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MEMORANDUM FOR: Thomas M. Novak, Director
Division of Safety Programs
Office for Analysis and Evaluation
of Operational Data

FROM: Jack E. Rosenthal, Chief
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SUBJECT: HUMAN PERFORMANCE STUDY REPORT - LASALLE COUNTY UNIT 2 (4/20/92)

On April 20, 1992, the Unit 2 reactor was starting up at 20 percent power. The operators shutdown the reactor water cleanup system (RWCU) to verify the RWCU containment isolation valves limit switch settings. About a minute later, an RWCU regenerative heat exchanger relief valve lifted, discharging reactor coolant to the reactor building equipment drain tank at 95 gpm. The operator bypassed the automatic RWCU isolation signals for 3½ minutes, then allowed the automatic isolation.

Both RWCU containment isolation valves' internals and motors had been replaced after an April 2, 1992 event, in which both valve motors were damaged due to faulty limit switch settings. On April 20, 1992, a special test was in progress to verify these valves' limit switch settings. The special test procedure cautioned that operation of the RWCU supply isolation valves without thermal overload protection (as would occur with an automatic isolation) could damage the motor or the valve.

A nuclear station operator (NSO) shutdown the RWCU pumps by closing the RWCU system return valve before stopping the RWCU pumps. About a minute later, RWCU high differential flow alarms annunciated, indicating that the RWCU would isolate after a 45 second time delay if the condition was not cleared. The NSO and shift foreman (SF) observed RWCU system front panel indications, which appeared normal except for the high differential flow alarms. The SF decided to bypass the RWCU automatic isolation signal using the key-locked switches, thinking that it was spurious.

After the isolation was bypassed, another NSO observed an increasing level in the reactor building equipment drain tank and an equipment attendant reported water running through the "B" RWCU regenerative heat exchanger return-side relief valve discharge line sightglass. The NSO asked the SF and the shift control room engineer (SCRE) how to isolate the RWCU and both agreed to allow the automatic engineered safety feature (ESF) isolation. The bypass keys were removed, an automatic RWCU isolation occurred about 3½ minutes after the

initial alarm, and the relief valve reseated. The special test was completed and the RWCU system was returned to service.

The SCRE and shift engineer decided that an emergency declaration was not required, but made a four-hour non-emergency notification about the ESF actuation.

As part of the AEOD program to study the human performance aspects of operational event, a team was sent to the site on April 22, 1992. The team leader was John Kauffman of AEOD; other team members were Robert Spence of AEOD and Dr. Susan Hill of the Idaho National Engineering Laboratory (INEL). The team was onsite for two days and gathered data from discussions, plant logs and recordings, review of operations and training materials, and interviews with control room operators and other station staff. Enclosed is the report of the results of this human performance study. Specific human performance aspects of this event are addressed in this memorandum.

RWCU System Operation

The reactor operator may have contributed to the cause of the RWCU relief valve lifting because he shut the RWCU system return valve prior to stopping the RWCU pumps, in reverse order to that stated in the procedure. Operating the RWCU pumps with a closed discharge valve raised the RWCU return line to pump shutoff-head pressure. However, that pressure was still below the setpoint of the relief valve. The pressure increase which lifted the relief valve was most probably the result of heat up of the water trapped between the pump discharge check valves and the return line isolation valves. Once the relief valve lifted, it did not reset until the RWCU suction side was isolated from the reactor. Prior events that involved lifting of RWCU relief valves may have been due to the same cause. Prior root cause analysis did not identify this mechanism.

Bypassing ESF Isolation Signals

A senior reactor operator (SRO) directed bypassing automatic, 45 sec time-delayed, RWCU isolation signals, thinking they were spurious. These ESF signals were bypassed for 3 ½ minutes, while a valid signal was present.

Bypassing an ESF signal and entering a Technical Specification Limiting Condition for Operation can not be justified for testing purposes, when there were multiple control room indications that the signal is valid, including high RWCU differential flow and increasing reactor building equipment drain tank level.

A number of factors that pre-conditioned the operators to avoid automatic, RWCU isolations became apparent during operator interviews, including:

- The NSO wanted to permit completion of the special test
- The on-going test procedure contained a precaution concerning potential valve and operator damage.
- Spurious differential flow alarms had occurred often in the past when manipulating the system.
- There was time pressure to make a decision within the 45 second delay time, based on limited control room front panel instrumentation.

Procedures

The existing procedures may also have contributed to the environment in which the SF and SCRE decided to allow the RWCU isolation valves to close automatically, without thermal overload protection, despite test precautions; specifically:

- The operators lacked confidence in the usefulness of plant procedures.

  The operators did not use any procedures during the 3½ minute event. One operator described his attitude towards the plant procedures during his interview by noting the many revisions they had undergone and that an operator "has to go through three pages to find one step that is needed". He relies on memory and experience to handle an emergency, then checks the procedure for actions and followup. Operators must have confidence in the usefulness of plant procedures, or they will not use them in an emergency. To be useful they must be user friendly, correct, complete, and address the issue directly.

- The alarm response procedure did not provide guidance on the use of available control room indication for identifying the cause or validity of high RWCU differential flow alarms.

  The alarm response procedure states only,

  > ATTEMPT to identify the cause and CORRECT the high differential flow condition, if this cannot be achieved in 45 seconds and the system trips, PERFORM the following...

- The special test procedure contained a partially incorrect precaution about potential valve damage and lacked direction for recovery in case of a RWCU isolation signal.

  The test procedure incorrectly cautioned that,

  > To prevent possible motor operator and valve damage if the torque switch fails to operate, ensure that the thermal overload device for the valve being tested is not bypassed.

  The operators understood that operation of the RWCU supply isolation valves without thermal overload protection, as would occur with an automatic isolation, could have created an unisolable reactor coolant system (RCS) leak. The test engineer indicated, in a later interview, that only damage to the valves' motors was a valid concern.

  Although an RWCU isolation was a likely result of shutting down the system for testing, the test procedure did not provide explicit guidance for response to high differential flow alarms and isolations. Expected potential problems and recovery therefrom were not addressed in special test procedures.

Management Impact on Operator Performance Shaping

Although licensee management was not interviewed for this study, the items described above are ultimately the responsibility of management. The following aspects of operations at LaSalle are particularly relevant as responsibilities of management which shaped operator performance during the event:

- Administrative guidance for bypassing or disabling an ESF actuation was lacking.

- The operators had been criticized for allowing the RWCU isolation in the April 2, 1992 event, which damaged both RWCU containment isolation valve motors.

- The operating daily orders stated that "We should however try to prevent these isolations from occurring (it is a lot less hassle)".

- Bypassing differential flow alarms and entering the limiting condition for operation (LCO) time clock for testing were accepted practices.

- The operators lacked understanding of the required order of performance of procedural directions.

Teamwork, Command and Control

The teamwork in the control room and coordination with personnel in the plant were positive factors in the ability to obtain needed information and determine the validity of the RWCU high differential flow alarm. The command and control within the control room were carried out in accordance with expected practices.

This report is being sent to Region III for appropriate distribution within the region.

Original signed by Jack E. Rosenthal

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Enclosure: As stated

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