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)
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TITLE (4)

SINGLE FAILURE CONDITIONS THAT COULD HAVE POTENTIALLY COMPROMISED THE ABILITY OF THE SERVICE WATER SYSTEM FROM COMPLETING ITS SAFETY FUNCTION DURING THE RECIRCULATION PHASE OF AN ACCIDENT

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
08	05	94	95	- 025	00	11	13	95	Salem station Unit 2	05000311
									FACILITY NAME	DOCKET NUMBER

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

OPERATING MODE (9)		20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(i)	50.73(a)(2)(viii)
POWER LEVEL (10)		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)
Howard Berrick	609 339-1862

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
YES (If yes, complete EXPECTED SUBMISSION DATE).	X	NO				

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

On October 12, 1995, during Salem system restart readiness reviews, Problem Reports (PRs) associated with Service Water System (SW) alignment concerns, which had been identified in 1994, were screened for the proper disposition of reportability. It was determined at this time that the reportability criteria, as defined in 10CFR50.72(b)(2)(i), was met for these PRs, which had been initiated on August 5, 1994. The most significant conditions described in these PRs (i.e., single failures) could have resulted in an alignment with the potential for runout / cavitation with only 2 SW pumps running during the recirculation phase of a LOCA. This condition was beyond previously analyzed conditions and could have potentially affected the ability of the system to perform/complete its design function. At the point of initiation (8/94), actions had already been implemented that would have significantly mitigated these conditions and additional procedure changes were subsequently made to further improve the resulting condition.

Plant and System Identification:

Westinghouse - Pressurized Water Reactor

Energy Industry Identification System (EIIS) codes appear in the text as {xx}

Identification of Occurrence:

Event Date: August 5, 1994

Discovery date: October 12, 1995

Report date: November 13, 1995

Conditions Prior to Occurrence:

Unit 1

Mode: Defueled Reactor Power: N/A Unit Load: N/A

Unit 2

Mode: 5 Reactor Power: N/A Unit Load: N/A

Description/Analysis of Occurrence:

The Salem Service Water system is an open cooling water system that is described in section 9.2.1 of the Final Safety Analysis Report (FSAR). In this section of the FSAR it is stated that minimum recirculation requirements can be met with 2 SW pumps. The original (1978) PSE&G SWS Description (and the subsequent Configuration Baseline Document) indicate that minimum safeguards can be carried with 2 SW pumps and that minimum safeguards includes 3 Containment Fan Coil Units (CFCU) and 1 Component Cooling Heat Exchanger (CCHX).

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

Description/Analysis of Occurrence (cont'd):

In June 1994, during preparation of a SW Mode of Operation calculation, which used the system hydraulic model to evaluate various configuration of the system and potential single failures, it was identified that plant procedures did not contain specific instructions to limit system flow for 2 pump accident alignments. The 2 pump conditions can typically result from initiating events (e.g. accident / blackout) in conjunction with single failures (or prior LCO condition). Compensatory actions had already been put in place for other high flow concerns, which significantly mitigated the consequence of these alignments. On August 5, 1994, the subject Problem Reports were initiated and evaluated for operability. The system was determined to be operable based on the compensatory actions noted above. A procedure revision request was submitted to revise the Salem Emergency Operating Procedures to address these concerns, however, due to the complexities of the Salem design (3 vital bus, 2 safety trains), an immediate revision was not viable. Additional compensatory actions were taken shortly after the discovery point to further improve these alignments and a long term priority was assigned to the resolution of the PRs. A reportability review was requested from Licensing following the long term priority determination.

On October 12, 1995, during subsequent reviews of the subject Problem Reports, it was determined that the conditions described (i.e. prior to compensatory actions) could have potentially challenged the ability of the system to perform its safety function. Accordingly, this condition was reported to the Commission (NRC) pursuant to the requirements of 10CFR50.72(b)(2)(i).

Analysis and timeline:

The technical issues identified in this LER were self-discovered during preparation for a Service Water Operational Performance Inspection (SWSOPI) conducted in 1994. During this period a computer flow model was developed that enabled an improved understanding of the system design basis and led to the discovery of potential for higher pump flows under certain conditions. The following time line is provided to facilitate the understanding of this occurrence:

In 1992 a project was initiated for the upgrade of the Salem SW pumps with an improved design. This scope included the development of a computer based system flow model in order to provide an updated basis for the design rating of the new SW pumps. Until this time, the only basis that could be located for the pump rating was the flow tables of the original PSE&G system description.

Description / Analysis of Occurrence (con'd):

One of the driving factors for the pump upgrade was a Design Discrepancy relative to pump NPSH requirements at the design low low water level of 76 feet. Initial screening of this discrepancy assigned a long term priority based on PRA. This assessment was not questioned, based on the fact that the lowest levels of the Delaware River experienced during the years of plant operation, still provided a reasonable margin above the point that would challenge NPSH at the pump design flow rate (10,875 gpm).

In late 1993 during the incorporation of test data on the flow model, preliminary results (using the still unverified model) indicated that higher flows were possible due to the single failure of a CCHX air operated control valve to the full open position with 3 operating pumps. Engineering and Licensing personnel discussed the Licensing implications of these evolving issues (SW flow and pump NPSH). It was determined, since the prevalent system flow conditions were low due to cold water, and the predictive calculation had not yet been verified / approved, no immediate Licensing actions would be appropriate.

In May 1994, a Justification for Continued Operation (JCO) was approved by the Station SORC to address SW pump NPSH concerns, including DCPs for the addition of fixed resistances to the CCHX flow paths, a Severe Weather Procedure revision, and CCHX normal Operating Procedure Revisions. DCPs for the CCHX fixed resistances were implemented prior to the end of May.

In June 1994, during the initial reviews of the input assumptions for the Mode Op Calculation, engineering was unable to confirm the existence of procedures that limit flow for 2 SW pump accident alignments. This calculation was intended to review all known system alignments (based on a detailed procedural review) and potential single failures, using the approved model.

A procedure revision request was subsequently initiated to revise the Salem Emergency Operating Procedures (EOPs) in order to address the 2 Service Water pump alignment concerns. At the point that it was recognized that an immediate revision was not viable, the subject PR's were initiated. The PRs were originally evaluated for operability based on the compensatory actions that had already been implemented in May of 1994. Although intended to specifically address a different failure, these actions also significantly mitigated the concerns with high SW pump flows and NPSH for the subject PRs.

In September of 1994, additional compensatory measures were established by revising the CCHX operating procedures to support flows that were consistent with those previously evaluated by the JCO. These actions specifically addressed the 2 pump alignment concerns of the PRs on an interim basis until more permanent Salem EOP changes could be developed and implemented.

Description/Analysis of Occurrence (cont'd):

In August of 1995 during SW system readiness reviews, the disposition of the reportability screens contained in these PRs were raised with the System Manager. At this point it was discovered that the reportability evaluation screens for the PRs had not been dispositioned. On October 12, 1995, the conditions described in the problem reports are determined to have been reportable as a 4 hour report to the NRC.

Apparent Cause of Occurrence:

The apparent cause of this occurrence has been attributed to a limited appreciation of the significance of operating the the SW system in a normally cross-tied mode. The reason for this mode of operation was not clearly stated in original plant design basis documents. This design results in pumps that are affected equally by potential high flow conditions. The importance of the normal alignment was not fully understood until the development of the computer flow model in 1994 and the subsequent single failure evaluations/procedural reviews, which identified pump flows significantly higher than the original design basis (10,875 gpm). These high flows provided a further concern for the already recognized small NPSH margin for the existing SW pump design.

Additional significant contributing causal factors to this event are; A) Lack of clear, consistent procedural guidance for correcting conditions adverse to quality (making prompt reportability determinations) as demonstrated by the long term priority assigned by the DEF / PRs and B) Limited training on Operability / Licensing Basis reportability requirements in the design organization.

Prior Similar Occurrences:

There are no prior similar occurrences to this event.

Safety Significance

The relative Safety Significance at the point of discovery of these issues was very low. Positive compensatory actions had already been taken (5/94) in response to other high flow scenarios that had been discovered earlier (late 1993 to early 1994) with the development of the SW system flow model. These compensatory actions significantly mitigated the concerns with high pump flows and NPSH margin.

Safety Significance (Cont'd)

With regard to the NPSH discrepancy, until the development of the flow model in early 1994, only the original pump design flow rate had been used for NPSH evaluation purposes. At this flow rate even the lowest river levels experienced during the years of Plant operation exceeded the required NPSH for the current SW pumps by a reasonable margin. The high SW flow conditions are typically the result of design basis accident alignments with single failures and, as such, are not required to be postulated concurrently with the extremely low low design water level (76 feet) identified in the Salem FSAR.

Prior to the discovery of the potential for higher pump flows with the development of the flow model, there was little safety significance for these issues for the following reasons:

1. If left uncorrected, high SW pump flow would have the potential to affect the ability of the system to meet design basis requirements in the ECCS recirculation mode. While no specific procedural guidance existed (prior to 1994) to avoid placing the system in this configuration, the condition (high SW flow) would have been readily detectable by the low system pressure alarm (overhead alarm) or fluctuating pump amperage indications (control console). Furthermore, since this condition (highest SW flow demand) would have typically occurred in the ECCS recirculation mode, operator action would have been expected, by training, although specific procedural guidance was not available.

2. Generic Letter 91-018 states that PRA is a useful tool for determining relative safety significance. The probability of the scenarios in each of the 2 pump system alignments, that were the most significant item of these PRs, is very low. Several of the scenarios involve an assumption that redundant equipment is out of service, which further reduces the probability of occurrence.

Corrective Actions:

With respect to the technical issues of the SW system:

The SW System Configuration Baseline Document (CBD) will be revised to clearly identify the design basis and significance for normal operation in the cross-tied mode. This revision will be completed by May 31, 1996.

Corrective Actions (Cont'd):

Pump NPSH margin is currently protected by the river level/NPSH monitoring instructions contained in the Abnormal Environmental Procedure (SC.OP-AB.ZZ-0001(Q), which require the plants to be taken to cold shutdown condition if NPSH available drops to a pre-established threshold value. These instructions will be removed when the pump upgrades are completed, which is scheduled to be completed in 1996. There are presently 2 new design (Johnston) SW pumps installed (#12 and 26). The new design pumps have substantially lower NPSH requirements (includes the full range of possible flow) than the current Layne and Bowler pumps.

Fixed flow restrictions were applied to the largest flow path in the Nuclear area of the system (CCHX's). This was added by DCP's 1EC3316 and 2EC3274 as documented in JCO S-C-SW-MEE-0893, Revision 1. This restriction significantly improved the maximum pump flows for all of the possible alignment scenarios that have been evaluated.

Restoration of SW flow to the CCHXs during recovery from a safety injection / blackout alignment is established by a direct EOP reference to the normal operating procedures. These procedures have different control valve restoration instructions based on the number of operating pumps.

The Loss Of SW Header Pressure Procedure (S1/2 OP-AB.SW-0001(Q)) was revised to specifically call attention to the potential concern with SW pump high flow/NPSH and to identify appropriate operator responses to these conditions.

With respect to the technical issues of the SW system:

Permanent procedure revisions are being developed (both Normal and Emergency Operating) to address the specific concerns of the Problem Reports. These revisions will be implemented by April 1996.

In regard to the lateness of this report:

The Corrective Action Program (NC.NA-AP.ZZ-0006(Q), has been significantly improved by combining the previous processes for reporting conditions adverse to quality, lowering the program threshold, formalizing the Operability Determination Process, increasing management involvement and oversight, and clearly communicating management expectations regarding timeliness of evaluations and corrective actions.

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Corrective Actions (Cont'd):

The Program has also been improved to specifically define a hierarchy of event significance levels with corresponding required levels of cause investigation, including prompt operability/reportability determination. The revision also simplified and centralized the method used to enter, track and process conditions adverse to quality.

A new corrective action department has been established to provide heightened management focus on the corrective action process and established daily (weekday) management review of identified conditions adverse to quality.

A copy of this LER will be forwarded to the Nuclear Training Center for evaluation and incorporation into the Operability / Reportability training for Design Engineering personnel.