ANSWERS TO QUESTIONS

CONCERNING A POSTULATED REFUELING ACCIDENT

INSIDE THE CONTAINMENT BUILDING

Indian Point Units 2 and 3

Docket Nos. 50-247 and 50-286

June 15, 1977

QUESTION 1. You have not provided a basis for your conclusion that the consequences of this accident are well within the guidelines of the 10 CFR Part 100. Provide the basis for your model for mixing within the containment and for isolating the containment before a complete release of activity to the environment occurs. Include the following specific technical information for both Units 2 and 3:

a. Estimate the volume of air in containment that the activity released from the failed fuel assembly is expected to be mixed with before release from the containment.

b. Indicate what specific ventilation equipment will be required to be in service during refueling that will affect the mixing of the activity inside the containment.

ANSWER 1. (a) and (b)

A postulated drop of a fuel assembly in the reactor cavity was analyzed in the Final Safety Analysis Reports (FSAR), for Indian Point Units 2 and 3. The assumptions used in these analyses are described in Section 14.2 of the FSARs. The results of the analyses indicated that the releases following a postulated fuel handling accident inside the Vapor Containment Building (VCB) were substantially less than the 10 CFR Part 100 limits.

In response to the NRC letter of January 17, 1977, a detailed analysis of a postulated refueling accident inside the VCB of Indian Point Units 2 and 3 was submitted on March 21, 1977. The assumptions made for these evaluations conformed with the requirements specified in Regulatory Guide 1.25, entitled "Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facilities". These analyses of the postulated accident yielded calculated offsite doses for both units that were small fractions of the 10 CFR Part 100 guidelines.

By letter dated May 5, 1977, the NRC requested that a further study of the postulated refueling accident inside the VCB be performed. To answer the Commission's questions set forth in this letter, four cases were considered. These cases evaluate the potential mixing and releases following the postulated accident for a range of ventilation system conditions that can exist inside the VCB. With the following exceptions, the four cases made use of the same very conservative assumptions that were utilized in the analyses provided in our letter of March 21, 1977:

a. No operator action to initiate VCB isolation is assumed to take place for 15 minutes following the postulated accident. This time replaces the 10 minutes that was assumed in our analysis of March 21, 1977, as requested by the Regulatory Staff.

b. Conservative assumptions for atmospheric diffusion outlined in Regulatory Guide 1.25, were used in the analyses. The diffusion factors were determined using the Sagendorf Model and 5% $\chi/Q$ values.

c. It was assumed in the analysis of March 21, 1977, that there was no time of transit of the gases released from the postulated failed fuel assembly to the exhaust system of the VCB. The postulated gaseous releases were assumed to be released directly into the VCB exhaust duct at a rate such that all of the gases would escape from the building over a two hour period. For the purposes of this analysis, however, the transit times of these released gases from the refueling pool surface to the VCB exhaust duct and to the radiation monitors were calculated.

Transit times were calculated by approximating the volume of air around a VCB exhaust duct or a VCB air recirculation unit by a spherical wedge section. This wedge section excluded those volumes occupied by equipment within the VCB. All points on the spherical surface of the wedge and hence equi-distant from the suction point were assumed to have the same velocity. These velocities were calculated using conservatively high design VCB exhaust flow rates, VCB air recirculation unit flow rates and refueling pool sweep flow rates.

For the cases in which one or more air recirculation units was assumed to be operating, the point of impingement on the wall of the VCB and the transit times of the released gases were calculated using a vector addition of the calculated gas flow rates. It was conservatively assumed that no upward mixing of the gases took place. A flow division of the released gases between the VCB exhaust ducts and VCB air recirculation unit number 5 was then determined.

For the case in which no VCB air recirculation unit is running (case number four), the NRC recommended model was used to determine the gas transit times. The analysis assumes that the air flow path in the VCB is continuous from the surface of the refueling pool to the annulus area outside the crane wall.

d. No attempt was made in the March 21, 1977, analysis to calculate mixing volumes of the postulated released gas within the VCB. Instead, the released gas was assumed to be expelled from the VCB at a rate such that all of the gas would escape from the building over a two hour period.

As part of this analysis, however, such mixing volumes were calculated. For case number four in which it was assumed that no VCB air recirculation units were operating, the NRC recommended model was followed. A mixing volume of 600,000 cubic feet was calculated for the postulated gaseous release during its transit time to the VCB exhaust ducts. For the three other cases which were examined, a conservatively small minimum mixing volume was calculated for the portion of the released gas that is deflected toward the VCB exhaust. This mixing volume was determined using the volume of the annulus between the crane wall and the wall of the VCB from the VCB purge exhaust point to the nearest point of gas impingement on the wall of the VCB. This volume was calculated to be at least 25,000 cubic feet.

The following four cases evaluate the release of gaseous activity for a range of ventilation system conditions following a postulated refueling accident inside the VCB:

| | TIME FROM POINT OF RELEASE TO VCB MONITOR SAMPLE LINE INTAKE | TIME FROM POINT OF RELEASE TO VCB PURGE EXHAUST DUCT | CALCULATED MINIMUM MIXING VOLUME |
|---|---|---|---|
| CASE 1 (VCB air recirculation unit #5 operating) | 1.04 minutes | 1.39 minutes | 25,000 $ft^3$ |
| CASE 2 (VCB air recirculation unit #2 operating) | 1.83 minutes | 0.85 minutes | 25,000 $ft^3$ |
| CASE 3 (all five VCB air recirculation units operating) | 0.29 minutes | 0.18 minutes | 25,000 $ft^3$ |
| CASE 4 (no VCB air recirculation units operating) | 10.73 minutes | 10.73 minutes | 600,000 $ft^3$ |

QUESTION 1. You have not provided a basis for your conclusion that the consequences of this accident are well within the guidelines of 10 CFR Part 100. Provide the basis for your model for mixing within the containment and for isolating the containment before a complete release of activity to the environment occurs. Include the following specific technical information for both Units 2 and 3:

c. Provide the location of all monitors which will automatically isolate the containment following the accident. If the monitor is a sampling monitor, provide the following additional information:

1. The location of the sample intake;

2. The delay time from when the contaminated air reaches the sample line intake point to the initiation of the containment isolation signal;

3. The sample line length, inside diameter and flow rate;

4. The response time of the monitor; and

5. The number of sample lines, sample monitors and pumps.

ANSWER 1. (c)

Channel R-11, the VCB air particulate monitor and Channel R-12, the VCB radio-gas monitor will generate an automatic isolation signal following the postulated refueling accident. These two monitors measure air particulare radioactivity and radio-gas activity in an air sample drawn from inside the Vapor Containment Building. As described in our response of March 21, 1977, pages 2-3, the continuous samples for this monitoring system are taken at the inlet of VCB air recirculation unit numbers 21 and 25 for Indian Point Unit No. 2, and unit numbers 31 and 35 for Indian Point Unit No. 3. These units are located on diametrically opposite sides of the VCB. The sample lines from both units have a maximum inside diameter of one inch. Flow rate through these sample lines is 10 cubic feet per minute established by the sample pump in the radiation monitor package. The two sample lines have a combined length of about 150 feet before they join. A single one inch diameter sample line then runs the remaining 30 feet to the radiation monitors. The time required for the gas sample to travel from the sample suction point to the radiation monitors is conservatively calculated to be less than 15 seconds.

Response times for the detectors and all the electrical equipment associated with the alarm function and the VCB isolation valve actuation is less than one second. This response time was derived from the equipment manuals using conservatively high time constants for detector response and assuming that the alarm setpoints are at full scale.

The total response time from the point where the postulated radioactive release reaches the sample line intake until the initiation of the VCB isolation signal, is less than 16 seconds.

QUESTION 1. You have not provided a basis for your conclusion that the consequences of this accident are well within the guidelines of 10 CFR Part 100. Provide the basis for your model for mixing within the containment and for isolating the containment before a complete release of activity to the environment occurs. Include the following specific technical information for both Units 2 and 3:

d. Provide the time elapsed from release of the activity from the refueling pool to when the activity reaches:

1. The purge line inboard isolation valve; and

2. The containment monitors sample line intakes.

ANSWER 1. (d)

Refer to the answers in Questions 1(a) and 1(b).

QUESTION 1. You have not provided a basis for your conclusion that the consequences of this accident are well within the guidelines of 10 CFR Part 100. Provide the basis for your model for mixing within the containment and for isolating the containment before a complete release of activity to the environment occurs. Include the following specific technical information for both Units 2 and 3:

e. Provide the time elapsed between receipt of the containment isolation signal and complete closure of the containment purge line valves.

ANSWER 1. (e)

As explained on page 6 of the March 21, 1977 letter, closure times for the VCB ventilation isolation valves are required to be 2 seconds or less.

QUESTION 1. You have not provided a basis for your conclusion that the consequences of this accident are well within the guidelines of 10 CFR Part 100. Provide the basis for your model for mixing within the containment and for isolating the containment before a complete release of activity to the environment occurs. Include the following specific technical information for both Units 2 and 3:

f. Indicate if the release will be through charcoal filters and the expected efficiency for the removal of iodine. Indicate if the filters and fans are safety grade.

ANSWER 1. (f)

As explained on page 7 of the March 21, 1977 letter, releases from the VCB will always pass through HEPA and charcoal bed filters. In addition, there are two other filter systems which could be available to remove iodine from the air inside the VCB prior to the release from the building. No credit has been taken for any of these systems.

QUESTION 1. You have not provided a basis for your conclusion that the consequences of this accident are well within the guidelines of 10 CFR Part 100. Provide the basis for your model for mixing within the containment and for isolating the containment before a complete release of activity to the environment occurs. Include the following specific technical information for both Units 2 and 3:

g. Provide arrangement drawings and P&IDs showing the equipment listed in Questions 1(b), 1(c), 1(e), and 1(f).

ANSWER 1. (f)

These drawings have been supplied to the Commission as figures 5.1-2 through 5.1-7 in the Indian Point Unit No. 2 and 3 Final Safety Analysis Report (FSAR), figures 6.4-3 and 6.4-4 of the Indian Point Unit No. 2 FSAR and figures 6.4-1 and 6.4-3 of the Indian Point Unit No. 3 FSAR. In addition, flow diagrams for the Indian Point Unit Nos. 2 and 3 VCB ventilation systems which are more current than those diagrams included in the FSARs are attached to this submittal.

QUESTION 2. Based on the above information and the source term parameters of Regulatory Guide 1.25, estimate the offsite doses assuming a postulated worst single failure. Provide, for the equipment required to reduce the consequences of this accident, the safety class, redundancy, power source and technical specification requirements.

ANSWER 2.

Only the VCB isolation valves are required to operate if the isolation signal is manually initiated following the postulated refueling accident. These valves are designed to meet redundancy requirements and seismic design criteria. Power to the valves is provided by safeguards power supplies. Valve testing requirements and operability standards are established in the Technical Specifications for the two units.

The radiation monitors, R-11 and R-12, either of which could generate an automatic VCB isolation signal, are powered from safeguards power supplies and are classified class I seismic. The Technical Specifications for both Units 2 and 3 require that these systems be tested and verified to be operable prior to the start of refueling operations.

Total Offsite Thyroid Dose (Rems)

| | | VCB Isolation Assuming Operation of Radiation Monitors | VCB Isolation Assuming Manual Action After 15 Minutes |
|---|---|---|---|
| Case 1 | IP2 | 0 | 72.7 |
| | IP3 | 0 | 190.0 |
| Case 2 | IP2 | 106.3 | 106.3 |
| | IP3 | 277.8 | 277.8 |
| Case 3 | IP2 | 83.4 | 83.4 |
| | IP3 | 218.0 | 218.0 |
| Case 4 | IP2 | 3.7 | 51.9 |
| | IP3 | 9.5 | 135.7 |
| March 21, 1977 Analysis (using a 15 minute release time). | IP2 | - | 22.0 |
| | IP3 | - | 57.5 |

Note: The worst case maximum calculated whole body dose was determined to be 0.47 Rem for Indian Point Unit No. 2 and 1.24 Rems for Indian Point Unit No. 3.

QUESTION 3. Propose any Technical Specifications needed to ensure that physical parameters stated in Questions 1 and 2, will be maintained (in a conservative sense) during all fuel handling operations within the containment.

ANSWER 3.

No changes in the Technical Specifications of either unit are required to ensure that these conservatively calculated consequences of a postulated refueling accident are within the 10 CFR Part 100 offsite exposure guidelines for the lifetimes of the facilities.

For the purposes of performing these analyses, many very conservative simplifying assumptions have been made. In fact, the most likely consequences following the postulated refueling accident are that little or no radioactive releases would escape from the VCB.