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February 14, 1974

Mr. James G. Keppler
Regional Director
Directorate of Regulatory
Operations - Region III
U.S. Atomic Energy Commission
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Subject: Response to Regulatory Operations Information Request No. 74-1, "Abnormal Occurrences in Piping Systems" for Dresden and Quad-Cities Stations, AEC Dkts 50-10, 50-237, 50-249, 50-254 and 50-265

Dear Mr. Keppler:

This reply is submitted in response to your Information Request 74-1, dated January 11, 1974, which requested information on occurrences resulting in vibrations or unanticipated dynamic forces to specified systems at Dresden and Quad-Cities Stations.

Attached are reports submitted to this office from Dresden and Quad-Cities Stations outlining six incidents which occurred in Class B piping systems. All these incidents have been reported to the AEC.

If further information is required, please contact this office.

Very truly yours,

J. S. Abel
Nuclear Licensing Administrator
Boiling Water Reactors

Att.

cc Mr. Boyce H. Grier
Assistant Director for
Construction and Operation
Directorate of Regulatory Operations
U.S. Atomic Energy Commission
Washington, D.C. 20545

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ABNORMAL OCCURRENCES IN PIPING SYSTEMS AT DRESDEN STATION

DRESDEN UNIT 1

No abnormal occurrences in piping systems

DRESDEN UNIT 2

1) May 29, 1970

The situation was discovered at 0050 hours May 29, 1970 while checking the HPCI system in preparation for a test run.

The HPCI turbine had been taken out of service at 0730 hours May 28 for a steam strainer inspection. This work was completed and HPCI was placed back in service at 1628 hours May 28, 1970.

During the outage a scram occurred following which water level rose to the HPCI steam nozzle which allowed water to enter the steam line up to the outboard isolation valve which was closed.

When HPCI was placed in service at 1628 hours the accumulated water was forced down the steam line causing unusual hydraulic forces on the steam line, particularly at the bends.

During the HPCI outage the inboard isolation valve located close to the reactor was not closed. The outboard isolation valve was closed along with the valve ahead of the turbine stop valve. This was the established procedure.

A revised procedure has been placed in effect which requires the inboard and outboard isolation valves to be closed when taking HPCI out of service. This, along with a steam line draining procedure for restoring the system to service will insure any collected water will be drained from the header before appling reactor pressure to the line.

2) March 29, 1971

The unit had been shutdown for refueling and the core spray subsystem had been out of service for modifications to the logic circuitry. Upon completion of testing the modifications the core spray surveillance test was performed at 0330 hours March 29, 1971 to demonstrate operability. At 1100 hours during a routine operator inspection seismic restraints on the 2A core spray subsystem line 1403, exterior to the drywell, were found damaged.

Further investigation revealed that three seismic restraints and one hanger on the 2A core spray subsystem line had been damaged. The 2C core spray subsystem line 1404 was also inspected and three seismic restraints and two hangers were found damaged. Visual inspection revealed no piping damage, although line 1404 appeared to be "sprung" one to two inches from its original position.

Subsequent evaluation indicated that the damage was the result of a "water hammer". The core spray subsystem was idle for an extended period of time and leakage of water through the core spray pump discharge stop check valve drained the core spray line. Subsequent operation of the pump resulted in acceleration of a "water slug" in the line causing a "water hammer".

To prevent recurrence of the "water hammer" a "jockey" pump was installed that takes suction from the torus and discharges to the core spray and low pressure coolant injection lines to keep the line filled. A similar system was installed on unit #3.

3) September 28, 1971

At 2058 on 9/28/71 while at a load of 384 MWe and while surveillance testing was in progress for timing of the shutdown cooling system isolation valves a vibrational shock was felt in the control room. Simultaneously there was indications of effects on the reactor system, including "A" recirculating water pump vibration alarm. The pump was shut down and on the following morning a review was made of the situation at which time it was concluded that an inspection of the related systems inside the drywell would be prudent.

The unit was taken off system at 1703 on 9/29/71 and the reactor placed in cold shutdown condition, drywell de-inerted and cooled for inspection. Visual inspection revealed about 8' of mirror insulation dislocated immediately upstream of penetration X-111B on the carbon steel line and downstream of the shutdown cooling isolation valve M02-1101-1B. Subsequent magnetic particle inspection of the two elbow welds at this location and stress analysis indicated no distress of this piping or related "A" recirculation piping. "A" recirculating water pump was subsequently operated at 28% (minimum) speed while taking vibration data with satisfactory results. The review of the entire situation by G.E. and C.E. (SRB and NRB) concluded that no damage had been sustained by the primary system or the shutdown cooling system inside or outside the drywell and that the reactor could be safely returned to service.

A review of the sequence of testing isolation valves could not explain all of the indicated effects, however it was concluded that a water hammer must have occurred as a result of the testing. It was further concluded that the testing of these valves should be conducted in the future only with the reactor cooled down to normal shutdown system operating temperatures.

Plant startup was authorized after concurrence by the NRB which required that all seven shutdown cooling system valves be closed electrically and then checked for proper seating. This was done and proper seating did occur on electrical operation. AEC Compliance was informed of our intent to restart after a discussion of the findings and had no objection.

INVESTIGATION FOR POSSIBLE DAMAGE

a. On 9-29-71 a thorough visual inspection was made of the shutdown cooling system piping, equipment, piping supports, insulation

and connections to LPCI piping and drywell penetrations (which were also leak tested). In all testing and inspections there was no visible distress with the exception of the 2A heat exchanger which showed the hold down bolts bent to the south and a small corner segment of the concrete support (6" x 4" x 3") cracked but still in place. The crack did not appear to communicate with the holdown bolt.

b. On 9-30-71 a thorough visual inspection was made of piping and equipment inside the drywell. No abnormalities were noted except for an 8' section (3 pieces) of Mirror insulation which had become loosened from the pipe. The impressions on the insulation plus scoring of the pipe at the support saddle showed that abnormal movement of this section had occurred in the amount of 5/8". No permanent set was observable in the piping.

c. On 9-30-71 the 1A valve was operated to determine by valve observation the limit switch actuation and valve movement. The valve closed fully electrically seven times. The red position indicating light cleared only 3 out of 7 times. The valve was fully seated in all cases as shown by attempts to manually "pull up" on the valve operator.

d. On October 1, 1971 the two welds at the elbow in line 2-1001-16"-B were magnetic particle inspected and no defects found.

e. On October 1, 1971 the "A" recirculating water pump was operated at 28% speed and vibration data taken as performed during the pre-op tests. The highest vibration noted was only 0.6 mils which compared favorably with the pre-op data. (The motor max. vibration was only 0.7 mils).

f. On 10-1-71 the station maintenance crew checked the 1A valve operation and Limitorque operator. It was concluded that the valve operator tripped on torque on valve seating prior to engaging the closed limit switch. The 2B valve, which could not be opened when attempting to place the shutdown system in operation on 9-30-71 was repaired after inspection showed mechanical problems in the limitorque operator.

g. On 10-1-71 Sargent & Lundy Engineers calculated the stresses in the shutdown loop piping due to the movement shown during inspection of the piping. The highest stress calculated was 16,715 psi, well within the yeild strength of the material. The calculational results were discussed by S & L with G.E. Co. engineers who concluded that no stresses of concern could be developed within the recirculation system piping or connections based on input from S & L. G.E. made a detailed calculation by a computer run for the data supplied by S & L to determine the magnitude of stress at areas of interest at the connection to the recirculating water piping. It was concluded that no significant stresses occurred and that further examination of the recirculating water piping was not justified.

HYPOTHESIS FOR WATER HAMMER

The last use of the shutdown cooling system was on July 22, 1971. It was the normal practice to leave the reactor coolant side of the heat exchangers full of water. They had never been inerted.

Reviewing the valve operating sequence it can be hypothesized that between 7-22-71 and 9-28-71 the "B" heat exchanger partially drained through valve leakage. Since the -1 and -2 valves remained closed during this period it is assumed that the header was initially full, and became pressurized when the 1A & B valves were opened. The opening of 5A & B valves had no effect since the LPCI check valves were closed. The opening of the 2A, B & C valves allowed the pressure in the header to be impressed on the A & C heat exchangers (pump discharges pressures noted at 175 and 50 psi respectively after the incident whereas B was C) and A & C had previously been noted at a pressure lower than 175 and 50 respectively. Since (by assumption and the 0 pressure reading) the "B" heat exchanger was partially drained, the pressure did not increase, but some flow passed through the pump (warming of the lines were noted following the incident) and into the partially drained heat exchanger.

The 2B valve is in a vertical section of line and when fully opened might have left an air bubble into the suction header in the drywell if the header had been sufficiently depressurized. However it is probably more likely that the header was still partially pressurized (since "C" shutdown pump increased to 50 psi and suction valve was opened after "B"). It is likely that partial venting of the header to the void in the "B" heat exchanger allowed some hot water in the header to convert to steam as the pressure was dropped to 50 psi. This left a steam bubble in the header which was collapsed when the 1A valve was opened and water rushed in the header toward the 1B valve (close to the "A" recirculating water pump) causing a mild thrust at that end of the pipe (verified by the dislocated insulation). This would account for the "A" recirc. pump high vibration.

DRESDEN UNIT 3

No Abnormal Occurrences in Piping Systems

ABNORMAL OCCURRENCES IN PIPING SYSTEMS AT QUAD-CITIES STATION

Unit 1 Recirculation/RHRS Vibration, 1/16/73

CAUSE AND OPERATIONAL SEQUENCE:

While increasing power with recirculation flow, a noise and high frequency vibration was heard in the Unit 1 reactor building. The vibration was strongest at the point where the B LPCI pipe penetrates the drywell. The vibration was present only between recirc pump speeds of 84 to 87 percent. The vibration was also present in the B recirculation loop piping inside primary containment. (Reference: B. Stephenson letter to Mr. A. Giambusso dated 2/16/73; BDS-73-23).

CORRECTIVE ACTION:

The reactor was brought to the hot-standby condition, and a thorough dyrwell inspection was conducted. No damage or abnormalities were observed in any recirc or RHRS piping supports. A vibration recorder and detector were installed on the B LPCI pipe to monitor vibration during unit startup. When the power level and recirc pump speed conditions were duplicated, no vibrations or noises were evident. Reactor pressure was varied through the 84 to 87 percent pump speed range with no effects. Since this occurrence, no further vibrations have been noticed on the recirculation or RHRS piping. A modification has been proposed, however, to install a vibration detector with a control room alarm.

Unit 2 Failure of Hanger Bolts for Torus Suction Header

CAUSE AND OPERATION SEQUENCE

During Phase IV startup testing, at which time relief valves and ECCS systems were being discharged to the suppression chamber, four torus suction header bolts were found to have failed. The hangers supported approximately a 90° segment of the suction header. Investigation revealed that the bolt guide holes on the torus and header brackets had been torch cut rather than cleanly drilled to the specified size, and it appeared that the hanger strap holes had been punched rather than drilled thus leaving a sharp edge. Additionally, fully threaded rather than partially threaded bolts were used.

CORRECTIVE ACTION

The failed specimens and the areas subjected to maximum stresses were inspected by an Edison metalurgist, representatives of Chicago Bridge and Iron Company, and Sargent & Lundy Engineers. The bolts were found to have sheared and no apparent yielding of the suppression chamber shell or the suction header were found to have occurred. Larger hanger straps, larger unthreaded bolts and drilled bolt heads were installed to prevent any further occurrences. (Reference: F.A. Palmer letter to Mr. E. J. Block dated 6/7/72; FAP-72-107).

Unit 1 Damaged RHRS Seismic Restraints 4/4/72

CAUSE AND OPERATIONAL SEQUENCE

While the reactor was in the shutdown mode, a damaged RHRS system pipe restraint was discovered and reported to the Unit 1 Operating Engineer. Subsequent visual inspection of the RHR system revealed: three seismic restraints damaged; two spring hangers bottomed; grout chipped on a seismic restraint; a valve would not open electrically; and four hangers damaged. The cause of the incident is believed to be improper venting of the RHR system with the resultant water hammer. The filling and venting procedure required the use of the jockey pump and the venting of system high points. The venting at high points left several possible points for air accumulation.

CORRECTIVE ACTION

Seismic restraints and pipe hangers were evaluated for damage by Sargent and Lundy and repaired under the direction of the General Electric Company. The filling and venting procedure was altered so that the larger flow and higher pressure condensate transfer system was used instead of the jockey pump. The motor operated valve was found to have a mechanical failure of the motor housing causing the brake to engage; it was repaired and tested satisfactorily. (Reference F. A. Palmer letter to Dr. Peter A. Morris dated April 11, 1972; FAP-72-84).

An intensive study is to be undertaken by Commonwealth Edison, General Electric and Southwest Research Institute concerning all vibration problems at Quad-Cities. Vibration data will be obtained throughout the feedwater system, as well as other systems and corrective action recommendations will be given following completion of these special tests.

MEMO ROUTE SLIP Form AEC-93 (Rev. May 14, 1947) AECM 0240	☐ See me about this. ☐ Note and return.	☐ For concurrence. ☐ For signature.	☐ For action. ☐ For information.

TO (Name and unit)	INITIALS	REMARKS
RO Chief, FS&EB RO:HQ (4) Licensing (4) DR Central Files Region I	DATE	Commonwealth Edison Company Dresden Units 1, 2 & 3 50-10, 50-237 and 50-249 Quad-Cities 1 & 2 50-254 & 50-265
TO (Name and unit)	INITIALS	REMARKS
Region II PDR Local PDR NSIC DTIE	DATE	
TO (Name and unit)	INITIALS	REMARKS
	DATE	
FROM (Name and unit) G. Fiorelli RO:III		REMARKS Attached is a copy of licensee's reply dtd 2-14-74 to RO Information Request 74-1.
PHONE NO.	DATE 3-6-74	

USE OTHER SIDE FOR ADDITIONAL REMARKS

GPO : 1971 O - 445-469