SK-79-51-1, Attachment A).

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.

RESPONSE: (4)

The post-accident sample panel is capable of obtaining pressurized reactor coolant samples from each of the two loops. Dissolved hydrogen gas measurements are obtained from these samples by performing a gas stripping function at the panel.

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 the Primary Containment System and the cooling water. Under both of the above conditions, the licensee shall provide for a chloride analysis within 24 hours of the sample being taken. For all other cases, the licensee shall provide for the analysis to be completed within four days. The chloride analysis does not have to be done on-site.

RESPONSE: (5)

Four days are available to accomplish an analysis on the reactor coolant chloride concentration. The ability to draw and analyze for this species is discussed in the response to Criterion 2.

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 criterion of GDC 19 (Appendix A.10CFR, 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 10CFR, Part 20 (NUREG-0578) to the GDC 19 criterion (October 30, 1979 letter from H. R. Denton to all licensees).]

RESPONSE: (6)

The design basis of radiological analysis for post-accident sampling capability of reactor coolant and containment atmosphere uses the radiological source terms consistent with Regulatory Guides 1.3 and 1.4:

- Reactor Coolant Source Term:
  100% noble gases, 50% halogens, and 1% solids of core inventory.

- Containment Atmosphere Source Term:
  100% noble gases and 25% halogens of core inventory.

One hour is taken for the credit of radioactive decay for both source terms. The sample panel has been designed to meet the specified dose criteria.

CRITERION: (7)

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

RESPONSE: (7)

The ability to analyze primary coolant samples for boron is available at Vermont Yankee by use of plasma emission spectrometry.

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 day for seven days following onset of the accident, and at least one sample per week until the accident condition no longer exists.

RESPONSE: (8)

Vermont Yankee utilizes in-line monitoring only for containment atmosphere hydrogen concentration. Redundant hydrogen/oxygen monitors are installed. The ability to grab a sample for off-line analysis has been previously discussed.

CRITERION: (9)

The licensee's radiological and chemical sample analysis capability shall include provisions to:

(a) Identify and quantify the isotopes of the nuclide categories discussed above to levels corresponding to the source terms given in Regulatory Guide 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 mCi/g to 10 mCi/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 acceptable 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.

RESPONSE: (9)

In keeping with ALARA considerations until specific activities of the coolant have been determined, as small a volume of samples as necessary should be withdrawn from the panel. Unless it is known that other than radioisotopic analyses will be required, the initial samples can be limited to 1.0 ml of liquid and 1.0 cc of gas. These small volumes would be transported to the laboratory in a shielded sample carrier. Larger volumes could be transferred from the syringe to a sample vial, and transported in a portable shielded pig.

Upon return of the samples to the laboratory, samples would be prepared as necessary for counting and radioisotopic analysis. The 20% dead time criteria would be met by a combination of redilutions and distance separation of the sample off the surface of the detector. The necessary equipment is available for making the dilutions.

Prior to bringing samples into the Counting Room, a background count would be made on the MCA to be used for the analysis. If additional shielding is required, additional lead bricks would be placed around the detector. Once reduced to a workable level, the background would be stored in the computer memory. (If the background cannot be reduced by practical means, movement of the analyzer to a lower background area would be considered.)

Samples would then be brought, one at a time, to the counting facility and analyzed in that geometry which provides the most accurate results with the least dead time. If it is found that the dead time is not satisfied, a subsequent redilution would be required. Containment atmosphere samples would be treated in a similar manner.

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.

RESPONSE: (10)

The radiological analysis capability is discussed in response to Criterion 9.

As described in the previous responses, no on-line monitoring is utilized for chemical analyses of the reactor coolant. The present concept is to extract diluted samples from the sample panel and perform wet chemistry analyses by standard methods in the lab.

For these chemical analyses, the ability of Vermont Yankee to meet the accuracy, range, and sensitivity requirements will depend on the concentrations of chemicals in the reactor coolant sample and the amount of dilution necessary to allow handling the sample.

CRITERION: (11)

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

(a) Provisions 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 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 absorbers and high-efficiency particulate air (HEPA) filters.

RESPONSE: (11a)

RCS SAMPLING

The Post-Accident Sampling System is capable of obtaining samples from two places in the Reactor Coolant System under accident conditions.

Loop samples are taken from sampling points located on one jet pump of each loop. Each sample line is equipped with an excess flow check valve to provide a passive means for limiting RCS sample flow out of containment should a downstream sample line rupture occur. In addition, containment sample valves can be remotely operated to isolate the sample lines.

Purging of the sample lines is accomplished by establishing flow through the panel and returning the flow to the torus via the HPCI turbine exhaust drain. Blockage of an individual loop sample line will not prevent sampling of the alternate loop. Blockage of the common capillary tube may limit the ability to obtain samples; however, past sampling has been conducted with no problems identified.

The sample panel has one sample return line. This line can be valved to the HPCI exhaust drain line for returning samples to the containment. This flow path is used under all conditions since it is desirable to return the sample purge flow to a closed system or containment.

Each sample line of the Post-Accident Sampling System has been kept as short and as small as possible to limit the volume of fluid needed to be taken from the system.

CONTAINMENT ATMOSPHERE SAMPLING

The Containment Atmosphere Sampling System draws containment air samples from a point downstream of the hydrogen/oxygen monitors.

Purging of the sampling lines is accomplished by establishing flow through the hydrogen/oxygen analyzers using the analyzer sample pumps. Removable sample cylinders can be installed downstream of the analyzers with bypass lines to allow continuous sample purging. Presently, we are evaluating the sampling system to determine the need to further reduce plateout and minimize distortion in the sample lines.

RESPONSE: (11b)

The need for installing and maintaining filtration for the Post-Accident Sampling System is discussed in Reference (d).

ATTACHMENT A