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Docket No. 50-267

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MEMORANDUM FOR: E. L. Jordan, Deputy Director
Division of Resident and
Regional Reactor Inspection, IE

THRU: W. R. Mills, Acting Section Chief, Events Evaluation Section,
Reactor Engineering Branch, DRRRI, IE

FROM: H. W. Woods, Reactor Systems Specialist, Events Evaluation
Section, Reactor Engineering Branch, DRRRI, IE

SUBJECT: H. B. ROBINSON EVENT ON JANUARY 29, 1981

I. Description of Event

Early on January 29, 1981, the plant was having problems with the hydraulic pumps on the turbine Electro-Hydraulic Control (EHC) system. One pump had significant vibrations when in service, and the other had a significant oil leak through the shaft seal. The operators were shifting back and forth between use of these two pumps while decreasing plant power as rapidly as possible so that the plant could be taken off-line and the EHC pumps fixed.

At 0624 with turbine load at about 6%, the operators were shifting the EHC between those pumps when the second (2nd) generator output breaker was opened to separate the plant from the grid. This combination of transients produced a very quick oscillation of the governor valves which admitted a quick pulse of steam into the steamline, producing two momentary high steam flow signals. Since the primary system had already been cooled below the "low T average" setpoint, this produced a Safety Injection (SI) on coincidence of two out of three high steam flow - low T average signals. The plant tripped on "P7," i.e., first stage pressure instantaneously indicated power greater than 10%, which will trip the plant unless the output breakers are closed.

The SI signal existed long enough to pick up "B" train SI relays but not the corresponding "A" train relays. Observing the "B" pumps running but not "A" pumps, the operators manually initiated the "A" train SI. (NOTE: no actual injection occurred at this time since reactor pressure was around 2200 psig and shutoff head for the SI pumps at H. B. Robinson is about 1500 psig).

At 0628, noting that pressurizer level was at 18% and increasing and primary system pressure was at 2200 psig and steady, the operators reset the SI. No reactor coolant pumps were tripped.

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Continuing to recover from the plant trip and SI, at 0637 the plant operators restored letdown (which is isolated on an SI) and stopped one charging pump. It is noted here that apparently no written procedure exists for recovery from an inadvertent SI; lacking such a procedure, the operator tried to restore letdown without resetting the air system that operates the let down isolation valves. Noting that letdown had not been restored, the operators realized the problem, went to a different panel and reset the air system, and then restored letdown.

Following restoration of letdown, the pressurizer level continued to increase but primary system pressure was decreasing, containment dewpoint increased from 85°F to 90°F, count rate in the containment went from 300 to 400 cpm, containment pressure increased from 0.12 psig to a maximum of 0.25 psig, and Heating-Ventilating and Air Conditioning (HVAC) condensate alarms were received (all indicative of a primary system leak into containment).

At 0645, the operators re-isolated letdown but primary system pressure continued to decrease, reaching 1715 psig at 0701 at which time a low pressure, automatic SI was initiated (but no water was injected since SI pump shutoff head is 1500 psig). At 0715, unsure what was causing the continued depressurization with the letdown isolated (where the leak was suspected as all parameters except Pressurizer pressure indicated the leak had been isolated) the operators isolated the charging line, stopped the "B" and "C" RCPs, and turned on the pressurizer backup heaters (previously only 900 Kw of heaters had been on). These actions arrested the pressure decrease, and the reactor was restored in an orderly manner to normal hot shutdown pressure and temperature. Minimum subcooling during the event was 60 to 70°F, and minimum pressure was 1620 psig, above the SI pump shutoff head. No flow was ever indicated from the SI.

At 0730, the 12" water level alarm in the keyway sump was received, indicating about 3000 gallons of water in containment. Sometime before 1400 the same day, the 15" alarm (~ 6000 gallons) was received. These estimates of the water amounts are extremely rough because the curve showing water volume vs. level in the keyway ("incore" area) covers 600,000 gallons, and these measurements therefore are assuming less than 1% error in the curve.

Later investigation revealed that there were several contributors to the above sequence of events.

- (1) Leakage from the primary system into containment was from a header in the letdown system just downstream of the regenerative heat exchanger and the letdown orifices. This header had two leakage paths to the containment atmosphere. First, the 600-psig-setpoint relief valve on that header (which discharges to the pressurizer relief tank) had a failed bellows such that leakage past the stem went directly into containment. This was a minor leak compared to

the second leak, which was from a 3/4" drain-line from the header with a manual valve (#204-C, normally closed) leading to a capped pipe nipple. The valve was found to have a very loose packing so that it could easily be turned, and it was open "four or five turns." The cap was missing, there was a "dimple" in the concrete floor beneath the drain, and the last turn of threads on the drain nipple was stripped.

The possibility of a pressure pulse or water hammer causing these failures was investigated, but no evidence (strip chart data, failed pipe hangers, abnormal valve line up due to lack of a SI reset procedure, etc.) has been found. The most likely explanation is that vibrations from the positive displacement charging pump worked the #204-C valve open and the cap loose, and the transient of isolating and re-initiating letdown finally caused the cap to come off. The cause of the relief-valve bellows failure (a much smaller leak) is still being investigated.

The relief valve bellows has been replaced, the #204-C valve packing has been tightened, the valve closed and locked, other similar valves in the vicinity have been verified closed and their packings have been tightened, and the valve handwheels locked. The cap down-stream of the #204-C valve has been replaced and properly tightened.

- (2) Water collected in the keyway reached the 12" alarm level (~ 3000 gal) at 0715 January 29, 1981, and the 15" (~ 6000 gal) alarm level sometime before 1400. Flow calculations for the open 3/4" drain line predicted 100 to 120 gpm under pressure conditions present in the letdown system. Since the letdown system was only un-isolated from 0637 to 0645, this would account for only around 960 gallons of the initial 3000. However, sump level at the start of the leak is not known, it is not known how much leakage came from the failed bellows (rate and time period both are unknown), the "3000" gallons associated with the 6" alarm is not an exact number, and in addition between 0645 (when letdown was isolated) and 0715 (when the 6" alarm was received) there was leakage past the air operated letdown isolation valve in the letdown system and out the drain, and there was an unknown amount of drainage from other parts of the letdown system. In summary, it cannot be concluded with certainty how much water leaked into the containment. It can be concluded that all sources of leakage into the containment have been found based on RCS leakage determination and visual inspections in containment. (The additional ~ 3000 gallons collected* between 0715 and ~ 1400 are attributed to leakage past the isolation valve).

*The 6000 gallons (total) were not pumped out during this time period because post-TMI requirements required containment isolation, including sump flow, upon receipt of an SI signal, so the pumps were not operating during the time the ~ 6000 gallons were accumulating.

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Before the licensee resumed power operation but after he had put the systems into their normal status, he was required to enter containment to verify the lack of other leakage sources (there were none). He also repaired the letdown isolation valve and verified its integrity, and pumped out the keyway.

- (3) Reactor depressurization during the event was caused by a stuck-open pressurizer spray valve, as determined by subsequent testing following the event ("B" valve stuck during such testing). The valve has been repaired and verified operable.
- (4) The EHC pumps and EHC system have been repaired and tested satisfactorily. The system will be carefully observed to further verify its proper operation upon restart.
- (5) After this event, for three to six hours there was indication that "B" Steam Generator had a 0.3 gpm primary to secondary leak (based on secondary side radioactivity of 10^{-4} Ci/cc). The indication then went away. Either there was a small leak which subsequently closed, or the transient stirred "crud" in the secondary system which caused the indication. Upon restart, the plant will monitor carefully for SG leaks (none have been detected following plant startup).
- (6) A 3% level increase in the reactor drain tank occurred early in this event. This is believed to be due to lifting of the letdown system relief valve while the letdown system was isolated, due to the leakage of the letdown system isolation valve previously mentioned.

II. Cause of Event

There appear to have been multiple contributors to this event, as described in Section I.

III. Corrective Action

(a) Short Term

Detailed in Section I.

(b) Long Term

The possibility of a pressure pulse in the letdown system will be further investigated by the licensee, for example, be examination of the failed bellows for failure mode, further pipe hanger examinations, etc. The bellows failure is being investigated as a generic item by W with Crosby Valve Co., the valve vendor.

The need for an SI recovery procedure will be evaluated. The licensee has evaluated this need, and is actively preparing such a procedure.

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IV. Evaluation

Based on the corrective actions detailed in Section I, we concluded that continued operation was acceptable.

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