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Washington, D.C. 20555

Subject: Oregon State University TRIGA Reactor (OSTR), License No. R-106, Docket No. 50-243; written report filed as a follow-up to telephone conversations with USNRC staff regarding an event which occurred on February 15, 1991.

Gentlemen:

On February 15, 1991, Dr. Brian Dodd, Reactor Administrator for the OSTR, contacted the USNRC's Region V office by telephone to discuss a situation which occurred earlier on the same date. This written report is being filed as a follow-up to the above referenced telephone notification in keeping with the OSTR's policy of open communication with the NRC on matters which we believe to be of mutual interest. In addition to notification of the Region V office, the event was reported by telephone to the Oregon Department of Energy and was reported verbally to the Chairman of the OSTR Reactor Operations Committee and to the Oregon State University Radiation Safety Officer. These latter notifications were also made in a timely manner on February 15, 1991.

A description of the event itself, including our analysis of its cause; corrective actions taken; measures implemented or planned to prevent or reduce the possibility of a reoccurrence; lessons learned; and specific conclusions regarding the event are included as part of this report. The information submitted in this report, including the corrective and preventative actions, has been reviewed and approved by the OSTR Reactor Operations Committee.

BACKGROUND INFORMATION

In January of 1991, the OSTR staff decided to add a water retention and recirculation system to the reactor water purification loop. One major purpose of this new system was to provide a method for collecting water used during ion exchange resin changes so that this water could be retained and subsequently used as makeup water for the primary coolant. An additional feature of the new system was its ability to allow the use of distilled water for makeup water and thereby increase the lifetime of the ion exchange resins.

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Although the preceding new capabilities were considered desirable from an operational standpoint, the basic motivation behind the addition of the new system was the fact that its use would virtually eliminate the discharge of any water from the reactor facility. This was viewed as a positive action and very much in keeping with the OSTR's commitment to the ALARA concept, even though the amount of radioactivity annually discharged via water into the sanitary sewer is extremely small.

The addition of the new water retention and recirculation system was reviewed and approved in a 10 CFR 50.59 safety evaluation dated January 14, 1991. This evaluation determined that the new system did not create an unreviewed safety question nor did it require a change to the OSTR license or technical specifications.

DESCRIPTION OF OCCURRENCE AND POSSIBLE CAUSES

At approximately 8:10 a.m. on February 15, 1991, the Reactor Supervisor noticed that the water level in the reactor tank was lower than normal (i.e., down about 6 to 10 inches). Finding no obvious cause for the low water level from his location on the reactor top, the Reactor Supervisor proceeded to the first floor of the reactor bay and entered the adjacent heat exchanger room where the majority of the pumps and piping for the reactor cooling system are located. Upon entering the heat exchanger room, a small stream of water was observed to be running out from under the concrete block shield which surrounds the demineralizer tank. The water was flowing to a floor drain in the center of the heat exchanger room. The Reactor Supervisor then looked down inside the concrete block shield and noticed that one of the new PVC valves associated with the water retention and recirculation system had cracked near the point where the valve was screwed into the demineralizer tank. Water was leaking through the crack onto the floor. Upon making this observation, the Reactor Supervisor turned off two nearby valves in the water purification loop and immediately stopped the leak. Shortly thereafter, the Reactor Supervisor notified the Reactor Administrator and the Senior Health Physicist, and a series of activities were undertaken to assess the cause and impact of the event, to initiate required notifications, and to formulate appropriate corrective and preventative actions.

In keeping with this action plan, a reactor water sample was immediately taken and analyzed to determine the radioactivity concentration of the water released down the drain. The routing of the drain, which was generally believed to go to the facility's liquid holdup tank, was double-checked and it was determined that the drain apparently went directly to the sanitary sewer. The water level in the tank was measured to be approximately 10 1/2 inches below the normal full level and from this it was determined that approximately 200 to 215 gallons of water were released to the sewer.

As a result of the previously mentioned water sample, it was determined that the concentration of radioactive material in the water released to the sewer was very low (approximately 1.6% of the applicable limit). This conclusion was based on values and regulations specified in 10 CFR 20, Appendix B, Table I, Column 2, which is applicable to sewer disposal of liquids.

As part of the follow-up assessment, it was recognized that the reactor tank low water level alarm did not function correctly, although this alarm is tested monthly and has always functioned correctly during each test. The water level alarm involves a float mechanism designed to trigger a microswitch for low water and a separate microswitch for high water. The monthly test of these alarms involves manually pushing the float down until it engages the low water microswitch and then raising the float manually until it engages the high water microswitch. No abnormalities have been observed during this monthly testing procedure, and the Reactor Supervisor volunteered that he remembered the low water level alarm functioning properly when the reactor tank water was intentionally lowered at some previous time.

With respect to why this entire event occurred, first of all it appears that the new valve may have cracked due to stresses induced by piping vibrations together with the weight of the water in the pipes near the valve. These factors are believed to have been effective in causing the valve to crack because the piping was inadequately supported.

Tests of the reactor tank low water level alarm conducted on February 15 (the day the leak occurred) indicated that the low water level microswitch required slightly more force than originally needed in order to activate the alarm signal. It is not clear why this situation existed.

After the above evaluations, and an evaluation of the OSTR license and technical specifications, an initial telephone notification to the NRC's Region V office was made at 11:17 a.m. on February 15. The initial conversation was between Dr. Brian Dodd of OSU and Mr. Dennis Schaeffer of the NRC. This telephone call was followed by several other calls primarily to Mr. Jim Reese at the NRC's Region V office. During the final conversation with the NRC, Mr. Marvin Mendonca from NRC headquarters was also on the phone. After notifying the NRC, an initial telephone notification was also made to the Oregon Department of Energy at approximately 11:[illegible] a.m. During each of these telephone conversations, the details of the event were described and plans for corrective and preventative actions were reviewed to the extent that such actions had been taken or were definitely planned. On February 19, 1991, A. G. Johnson also reviewed the entire event with Mr. Al Adams, who is the OSTR project manager at NRC headquarters.

CORRECTIVE ACTIONS

As indicated previously, immediate corrective action was taken by the Reactor Supervisor who stopped the water leaking from the cracked valve by closing two nearby valves in the water purification system, which in turn isolated the demineralizer tank. Subsequent to this action, the cracked valve was removed and replaced with a new valve, but the orientation of the new valve was reversed so that the heavier portion of the valve body casting was screwed into the demineralizer tank thus providing more strength at the point where the previous valve cracked.

After it was recognized that the low water level alarm did not function correctly, the Scientific Instrument Technician examined the microswitches currently being used and replaced both the low water and the high water microswitches with switches having significantly greater sensitivity. The significance of this action was immediately evident in that the force required to operate the new microswitches was much less than that previously required, and therefore the sensitivity of the low and high water level alarms was greatly increased. This was vividly indicated when it was demonstrated that the weight of the float rod alone, without the weight of the float, would easily activate the microswitch for the low water level alarm.

MEASURES TO PREVENT THE REOCCURRENCE OF SUCH AN EVENT

Any event of this nature is taken very seriously by the OSTR operational staff and management. Therefore, we have implemented immediate positive action to ensure, to the maximum extent possible, that an event such as the one described in this report will not reoccur. We believe that the following actions, most of which have already been implemented, will be effective in achieving this objective.

1. As noted, the reactor tank low water level and high water level alarm device has been equipped with more sensitive microswitches.

2. Monthly testing of the low and high water level alarm for the reactor tank will continue as presently scheduled using the current testing procedure. However, on an annual frequency (interval not to exceed 15 months) the low water level alarm will be tested by actually lowering the water level in the reactor tank to a point where the alarm will activate. As per technical specification 5.7, the alarm will be required to activate before the drop in water level exceeds 6 inches. NOTE: The new water containment system will make it possible to perform this test without discharging any water to the sewer system.

3. There are two floor drains in the heat exchanger room. The floor drain which was involved in this event has been plugged so that it is no longer functioning as a serviceable drain. This drain was plugged because it turned out to be the only drain in the reactor bay complex which did not lead to the liquid holdup tank. As a result, it is now impossible for reactor water to drain directly into the sanitary sewer system.

4. A small concrete barrier (dam) is being constructed across an exterior door in the heat exchanger room so that should there be any further water spilled on the floor of this room it will be routed into the floor drain in this room which leads to the liquid holdup tank.

5. To reduce stress on the pipes and other components of the new water retention and recirculation system, significant additional pipe supports have been added throughout the system. These supports have eliminated stresses and vibrations due to water movement through the system and from the weight of water in the pipes.

6. OSTR operating procedures (OSTROPS 2 and 3) addressing the Reactor Startup Checklist Procedures and the Reactor Shutdown Checklist Procedures will be modified to incorporate routine opening and closing of appropriate valves in the water purification system in order to open and then isolate the demineralizer tank and the new water retention and recirculation system from the reactor tank. Isolation of these systems will occur as part of the formal shutdown checklist and opening will occur as part of the formal startup checklist. This action in itself will prevent significant water leakage due to an event similar to the one described in this report.

7. Two new valves will be installed near the reactor tank which will be opened and closed as part of the startup and shutdown procedures. After installation, these valves will be used in lieu of the valves mentioned in the preceding item and will enable isolation of the entire water purification, retention, and recirculation system from the reactor tank.

8. The Reactor Administrator conducted an audit of the techniques currently in use at the OSTR to check and/or test various reactor systems. The purpose of the audit was to assess the validity of procedures being used to perform tests or checks on systems like the low water level alarm. It was concluded that existing procedures seem to be appropriate for the tests and checks they address.

LESSONS LEARNED

1. There appear to be two aspects of this event which might be helpful to other research reactor facilities. The first of these involves the type of test being performed on water level alarms. Since it is probable that few facilities actually lower the water level in their reactor tank to test the low water level alarm, it would follow that most facilities are using some type of manual activation of the alarm circuit. In view of the experience at the OSTR, we would encourage all facilities to examine the validity of their testing process for their water level alarms.

2. As a second item, it would seem prudent to recommend that drain paths for all reactor facility drains be double checked.

CONCLUSIONS

Although there were no radiological or reactor safety factors associated with the event described in this report, the OSTR staff regrets that such an event occurred. Our reactor program continues to operate under a policy where safety and compliance with regulatory requirements are of the utmost importance, and support from the University's administration makes it clear that they fully underwrite this mode of operation. As a result, we wish to emphasize that we do not take such events lightly and that we will implement every reasonable action to prevent a reoccurrence. With respect to this commitment, we would like to summarize for your consideration key factors relating to the previous event.

1. The component which failed in this event was in a new system that had been installed to virtually eliminate the release of liquids from the OSTR consistent with our strong commitment to ALARA.

2. The concentration of radioactive material in the water released to the sanitary sewer system was very low and contained only about 1.6% of the applicable NRC concentration limit. Of this 1.6% value, 97% of the radioactivity released was tritium. As a result of this situation, we believe it is clear that there was no radiological risk.

3. The low water level alarm in the reactor tank had been successfully tested every single month and in fact this alarm appears to have operated correctly in at least one previous instance when the water level in the reactor tank was intentionally lowered. Furthermore, the sensitivity of this alarm has now been significantly increased.

4. All drains now operable within the reactor bay and heat exchanger room will carry water directly to the liquid holdup tank (i.e., there is no internal pathway for liquid discharge directly into the sanitary sewer).

5. As specified previously, additional actions (such as numerous new pipe supports) have been or will be implemented to prevent a reoccurrence of an event of this type.

Should there be questions regarding the information in this report or should you require more information, please let me know. It is our intent that this report be as complete and helpful as possible.

Yours sincerely,

A. G. Johnson

A. G. Johnson
Director

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cc: NRC-Region V
NRC-Al Adams
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