CATEGORY 1

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FACIL:50-305 Kewaunee Nuclear Power Plant, Wisconsin Public Servic 05000305
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RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 97-004-00:on 970409,unanalyzed condition existed during safety injection accumulator filling operations.Cause is unknown.Alternate path from SI pumps will be used to fill accumulators.W/970509 ltr.

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NRC-97-45

May 9, 1997

10 CFR 50.73

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Ladies/Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Reportable Occurrence 97-004-00

In accordance with the requirements of 10 CFR 50.73, "Licensee Event Report System," the attached Licensee Event Report (LER) for reportable occurrence 97-004-00 is being submitted.

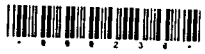
Sincerely,

M. L. Marchi
Manager - Nuclear Business Group

DLR

Attach.

cc - INPO Records Center
US NRC Senior Resident Inspector
US NRC, Region III



NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 04/30/98

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Kewuanee Nuclear Power Plant	05000305	1 OF 8

TITLE (4)
Unanalyzed Condition Exists During Safety Injection Accumulator Filling Operations

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 NAME	DOCKET NUMBER
04	09	97	97	-- 004 --	00	05	09	97	N/A	05000
									FACILITY NAME	DOCKET NUMBER
										05000

OPERATING MODE (9)	N
POWER LEVEL (10)	000

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

20.2201(b)	20.2203(a)(2)(v)	50.73(a)(2)(i)	50.73(a)(2)(viii)
20.2203(a)(1)	20.2203(a)(3)(i)	X 50.73(a)(2)(ii)	50.73(a)(2)(x)
20.2203(a)(2)(i)	20.2203(a)(3)(ii)	50.73(a)(2)(iii)	73.71
20.2203(a)(2)(ii)	20.2203(a)(4)	50.73(a)(2)(iv)	OTHER
20.2203(a)(2)(iii)	50.36(c)(1)	50.73(a)(2)(v)	Specify in Abstract below or in NRC Form 366A
20.2203(a)(2)(iv)	50.36(c)(2)	50.73(a)(2)(vii)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Dennis L. Rozell	(414)388-8766

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

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
X YES (If yes, complete EXPECTED SUBMISSION DATE).	NO		08	07	97

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On April 9, 1997, with the plant in refueling shutdown mode, it was discovered that, if an accident requiring Safety Injection (SI) were to occur during the filling operation of either SI accumulator, the amount of water injected into the reactor coolant system will be reduced by the amount of water being diverted into an accumulator. This potentially affects SI system accident analysis assumptions and results, and when using single failure criteria, the operating SI pump may exceed the design runout flow limit.

This issue has existed since initial plant startup. The effect that the accumulator filling operation had on the operability of the SI system during an accident was probably not considered at that time because of the infrequent occurrence and the short duration of the fill operation. Several potential short term corrective actions are being reviewed for possible implementation for the next operating cycle including: 1) use of an alternate path from the SI pumps to fill the accumulators, 2) modification of the control circuit for fill valves SI-101A and B so they will automatically close, or 3) throttling of SI-101A and B to reduce the amount of flow diverted to the accumulators. Long term corrective actions will be implemented following further investigation.

Description of Event

On April 9, 1997, with the plant in Refueling shutdown mode, during the review of a Licensee Event Report from a similar plant, it was discovered that an unanalyzed condition exists during Safety Injection (SI) accumulator [ACC] filling operations when the SI system [BQ] is required to be operable.

Attachment 1 shows a simplified diagram of the Safety Injection/Accumulator system. SI-10A [FCV] and SI-10B [FCV] are throttle valves used to balance the flow between the two reactor coolant system (RCS) [AB] cold leg injection lines.

During normal plant operation it may be necessary to raise the level in an accumulator. Kewaunee Nuclear Power Plant (KNPP) Technical Specification (TS) 3.3.a.1.A requires that "Each accumulator is pressurized to at least 700 psig and contains 1250 $ft^3 \pm 25$ ft^3 of water with a boron concentration of at least 1900 ppm, and is not isolated."

Operating procedure A-SI-33, "Abnormal Safety Injection Accumulator Level and Pressure" is used to adjust accumulator level whenever the level reaches the SI accumulator Low Level Alarm [LA]. This is a simple process: the SI recirculation to refueling water storage tank (RWST) [TK] valves (SI-208 [V] and SI-209[V], not shown on Attachment 1) are verified open, SI pump A or B is started (cross-tie valves SI-8A [V] and SI-8B [V] are normally open), then SI-101A [ISV] or SI-101B [ISV] is opened (depending on which accumulator is being filled). When the accumulator level reaches 38-40%, SI-101A or B is closed and the SI pump is stopped following a minimum run time of 15-20 minutes. Historically, SI-101A or B is only open for a couple of minutes during the accumulator filling evolution.

The SI system is required to operate during certain accidents to mitigate the consequences of the accident by providing core cooling and/or supplying borated water to the core. The accidents of concern are Steam Generator Tube Rupture, loss of coolant associated with a Rod Ejection Accident, Rupture of a Main Steam Line, Small Break Loss of Coolant Accident (LOCA), and Large Break LOCA.

Two issues have been identified which pertain to the time interval in which SI-101A or B is open for accumulator filling:

1) Single failure criteria assumes that one SI pump will not be available upon a SI signal during a LOCA. Therefore, only one SI pump will be available to provide accident mitigation which can be assumed to occur during accumulator filling. Because the amount of flow through the accumulator fill line under accident conditions is unknown, the operating SI pump has the potential for exceeding the design runout flow limit. If the pump is operated at runout conditions, the pump could be damaged which would result in a loss of the only available SI pump.

2) If one of the above accidents were to occur during the filling operation of either accumulator, the amount of water injected into the RCS will be reduced by the amount of water being diverted into an accumulator. The amount of water diverted during the progression of the accident will vary and depends upon several factors; i.e. the accident type (location and size of the break), RCS pressure, containment pressure and accumulator pressure. This potentially affects SI system accident analysis assumptions and results.

Both of these issues were reviewed to determine the potential impact on SI pump operability and accident analysis assumptions and results.

Cause of Event

During plant design, the need to fill the accumulators during normal power operation was recognized. The following statement is found in Updated Safety Analysis Report (USAR) Section 6.2.2 (Accumulators), "The level of borated water in each accumulator tank is adjusted remotely, as required, during normal plant operations. Refueling water is added using a safety injection pump. Water level is reduced by draining to the reactor coolant drain tank." There are no limitations identified in the USAR that would preclude the fill evolution. The effect that the accumulator filling operation had on the operability of the SI system during an accident was probably not considered at that time because of the infrequent occurrence and the short duration of the fill operation. This issue has existed since initial plant startup.

The assumptions used in the accident analyses also failed to recognize that additional flow would be diverted from the RCS during accumulator fill operations. The cause for failing to recognize these conditions is unknown.

Analysis of Event

This condition was reported at 1635 EST on April 9, 1997, in accordance with 10 CFR 50.72(b)(2)(I), "Any event, found while the reactor is shut down, that, had it been found while the reactor was in operation, would have resulted in the nuclear power plant, including its principal safety barriers, being seriously degraded or being in an unanalyzed condition that significantly compromises plant safety."

This report is being submitted in accordance with 10 CFR 50.73(a)(2)(ii)(B), "In a condition that was outside the design basis of the plant."

The accumulators are required by TS 3.3.a.1.A to be maintained at a pressure of greater than 700 psig. The amount of water diverted into an accumulator will vary depending upon the accumulator pressure and RCS pressure changes as the accident progresses. If the RCS pressure is greater than accumulator pressure more flow will be diverted to the accumulator (path of least resistance). If RCS pressure is less than the accumulator pressure, less flow will be diverted. During the initial stages of a Large Break LOCA, the RCS pressure drops quickly below accumulator pressure and the accumulator(s) will inject the supply of borated water into the RCS. After that, the accumulator pressure will be near RCS pressure and the amount of flow diverted to the accumulators will depend partly on the differential pressure between the two.

Currently, the SI flow rate acceptance criteria for Surveillance Procedure SP 33-191, "Safety Injection Flow Test," are as shown in the following table (note that due to system resistance through different paths, the acceptance criteria is dependent on the path and the pump). The flow rate for each pump is measured using flow transmitters (FT) [FT] FT-924 and FT-925, which are located upstream of the throttle valves (SI-10A & B). Each safety injection pump is capable of supplying 810 gpm (at the flow transmitters) at runout conditions. The margin between SP acceptance criteria and runout conditions is shown in the table for each flow path.

SP 33-191 SI Flow Rate Acceptance Criteria				
Safety Injection System Flow Paths	SI PUMP A (FT-925), gpm	Margin to Runout, gpm	SI PUMP B (FT-924), gpm	Margin to Runout, gpm
Loop A Cold Leg Flow (SI-11A open, SI-11B closed)	420-430	390-380	410-430	400-380
Loop B Cold Leg Flow (SI-11B open, SI-11A closed)	420-440	390-370	420-440	390-370
Loop A + B Cold Leg Flow (SI-11A & B open)	660-680	150-130	660-680	150-130
Total Flow (SI-11A & B open, Reactor Vessel paths open)	780-800 calculated	30-10	780-800 calculated	30-10
Reactor Vessel A + B flow	240-260	n/a	250-270	n/a
Cold Leg A + B Flow	520-540	290-270	520-540	290-270

The fill rate of each accumulator was measured to determine the maximum flow possible. The conditions during the measurement were: the accumulator level was at 20% level and pressure was at atmospheric conditions, RCS isolation valves (SI-11A, SI-11B) [ISV] were closed, and the SI pump recirculation line open. Accumulator fill rates of 190 gpm and 273 gpm for accumulator "A" and "B" respectively were measured. Accumulator "B" has a higher rate because the fill line connection point is upstream of throttling valve SI-10B where as Accumulator "A" fill line is connected downstream of SI-10A. With SI-11A and B open, less flow will be diverted to the accumulators. Actual fill rates during accident conditions are dynamic and would depend on the relationship between accumulator and RCS pressure.

The Large Break LOCA would be the bounding accident for pump runout concerns since the RCS pressure would quickly be reduced and present the greatest challenge to the SI pumps. A SBLOCA does not pose a problem with respect to runout since the RCS pressure remains elevated, providing a higher back pressure on the SI system and thus reducing the SI pump flow.

During a LOCA, KNPP's design uses only the two cold leg injection paths for Safety Injection assuming one SI pump operable (the other pump is assumed to have failed) and one cold leg spilling to the containment floor. From surveillance testing acceptance criteria, total flow through all four injection paths is 780-800 gpm. Cold leg injection path A and B flow is 520-540 gpm and reactor vessel injection path flow is 240-260 gpm (SI pump A) or 250-270 gpm (for SI pump B). By subtracting the maximum cold leg flow allowed (540 gpm) from the pump runout flow of 810 gpm, a minimum margin of 270 gpm exists to protect the pump. The maximum measured accumulator fill flow was 273 gpm and is comparable to the reactor vessel flow acceptance criteria. As stated above, the actual fill rate will be less when SI-11A and B are open. If only one cold leg injection path is open, there is also sufficient margin (minimum of 370 gpm for loop B) to prevent a SI pump from reaching a runout condition. Therefore, it can be concluded that the accumulator fill operation would affect the cold leg injection flow in a manner similar to opening the reactor vessel flow. Therefore, neither SI pump would reach runout conditions.

Due to the infrequent occurrence and very short duration of the fill operation, the exposure time to this event is very limited. The following conditions must simultaneously exist:

1) The accumulator fill operation must be in progress (SI-101A or B are open for less than 5 minutes during the fill procedure),
2) A large break LOCA occurs,
3) One SI pump must fail to start or run.

Using current KNPP probabilistic risk assessment methods, this configuration results in a core damage frequency (CDF) of $5x10^{-5}$/year during the five minutes it exists. The increased core damage probability (CDP) due to one accumulator fill is $8x10^{-11}$. Conservatively assuming that the accumulator refill occurs every three weeks, the total CDP increase is $1.3x10^{-9}$ in a year. The configuration specific CDF and CDP increase are well below the limits of $1.0x10^{-3}$/year and $1.0x10^{-6}$ respectively in the Electric Power Research Institute's PSA Applications Guide.

The potential to divert high head safety injection flow from the reactor coolant system into the accumulator that is being filled (thus reducing or delaying the amount of water available to the RCS) could affect the consequences of the above stated accidents. It is unknown what impact the accumulator filling operation would have on an accident.

Corrective Actions

Several potential corrective actions are being reviewed for possible implementation for the next operating cycle (shown in the order of preference):

1) Use an alternate path from the SI pumps to fill the accumulators. The proposed path would allow the accumulator fill flow to be throttled by a common valve and prevent the possibility of pump runout. This will also ensure the analyzed amount of injection flow to the RCS during an accident is maintained.

2) Modify the control circuit for SI-101A & B such that, if an accident were to occur during accumulator filling, the fill valve would automatically close when the operator released the switch, thus terminating the flow diversion.

3) Throttle SI-101A and B to reduce the amount of flow diverted to the accumulators.

One of the above actions, or an acceptable alternative, will be completed prior to plant startup from the current refueling outage.

A long term (permanent) action(s) will be determined after further investigation and review of alternate corrective actions. The permanent corrective action(s) will be completed prior to startup from the next refueling outage.

Additional Iuformatiou

Safety Injection Pumps are Bingham-Willamette Co. (now Sulzer Bingham Co.), Model 4x6x9, Type CP, 11 stage, 3600 rpm pumps.

Equipment Failures

None

Similar Events

The following events involve issues which have existed since initial plant startup and which failed to properly consider plant design in safety analyses or testing methodology.

LER 91-008, "Inadequate Resistance Temperature Detector Response Time Results in Potential Inability to Meet High Energy Line Break Criteria

LER 91-009, "Error in Safety Injection Accumulator Level Indication Caused by Not Compensating for Effects of Nitrogen Density During Calibration"

LER 92-009, "Unanalyzed Condition Identified In Emergency Diesel Generator Load Sequence Design"

LER 92-015, "Unanalyzed Condition Identified in Steam Exclusion System Design"

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL	REVISION	
Kewaunee Nuclear Power Plant	05000305	97	-- 004 --	00	8 OF 8

TEXT *(If more space is required, use additional copies of NRC Form 366A)* **(17)**

Attachment 1
Simplified Safety Injection/Accumulator Flow Diagram