



Commonwealth Edison

Zion Generating Station
Shiloh Blvd. & Lake Michigan
Zion, Illinois 60099
Telephone 708 / 746-2084

February 1, 1991

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Dear Sir:

The enclosed Licensee Event Report number 91-001-00, Docket No. 50-304/DPR-48 from Zion Generating Station is being transmitted to you in accordance with the requirements of 10CFR50.73(a)(2)(i), which requires a 30 day written report for the completion of a plant shutdown required by the plant's Technical Specifications.

Very truly yours,

*W. R. K...
for*
T. P. Joyce
Station Manager
Zion Generating Station

TPJ/PG/dmg

Enclosure: Licensee Event Report

cc: NRC Region III Administrator
NRC Resident Inspector
INPO Record Center
CECo Distribution List

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LICENSEE EVENT REPORT (LER)

Form Rev 2.0

Facility Name (1) Zion Unit 2	Docket Number (2) 0 5 0 0 0 3 0 4	Page (3) 1 of 0 6
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Title (4)
Inoperable Safety Injection Pumps Due to Low Recirculation Flow

Event Date (5)			LER Number (6)			Report Date (7)			Other Facilities Involved (8)	
Month	Day	Year	Year	Sequential Number	Revision Number	Month	Day	Year	Facility Names	Docket Number(s)
0 1	0 4	9 1	9 1	0 0 1	0 0	0 2	0 1	9 1		

OPERATING MODE (9) 1

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10CFR (Check one or more of the following) (11)

<input type="checkbox"/> 20.402(b)	<input type="checkbox"/> 20.405(c)	<input type="checkbox"/> 50.73(a)(2)(iv)	<input type="checkbox"/> 73.71(b)
<input type="checkbox"/> 20.405(a)(1)(i)	<input type="checkbox"/> 50.36(c)(1)	<input type="checkbox"/> 50.73(a)(2)(v)	<input type="checkbox"/> 73.71(c)
<input type="checkbox"/> 20.405(a)(1)(ii)	<input type="checkbox"/> 50.36(c)(2)	<input type="checkbox"/> 50.73(a)(2)(vii)	<input type="checkbox"/> Other (Specify in Abstract below and in Text)
<input type="checkbox"/> 20.405(a)(1)(iii)	<input checked="" type="checkbox"/> 50.73(a)(2)(i)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)	
<input type="checkbox"/> 20.405(a)(1)(iv)	<input type="checkbox"/> 50.73(a)(2)(ii)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)	
<input type="checkbox"/> 20.405(a)(1)(v)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(x)	

POWER LEVEL (10) 9 | 9 | %

LICENSEE CONTACT FOR THIS LER (12)

Name	TELEPHONE NUMBER
Andrew E. Toy, Technical Staff Engineer ext. 2326	AREA CODE 7 0 8 7 4 6 -2 0 8 4

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS
X	B	Q	P						
			P	0 2 5					

SUPPLEMENTAL REPORT EXPECTED (14)

Expected Submission Date (15)

YES (If yes, complete EXPECTED SUBMISSION DATE) NO

ABSTRACT (Limit to 1400 spaces, i.e. approximately fifteen single-space typewritten lines) (16)

In accordance with Technical Specification 4.8.2.A.1, while Unit 2 was in the Power Operations Condition (Mode 1 - 99% Power), the monthly surveillance was performed for the Unit 2 Safety Injection pumps on January 4, 1991. Testing was conducted in accordance with Periodic Test 2A, entitled "Safety Injection System Tests." Both the 2A and the 2B Safety Injection pumps failed to satisfy the minimum recirculation flow required for Periodic Test 2A. The 2A and the 2B Safety Injection pumps were declared inoperable and the Limiting Condition for Operation as described in Technical Specification 3.8.2.D was entered. Unit 2 was brought to the Hot Shutdown Condition (Mode 3) within the required four (4) hours. Both Unit 2 Safety Injection pumps were shown to be operable within the allowed forty eight (48) hours thus terminating the Limiting Condition for Operation.

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TEXT Energy Industry Identification System (EIS) codes are identified in the text as [XX]

A. CONDITION PRIOR TO EVENT

MODE 1 - Power Operations RX Power 99% RCS [AB] Temperature/ Pressure 559 °F/ 2235 psig

B. DESCRIPTION OF EVENT

On Friday, January 4, 1991, with Unit 2 in Normal Power Operations (99% Reactor Power), Periodic Test (PT) 2A was performed for the Safety Injection (SI) pumps in compliance with Technical Specification (Tech Spec) 4.8.2.A.1. At 0950 hours, after the required fifteen minutes of operation in the recirculation phase, the recirculation flow was measured from flow indicator 2FI-SI04 for the 2A SI pump. The flow indicator read approximately 23 gallons per minute (gpm). At 1105 hours, after the required fifteen minutes of operation in the recirculation phase, the recirculation flow for the 2B SI pump was measured also from 2FI-SI04. The flow indicator read approximately 24 gpm for the 2B SI pump. The acceptance criteria established in PT-2A requires a minimum recirculation flow of 27 gpm. Failure to satisfy the acceptance criteria resulted in the 2A and the 2B SI pumps being declared inoperable at 1105 hours on 01/04/91. In this condition, Unit 2 entered the Limiting Condition for Operation (LCO) as described in Tech Spec 3.8.2.D. In accordance with the associated Action Statement, the unit was brought to the Hot Shutdown Condition (Mode 3) within the required four hours. Per Generating Station Emergency Plan (GSEP) criteria, an Unusual Event was declared at 1150 hours when the power reduction was initiated and the proper notifications were made. Within the forty eight hours allowed in Tech Spec 3.8.2.D, the Unit 2 SI pumps were returned to an operable condition and the Unusual Event was terminated at 1115 hours on 01/05/91.

C. APPARENT CAUSE OF EVENT

The investigation determined the cause to be a restriction in the pipe line downstream of the flow indicator 2FI-SI04. In PT-2A, each SI pump is tested independently. The test line-up requires each SI pump to operate by drawing suction from the Refueling Water Storage Tank (RWST) and discharging to a recirculation line which returns to the RWST. The recirculation lines for each SI pump combine to form one common line to the RWST. Between the pump discharge and the RWST, a variety of flow orifices, check valves, manual valves, flow indicators, Motor Operated Valves (MOVs), and connecting lines exist. Possible causes considered included partially closed valves, faulty gauges, leaking instrument valves, and pipe line restrictions. Each potential cause was systematically evaluated and dismissed as it was shown to be invalid.

Initially, all manual valves and MOVs were locally verified to be in the fully open position, therefore, the possibility of partially closed valves was dismissed. The flow indicator was evaluated by installing an additional calibrated differential pressure gauge. When the 2A SI pump was rerun, the permanent flow indicator measured the identical flow of 24 gpm as did the second independent gauge, thus dismissing concern for a faulty gauge. The possibility of a leaking valve was considered for the equalizing valve on the manifold of flow indicator 2FI-SI04 and for the manual valves in each of the recirculation lines for each pump. After various valve manipulations with one pump operating, the valves were shown not to leak and this consideration was dismissed.

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TEXT Energy Industry Identification System (EIIS) codes are identified in the text as [XX]																						

C. APPARENT CAUSE OF EVENT (con't)

The final possible cause was a pipe line restriction and this was investigated thoroughly. To begin the investigation, a pressure gauge was installed off of a sample point valve (2SI8932) on the common portion of the recirculation line, just upstream of the flow indicator, 2FI-SI04. During normal operation, the expected pressure reading at this gauge was calculated to be 30 psig. Using the pump curve, an additional pressure factor of approximately 20 psig was calculated to account for the reduced flow currently experienced by the pumps. Thus, at this sample point, a total pressure of 50 psig or greater during pump operation would indicate a restriction downstream of this sample point. If the measured pressure was less than that value, then the possibility still existed for a restriction upstream of the sample point. With these calculations, one gauge with a 0 to 60 psig range was selected. In addition, the calibrated differential pressure gauge used earlier at 2FI-SI04 was still installed.

In parallel with this effort, a review was performed to identify all connections to the SI recirculation line. Three lines were identified: the line from the boric acid blender, the line from the reactor coolant drain pumps, and the line from the spent fuel pit demineralizer and filter. The Operating Logs were reviewed to check for recent usage of these lines. This review showed that only the line from the boric acid blender was used recently. During the previous week, the boric acid blender line was used to increase the level in the RWST. Since this line connects with the SI recirculation line, boric acid could potentially deposit, harden, and cause a restriction to the SI recirculation flow. In an attempt to flush any potential restriction, approximately 650 gallons of warm water (approximately 200 degrees Fahrenheit) was sent through this boric acid blender line to the RWST.

With the pressure and differential pressure gauges installed and the flush of the boric acid blender line completed, the 2A SI pump was restarted. The recirculation flow was measured to be 24 gpm. The pressure at the sample point was greater than the 60 psig capability of the gauge and the differential pressure gauge at 2FI-SI04 indicated 18 inches of water column (INWC). From these results, it was concluded that the pipe restriction was downstream of the sample point and downstream of the flow indicator 2FI-SI04 (due to the measured pressure being greater than the expected value calculated earlier and the negligible differential pressure at the flow indicator).

With the restriction downstream of the flow indicator, the next consideration was given to the isolation MOVs, 2MOV-SI8813 and 2MOV-SI8814, in the common recirculation line returning to the RWST. While each MOV was stroked, current traces were recorded and compared to previous records. After review by the MOV Coordinator, no discrepancies were found to indicate valve problems.

To continue the investigation, the pressure gauge at the sample point was replaced with a 0 to 1500 psig gauge. The 2A SI pump was started again with the pressure gauge indicating 400 psig at the sample point. After approximately thirty seconds of operation, the pressure suddenly decreased from 400 psig to 35 psig, where it remained constant. The recirculation flow was verified to be 30 gpm for the 2A SI pump. The 2A SI pump was then secured and the 2B SI pump was started. The pressure gauge at the sample point indicated 35 psig with recirculation flow of 29 gpm for the 2B SI pump. With these results, PT-2A was performed with repeatable results in the historical range of 27 gpm for the 2A SI pump and 29 gpm for the 2B SI pump.

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C. APPARENT CAUSE OF EVENT (con't)

To dismiss the possibility that the recent stroking of the isolation MOVs in the SI recirculation line caused the increase flow, the 2A SI pump was rerun after stroking 2MOV-SI8813 and again after stroking 2MOV-SI8814. Both pump runs showed 29.5 gpm at the flow indicator and 35 psig at the sample point.

As a result of the investigation, the apparent cause of the low recirculation flow in the Unit 2 SI pumps was a restriction in the SI recirculation line, downstream of the flow indicator 2FI-SI04. It was concluded that the restriction was dislodged or eliminated from the recirculation line during the investigation as evidenced by the sudden decrease in pressure while the 2A SI pump was operating.

D. SAFETY ANALYSIS OF EVENT

Upon declaring both Unit 2 SI pumps inoperable, the unit was brought to the Hot Shutdown Condition (Mode 3) within the four hours allowed by Tech Spec 3.8.2.D. Within twenty three hours of declaring the pumps inoperable, both the 2A and the 2B SI pumps were returned to the operable condition. During the twenty three hours of inoperability, there was no condition which required the operation of the SI pumps.

In discussions with the engineering representatives of Pacific Pump Corporation, the operation of the pump at a recirculation flow of 24 gpm is acceptable for a cumulative duration of 10 hours. Beyond the ten hour span, a modest degradation of internal clearances begins to occur in the pump and the effect upon the hydraulic performance is imperceptible in their opinion. The duration of time that the SI pumps were run at a reduced recirculation flow was well within the 10 hour time span.

A request was made to the Nuclear Engineering Department (NED) to evaluate the effects of this degraded SI pump recirculation flow. NED determined that the SI pumps are only required to operate in the recirculation phase during monthly testing and during an accident that initiates a Safety Injection with the Reactor Coolant System pressure greater than 1500 psig. The conclusion was that the ten hours of allowed pump operation, at a pump recirculation flow of 24 gpm, was sufficient to bound any of the aforementioned scenarios.

E. CORRECTIVE ACTIONS

The initial corrective action was to bring the unit to the Hot Shutdown Condition as required per Tech Spec 3.8.2.D. A review of the PT-2A data (temperature, vibration, suction pressure, and discharge pressure) for both pumps revealed no abnormalities. The data indicated both pumps were operating within 1% of their respective manufacturer pump curves. Further investigation found indication of a probable restriction in the recirculation line. During the investigation, the restriction was either dislodged or eliminated and the pumps were returned to normal operation. PT-2A was performed with repeatable results and the pumps were declared operable.

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E. CORRECTIVE ACTIONS (con't)

A review of the recirculation line piping design showed that a portion of the piping, 2SI101-2"-AA-R, had a design pressure of 150 psig. The effect of overpressurizing this portion to 400 psig was evaluated by the original Architecture Engineer and the Nuclear Engineering Department. The specific portion of piping was specified to be Schedule 40S, ASTM A312 Grade 304. The Maximum Allowable Working Pressure for this piping is 1952 psig and, therefore, the piping was not overstressed during the 400 psig event.

In an effort to locate any material that may have dislodged from the recirculation line restriction, radiography and visual inspections were performed. Radiography Testing (RT) was performed on several lines which penetrate the bottom of the RWST and are in the vicinity of the area below where the recirculation line penetrates the top of the RWST. These lines are the RWST standpipe penetration, the Residual Heat Removal (RHR) suction line penetration, and the RHR recirculation line penetration. In addition, an RT was performed of the piping where the SI recirculation line connects with the boric acid blender line to identify any boric acid accumulation. No radiograph showed evidence of debris.

A remotely operated video submarine device was used to visually inspect the RWST. This resulted in finding approximately forty three items of various debris, including welding rod, baling wire, nails, and copper wire. A major accumulation of this debris was located in the area directly below the recirculation line penetration in the top of the RWST. All items were removed from the tank except for one piece of wire approximately five to six inches in length. This wire was located over the edge of the RWST standpipe penetration. During the attempt to remove the wire, it fell into the standpipe. The safety significance of this wire is negligible since no flow exists in the standpipe and any flow created by Emergency Core Cooling System (ECCS) pump suction would not be capable of dislodging it from the standpipe. In addition, small particles, approximately 1/16 of an inch in diameter, of boric acid were found in the bottom of the tank. These particles were left because they pose no harm to the ECCS pumps. The source of the recirculation line restriction could not be positively linked to any of the debris found in the tank. The Unit 1 RWST will be similarly visually inspected prior to coming out of cold shutdown following the current outage.

Several administrative precautions are now in place to prevent foreign material intrusion into the RWST and any of the ECCS trains. These precautions include ensuring that the RWST cover is in place and sealed. Prior to removing the cover to allow access, a temporary alteration or procedure must be used to document controls necessary to ensure no foreign material enters the RWST. Cleanliness inspections are performed during maintenance activities on all ECCS trains prior to closure. These precautions will ensure that no foreign material is inadvertently admitted into the ECCS System including the RWST.

A leakage test was performed on two manual isolation valves, 1VC8432 and 1VC8434, with no significant leakage identified. These valves are located downstream of the boric acid blender for isolating flow to the SI recirculation line and were considered a possible source of boric acid blockage had they leaked.

The final corrective action is a commitment to operate both Unit 2 SI pumps per PT-2A on a weekly basis for a period of one month. This will verify acceptable recirculation flow, pump vibrations, bearing temperatures, and proper pump curve operation. In addition, the pressure in the SI pump recirculation line will be monitored during these tests. Unit 2 has been in Power Operation (Mode 1) since 01/11/91. PT-2A has been performed three times with acceptable results that are consistent with historical data. The pressure in the recirculation line has also been consistent with that of unrestricted pipe flow as shown during the recent investigation.

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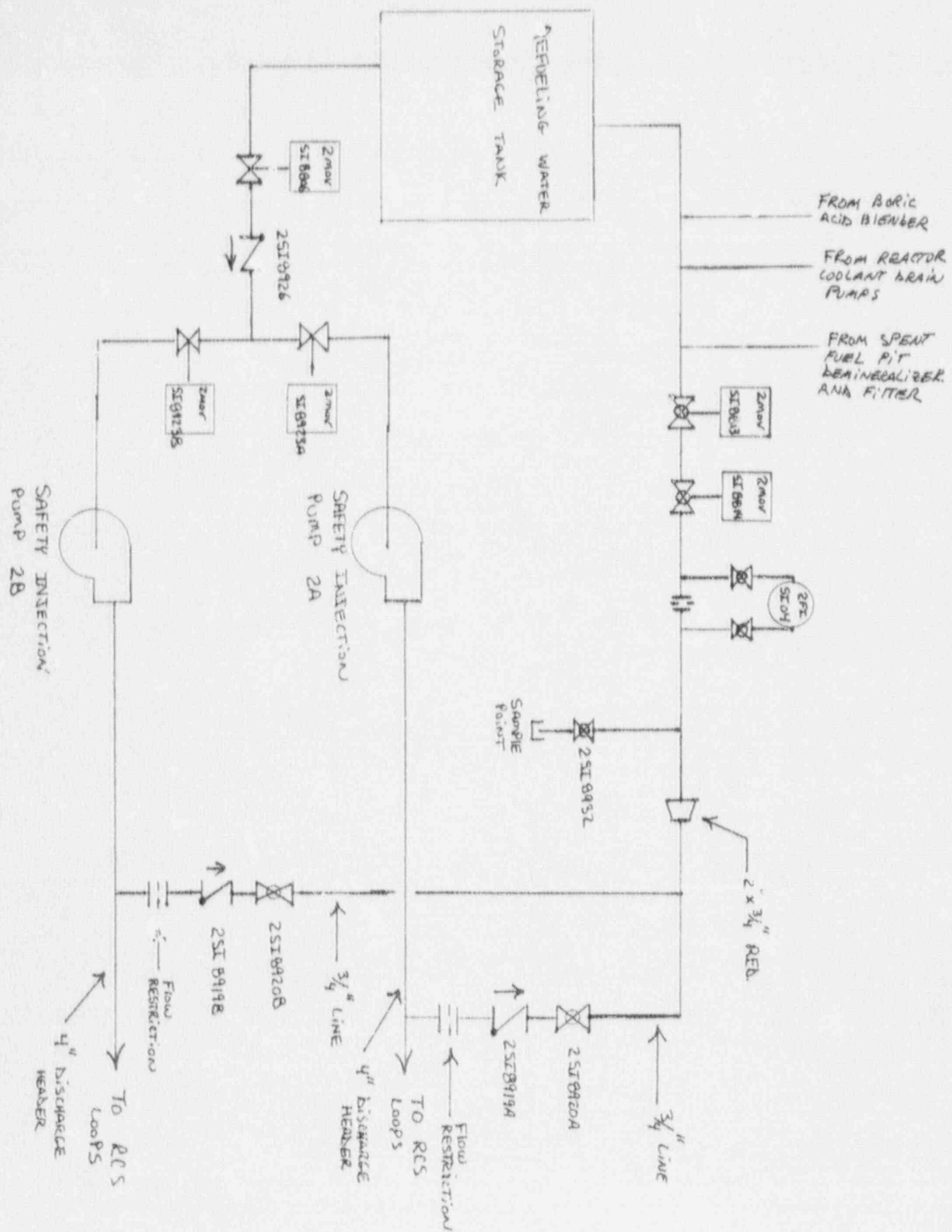
TEXT Energy Industry Identification System (EIIS) codes are identified in the text as [XX]

F. PREVIOUS EVENTS

- 11/05/90 - DVR 22-2-90-126 on the Unit 2 Safety Injection pump is considered a precursor to this event. The root cause is still being investigated under a supplemental report that is expected to be submitted on 02/28/91.
- 03/29/90 - Unit 1A Safety Injection pump, recirculation flow indicated 25 gpm, failure attributed to inaccurate reading of flow gauge.

G. COMPONENT FAILURE DATA

None.



SI DIAGRAM

DVR # 22-2-91-001

- Lost generation
- Cost > \$25,000
- Hazard or Spill
- Personnel injury
- Reactor trip
- ESF actuation
- NRC reportable
- LER
- PSE
- NRC violation, level _____
- GSEP event, class UE
- Tech Spec LCO
- Potential or future loss
SALP functional area MA

COMPONENT TYPE		FAILURE MODE		DEPARTMENT	
X	PIM	MIS		MIM	
X					
X					

LICENSED?	LEVEL	DEPT	TYPE		DETAIL	CODE
A						
A						
A						

TYPE		DETAIL	CODE	DEPARTMENT
B				
B				
B				

TYPE		DETAIL	CODE
C			

TYPE OF DETAIL PROC.

DEFICIENCY	CODE	TYPE
D		
D		
D		

TYPE		DETAIL	CODE	DEPT
E				
E				
E				