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ABSTRACT

On April 2, 1992, with the primary system solid and pressurized to 250 psig in the cold shutdown condition, the left channel Design Basis Accident (DBA) sequencer was inadvertently activated by technicians preparing to test the left channel Normal Shutdown Sequencer (NSD). The DBA sequencer operated properly and actuated the equipment it was programmed to actuate including Low Pressure Safety Injection (LPSI) pump P-67B and Containment Air Cooler fan V-4A. The inadvertent activation of the DBA sequencer was caused by improperly connecting test equipment with a test cable which had been incorrectly modified. After verifying that left channel DBA equipment had been properly actuated, the operators returned the left channel DBA equipment to its pre-event status. Corrective action in the form of 1) Revising test procedures by adding detail to ensure proper connection between plant sequencer test jacks and the Data

to ensure proper connection between plant sequencer test jacks and the Data Acquisition System, 2) Revising the labeling on test cable wires and plugs and installing labels on the sequencer test jacks and 3) correctly modifying the test cables.

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EVENT DESCRIPTION

At 0829 hours on April 2, 1992, with the primary coolant system [AB] solid at 250 psig in the cold shutdown condition, Instrument Technicians were connecting equipment to test normal shutdown operation of the left channel sequencer when the Design Basis Accident (DBA) operation of the sequencer was activated and actuated Low Pressure Safety Injection (LPSI) pump P-67B [BP;P] and Containment Air Cooler fan V-4A [BK;FAN]. Plant operators, after verifying that the left channel DBA equipment had actuated properly, returned that equipment to pre-event status. This event did not involve the failure of any equipment important to safety.

CAUSE OF THE EVENT

The cause of this event was the improper installation of improperly modified test equipment cables [CBL1]. The root cause was the lack of adequately detailed procedures, the lack of adequately labeled test cables and test connectors [CON], and the lack of detailed identification of all the wires in the test cables and their associated termination points on the test cable connectors.

ANALYSIS OF THE EVENT

Both the NSD and DBA sequencer operations are tested during refueling outages to verify the programmed starting times of the appropriate equipment. Four surveillance procedures perform this verification. They are:

- A. For the Normal Shutdown Sequencer Test, RT-13A is used for the Left Channel; and RT-13B is used for the Right Channel.
- B. For the Engineered Safeguards System Test (which test the DBA sequencer), RT-8C is used for Left Channel; and RT-8D is used for the Right Channel.

The test equipment used to perform the time interval measurement is called a "Data Acquisition System" (DAS). During each of the above listed surveillances, the DAS measures the actual time interval for individual contact closures as the sequencer is allowed to operate.

For the measurement process, the DAS is electrically connected into the wiring schemes of all of the input and output contacts on the sequencers. This interconnection is done with two test cables. Each test cable had a plug [CON] which was labeled Number 1 for one cable and Number 2 for the other cable at the end which connects to the sequencer cable jacks and a barrier terminal strip at the end which connects to the DAS. The sequencer had a pair of unlabeled jacks which mate with the plugs on the test cables.

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During the preparation for the tests, the DAS equipment that was previously used could not be made operational. Therefore, a new and different type of DAS was prepared for use. The old DAS had always been connected to the sequencers and operated by the Consumers Power Company General Office based System Maintenance and Construction Services Department (SMCSD). The new DAS required connection to the sequencers and operation by the plant Instrument and Control Department (I&C). Thus, the need to change the type of DAS equipment resulted in a different work group having to connect the test cables to the sequencers which was a contributing factor to the cause of the plugs on the test cables being incorrectly connected to their matching jacks on the left channel sequencer (plugs Number 1 and the Number 2 were reversed). This error, in combination with a different group performing the test, most probably occurred for one or all of the following reasons:

- Two plant prints, E-1508 and E-1509, described the connection of the DAS to the two sequencers. Connection to the left channel sequencer required use of E-1508, while connection to the right channel sequencer required use of E-1509. These prints were referenced in procedures RT-8C and RT-8D, however they were not adequately referenced in procedures RT-13A and RT-13B. These prints are no longer used since description of the cables, pins, and connectors is included in the revised versions of RT-8C, RT-8D, RT-13A and RT-13B.
- 2. Proper connection of the cable plugs and sequencer jacks was not a straightforward task. To assure the cable plugs were mated with the proper sequencer jacks, the wires in the cable had to be physically traced from the terminal strip, compared with the drawing, and a determination made as to which plugs and jacks are the proper match. Existing procedures did not include this information.
- 3. For proper installation, cable test plug Number 1 was required to be connected to the sequencer test jack which was attached to a cable leading to terminal strip TBL-2; and, cable test plug Number 2 was required to be connected to the sequencer test jack attached to a cable leading to terminal strip TBL-1.

Additionally, a second error was made when the cables were prepared for the test. When the old DAS was used, it was physically located in the cable spreading room. For this outage, arrangements were made to locate the new DAS in the Control Room. To avoid the congestion which would be caused by the long cables which had been required when the DAS was located in the Cable Spreading Room, the test cables were shortened. During the cable shortening process, several conductors in the cable were observed as "extras." These "extra" wires caused some confusion because plant drawings did not identify all of the conductors in the cables nor did they identify the corresponding pin connections on the cable plugs. Work instructions which were used to control the cable shortening stated, "Any unused wires should be taped out of the way." Although the person who wrote these instructions intended for the

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wires to be individually taped out of the way, they were folded back as a group and taped out of the way. Thus, the "extra" wires ended up electrically contacting each other and created short circuits across several independent electrical schemes when the cables from the DAS were incorrectly connected to the sequencer test jacks. Those electrical short circuits combined with the incorrect test cable connection to activate the left channel DBA sequencer which caused the actuation of the LPSI pump P-67B and containment Air Cooler Fan V-4A.

CORRECTIVE ACTION

- Procedures RT-13A and B and RT-8C and D were revised to ensure a proper connection between the DAS and the plant sequencers by identifying each wire in each test cable, the pin each wire is connected to on the plug end and the terminal the wire is connected to on the Data Acquisition System (DAS) end; and, to require the cables to be identity tested before use.
- 2) Labels were added to the sequencer test jacks to be consistent with plant procedures identified in action 1 above.
- 3) The test cables were correctly modified by taping the "extra" wires in the test cables in a manner which prevents those "extra" wires from contacting each other.

ADDITIONAL INFORMATION

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None