UNITED STATES DEPARTMENT OF COMMERCE
National Bureau of Standards
Washington, D.C. 20234

July 28, 1981

Mr. James R. Miller, Chief
Standardization and Special Projects Branch
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: Drain of Primary D_2O - Docket No. 50-184.

Dear Mr. Miller:

On the evening of July 17, 1981, the NBS reactor was secured for the weekend. The confinement building was locked and alarmed. Only authorized personnel are permitted entry under these conditions. On Saturday, July 18, 1981, at about 11:00 a.m. a senior operator made a routine inspection of the facility as is normally done when the reactor is secured for the weekend. Upon checking the control room he discovered that there was no primary D_2O level indication where normal is about 160 inches. The D_2O storage tank level was up to about 90 inches from a normal of about 50 inches. The operator attempted to establish D_2O flow but could not get flow indication. All these indicated that the vessel D_2O had drained into the storage tank, which would uncover the core.

The primary D_2O system is a completely closed system covered by a helium blanket. Examination of the level recorder chart indicated that the loss of level began approximately 13 hours earlier. The operator immediately checked all radiation monitors and all indications appeared normal. All other pertinent indications, including tritium monitor and leak detectors, also were normal. A survey of the top of the reactor was made and indicated background. A second senior operator who was in the vicinity of the reactor building assisted. The Deputy Chief, Reactor Operations was notified and he arrived at the facility shortly thereafter.

The vessel was refilled slowly from the storage tank. Again all radiation and temperature instrument indications appeared normal. Once normal level was established, an investigation was made to determine the source of the drainage. Using an ultrasonic probe the drainage source was traced to an air-operated one-inch valve (DWV-39) in a vessel fill line. Valve indication in the control room showed the valve to be closed. A physical check indicated that the valve was partially open and it was manually closed. Approximately three turns were required to gag the valve shut. Flow was established and both reactor inlet and outlet temperatures were around 100°F or less, indicating little or no heatup due to the core. Samples of both the helium sweep system and primary D_2O were analyzed and the results were normal. The facility was then secured for the evening. Throughout, there was little or no exposure to the personnel involved.

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During this period, and subsequently, DWV-39 and its air operator were carefully inspected. The results indicated that the problem of the valve not closing was due to a malfunction of the air controller. Even with a signal calling for the valve to be shut the air controller was keeping it partially open. Examination of the air controller showed it to be slightly out of adjustment and it was readjusted to specification, following which the valve functioned normally. This is the first time that the air controller had gone out of adjustment in almost 15 years of operation.

Upon inspection of the facility the next day, it was noted that the vessel level had dropped to slightly over 100 inches (approximately five feet above the core). There was no problem establishing flow and restoring level. All radiation and temperature indications were normal. The cause was traced to a small sample line which was not valved closed when the primary sample was taken the day before. The 100-inch level is considerably higher than the level to which the vessel level is normally lowered for operations such as refueling.

Normal shutdown procedures require that the core be cooled for 10 hours after shutdown from 10 MW before the facility is secured and left unattended. This assures that maximum core temperatures remain well below the required 800°F even without D_2O coolant. Nevertheless, the facility is checked daily by an operator when it is left unattended. Measurements made in the confined transfer lock during startup testing indicated that 8 hours after shutdown from 10 MW the fuel temperature of the hottest element, dry and without any auxiliary cooling, is around 550°F. In the present instance, the reactor had been shutdown for more than two weeks except for a few hours of operation on Tuesday, July 14, 1981, at power levels up to 6 MW. The lower power run terminated about 80 hours before the vessel draining occured which is eight times the required cooling time. On this basis it is estimated that the shutdown core temperature following loss of level was below normal fuel plate operating temperatures.

Following review by the Hazards Evaluation Committee, the reactor was restarted on schedule on July 20, 1981. All instrument indications were normal. Analyses of primary D_2O and helium sweep samples at both 1 and 10 MW were also normal. The reactor operated at full power uneventfully for the balance of the week when it was then routinely shut down for the weekend.

Procedures were instituted that require an operator be present anytime a primary D_2O sample is taken. A new checklist procedure for leaving the facility unattended was also instituted. This includes a check to assure that pertinent valves are closed and to require observation of vessel level for at least two hours after flow is secured to detect any changes indicating a possible loss of level.

Sincerely,

Robert S. Carter

Robert S. Carter
Chief, Reactor Radiation Division