UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555-0001

August 6, 1997

NRC INFORMATION NOTICE 97-62: UNRECOGNIZED REACTIVITY ADDITION DURING PLANT SHUTDOWN

Addressees

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to a recent incident in which a licensed reactor operator continuously inserted control rods to bring the reactor to the subcritical stage and then promptly withdrew the rods in order to take the reactor to the critical stage and return power to the point of adding heat (POAH). These actions constituted an unauthorized attempt to start up the reactor. It is expected that recipients will review this information for applicability to their facilities and consider actions, as appropriate. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

On February 19, 1997, the licensee observed that the containment spray (CS) pump 1C took an abnormally long time to start during a surveillance test and at 10:40 a.m. declared the pump inoperable. The Technical Specifications (TS) required that the CS pump be restored to an operable status within the next 48 hours or that Unit 1 be in hot shutdown within the following 4 hours. In the early morning of February 21, the licensee completed corrective maintenance on the CS pump 1C and initiated post-maintenance testing. However, the pump did not start within the required time and the licensee initiated additional troubleshooting efforts. Later that morning, a new operating crew began their first day of shift duty after 3 days off. Although the 48-hour limiting condition for operations (LCO) would expire in less than 4 hours, requiring entry into a 4-hour shutdown in accordance with the TS action statement, no plan had been developed to support an orderly and controlled shutdown of Unit 1.

At 10:40 a.m. on February 21, the 48-hour LCO expired and the licensee entered a 4-hour shutdown action statement for Unit 1. At approximately 11:00 a.m., plant management, operations management, and operations supervisors held an informal discussion regarding the status of the CS pump 1C and when to initiate the Unit 1 shutdown. Ten minutes later, the shift engineer (SE) conducted a formal shutdown briefing.

At 12:09 p.m., control room operators began reducing power at 0.25-percent per minute. At approximately 12:55 p.m., the licensee noted through a review of surveillance testing records that the CS pump 1C should have been declared inoperable at 10:20 a.m. rather than at 10:40 a.m. on February 19th. As a result, Unit 1 was required to be in hot shutdown by 2:20 p.m. instead of 2:40 p.m. in order to comply with the TS. The licensee subsequently increased the rate of power reduction to 0.5-percent per minute.

At approximately 2:05 p.m., with Unit 1 at 7-percent power, the SE directed the Unit Supervisor (US) to maintain the reactor critical because he expected the CS pump to be returned to service within a few minutes. The US and the primary nuclear station operator (NSO) reviewed the steps in the plant shutdown procedure for taking the turbine off-line and inserting control rods to establish power at or below the POAH, defined in the procedure as 0.025-percent power. The review consisted of the US's reading the relevant step aloud and requesting the primary NSO to locate the point on the intermediate power range monitor corresponding to 0.025-percent power. The primary NSO identified this point and then asked the US if he wanted him to drive control rods in. The US responded by re-reading the procedure step aloud, which states, "HOLD #363, ROD MOTION CONTROL' switch IN to minimize dumping steam and establish power at or less than the Point of Adding Heat ($2.5x10^{-2}$% IR)."

At 2:07 p.m., the main turbine was tripped and the primary NSO inserted control rods continuously for 3 minutes and 48 seconds (232 steps) until power indicated 0.025-percent. Reactor power continued to decrease as a result of the negative reactivity associated with the control rod insertion and when power reached 0.01 percent, the primary NSO informed the US that he intended to withdraw control rods to stabilize power at 0.025 percent. The primary NSO then proceeded to withdraw control rods continuously for 1 minute and 45 seconds (84 steps) until he was directed to trip the reactor by the US. The SE directed the US to trip the reactor because the CS pump had not been restored to service and Unit 1 was required to be in hot shutdown within the next 6 minutes to comply with the TS.

Discussion

The NRC dispatched an Augmented Inspection Team (AIT) to review the facts surrounding the February 21 event at Zion Nuclear Plant. The findings and conclusions of this inspection are documented in NRC Inspection Report 50-295/97006.

The AIT concluded that the US and SE did not exercise their respective responsibilities for ensuring that shift activities were conducted in a controlled manner and became focused on CS pump restoration activities and balance-of-plant problems. The shutdown briefing was informal, poorly planned, and ineffective. Operations supervisors did not provide any direction to the operating crew during the briefing regarding the decision point for proceeding

to hot shutdown. The SE did not provide clear direction to the US regarding his intent to keep the reactor critical after the main turbine had been tripped. Operations supervisors also failed to inform the operating crew of the intent to keep the reactor critical.

Despite a number of communications and control room indications such as "low rod insertion limit" annunciator, the "low-low rod insertion limit" annunciator, audible clicking of the group rod position step counter, control banks "C" rod bottom lights, and control bank C and D rod position indication, the US and the SE were unaware that the primary NSO had continuously inserted control rods a total of 232 steps, which placed the reactor in a substantially subcritical condition, and then continuously withdrew control rods 84 steps in an attempt to re-establish power at the POAH.

Upon noting that the control bank "C" rod bottom lights were illuminated, the qualified nuclear engineer (QNE) assigned to monitor the shutdown evolution asked the primary NSO "why control rods had been driven in so far." The primary NSO replied, "This doesn't look right, but I am just following procedures." Approximately 7 minutes later, the QNE observed that the primary NSO was withdrawing control rods, approached the operator, and stated that he "did not like what the operator was doing." The primary NSO responded that he was uncomfortable with what he was doing as well. However, neither the QNE nor the primary NSO informed the US of their concerns about control rod manipulations.

The actions of the primary NSO in continuously withdrawing control rods with the intent of taking the reactor to critical stage in order to re-establish power at the POAH reflected a significant lack of understanding of proper control rod manipulations for a controlled approach to criticality. Although he was concerned with the actions directed by a specific step in the shutdown procedure, the primary NSO did not adequately communicate his concerns to the US. The US also did not clarify the intent of the procedural step to the primary NSO.

Although the actual event did not pose a risk to the health and safety of the public, the event was considered safety significant from a human performance perspective. With the Unit 1 reactor substantially subcritical, a licensed reactor operator withdrew control rods continuously in an attempt to take the reactor to the critical stage, disregarding established procedural controls for conducting a safe reactor startup. The rod manipulations were conducted without the knowledge of operations supervisors. Proper manipulation of control rods during reactor shutdowns and startups is fundamental to operational safety.

This information notice requires no specific action or written response. If you have any questions about information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

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LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
97-61	U.S. Department of Health and Human Services Letter, to Medical Device Manufacturers, on the Year 2000 Problem	08/06/97	All U.S. Nuclear Regulatory Commission medical licensees, veterinarians, and manufacturers/distributors of medical devices
97-60	Incorrect Unreviewed Safety Question Determination Related to Emergency Core Cooling System Swapover from the Injection Mode to the Recirculation Mode	08/01/97	All holders of OLs or CPs for pressurized-water reactors
97-59	Fire Endurance Test Results of Versawrap Fire Barriers	08/01/97	All holders of OLs or CPs for nuclear power reactors
97-58	Mechanical Integrity of In-Situ Leach Injection Wells and Piping	07/31/97	Holders of and Applicants for Licenses for In-Situ Leach Facilities
97-57	Leak Testing of Packaging Used in the Transport of Radioactive Material	07/30/97	Suppliers and users of packaging for the transportation of radioactive material required to perform packaging leak tests
97-56	Possession Limits for Special Nuclear Material at the Environcare of Utah Low-Level Radioactive Waste Disposal Facility	07/28/97	All licensees authorized to possess special nuclear material

OL = Operating License
CP = Construction Permit

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