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)

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TITLE (4)

Condensate Storage Tank (CST) Unusable Volume Not Accounted For In Plant Procedures

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
03	22	96	96	020	01	12	16	96	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)			
POWER LEVEL (10)	000	20.2201(b)	20.2203(a)(2)(v)	[X] 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)
Robert W. Walpole, MP1 Nuclear Licensing Manager	(860)440-2191

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	MONTH	DAY	YEAR
[X] YES (If yes, complete EXPECTED SUBMISSION DATE).	[ ] NO		03	15	97

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

On March 22, 1996 at 1645 hours, with the plant shutdown and reactor in the COLD SHUTDOWN condition, it was determined that Millstone Unit No. 1 Technical Specification 3.5.C.3 has not been met in the past, and that Technical Specification 3.5.F.7(f) was not met during three past refueling outages. Technical Specification 3.5.C.3 requires a minimum of 250,000 gallons of usable water in the condensate storage tank (CST) to ensure operability of the feedwater coolant injection (FWCI) system. Engineering evaluations, which now include pump vortexing in the calculation of unusable volume, have concluded that the administrative requirement to maintain 300,000 gallons in the CST for normal operations was insufficient to ensure Technical Specification compliance. This event is reportable, pursuant to 10CFR50.73(a)(2)(i) as a condition prohibited by the plant's Technical Specifications. This event is also reportable, pursuant to 10CFR50.73(a)(2)(ii)(A) as an unanalyzed condition which significantly compromised plant safety, and was promptly reported, pursuant to 10CFR50.72(b)(2)(i), on March 22, 1996.

Technical Specification 3.5.F.7(f) requires a minimum of 414,000 gallons of usable water in the CST for reactor vessel makeup capability during refueling outages when the torus is drained, which cannot be met at based on the current calculated unusable volume. This event is reportable, pursuant to 10CFR50.73(a)(2)(i), as a condition prohibited by the plant's Technical Specifications.

There were no safety consequences as a result of this event.

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

I. Description of Event

On March 22, 1996, at 1645 hours, with the plant shutdown and reactor in the COLD SHUTDOWN condition, it was determined that Millstone Unit No. 1 Technical Specification 3.5.C.3 has not been met in the past, and that Technical Specification 3.5.F.7(f) was not met during three past refueling outages. Technical Specification 3.5.C.3 requires a minimum of 250,000 gallons of usable water in the condensate storage tank (CST) to ensure operability of the feedwater coolant injection (FWCI) system. Plant procedures require CST level to be greater than 300,000 gallons during normal operation. Engineering evaluations have concluded that approximately 68,000 gallons constitutes unusable volume due to instrument uncertainty, pump vortexing (utilizing the emergency condensate transfer (ECT) pump), and the elevation of the suction nozzle in the CST. Therefore, to meet this Technical Specification, plant procedures should have required CST level to be greater than 318,000 gallons at all times FWCI is required to be operable. This event is reportable, pursuant to 10CFR50.73(a)(2)(i) as a condition prohibited by the plant's Technical Specifications. This event is also reportable, pursuant to 10CFR50.73(a)(2)(ii)(A) as an unanalyzed condition which significantly compromised plant safety, and was promptly reported, pursuant to 10CFR50.72(b)(2)(i), on March 22, 1996.

Technical Specification 3.5.F.7(f) requires a minimum of 414,000 gallons of usable water in the CST for reactor vessel makeup capability during refueling outages when the torus is drained. Accounting for a total unusable volume of approximately 75,000 gallons (if one low pressure coolant injection (LPCI) pump is aligned to the CST suction line and flow is not throttled), the CST volume of 489,000 gallons required to meet this Technical Specification exceeds the 460,000 gallon design capacity of the tank. This event is reportable, pursuant to 10CFR50.73(a)(2)(i) as a condition prohibited by the plant's Technical Specifications.

Historically, plant records show the torus has been drained only three times in the past, during the 1980, 1982, and 1987 refueling outages. Currently, with the plant in COLD SHUTDOWN, the torus is not drained, and as such, Technical Specification 3.5.F.7(f) is not applicable. Administrative plant procedures are being updated to ensure at least 318,000 gallons are available in the CST at all times FWCI is required. In addition, Technical Specification, procedure and plant modifications are being evaluated to reduce the contribution of pump vortexing to unusable volume. There were no safety consequences as a result of this event.

II. Cause of Event

The root cause of this event was personnel error. The design calculations for the usable volume of the CST were incomplete, in that they failed to properly consider all contributions to unusable volumes in the CST.

III. Analysis of Event

Technical Specification 3.5.C.3 requires 250,000 usable gallons of water inventory in the CST to ensure FWCI operability during power operation. Additionally, Technical Specification 3.5.F.7(f) requires 414,000 usable gallons of CST water inventory during refueling operation when the torus is drained. Based on a recent reevaluation of the calculation methodologies of CST unusable volume, Technical Specification 3.5.C.3 has not been met in the past. This event is reportable, pursuant to 10CFR50.73(a)(2)(i)(B) as a condition prohibited by the plant's Technical Specifications. This event is also reportable, pursuant to 10CFR50.73(a)(2)(ii)(A) as an unanalyzed condition which significantly compromised plant safety, and was

promptly reported, pursuant to 10CFR50.72(b)(2)(i), on March 22, 1996. In addition, Technical Specification 3.5.F.7(f) was not met during the 1980, 1982, and 1987 refueling outages. This event is reportable, pursuant to 10CFR 50.73(a)(2)(i)(B), as a condition prohibited by the plant's Technical Specifications.

The original calculation of unusable CST volume did not account for the amount of water unavailable due to pump vortexing at the suction nozzle inside the tank. Adding this to the amount of unusable volume due to instrument uncertainties and the location of the pump suction line nozzle in the tank, the total unusable CST volume is estimated to be between 63,400 and 67,750 gallons for FWCI operational modes (with ECT pump flow), and at least 75,000 gallons (if one LPCI pump is aligned to the CST suction line and flow is not throttled) for refueling operations with the torus drained. In the latter case, suction is taken from the CST with one LPCI pump, which has a higher vortexing limit than the ECT Pump.

Analysis of Technical Specification 3.5.C.3 Compliance:

To meet the requirements of Technical Specification 3.5.C.3 when FWCI is required to be operable, total CST volume should have been maintained at all times at or above 318,000 gallons. Current administrative procedural controls only require the volume to be greater than 300,000 gallons for normal operation (RCS Temp. >/= 330 degrees F). Two specific accident scenarios were evaluated that credit use of the CST volume, the limiting Appendix 'R' scenario and the non-limiting FWCI / loss of normal power (LNP) scenario.

Limiting Appendix 'R' Scenario:

In 1987, during a review of the particular Appendix 'R' scenario for the worst case reactor building fire, a CST volume of at least 232,000 usable gallons was necessary to ensure achieving cold shutdown following this scenario. It is assumed that the ECT pump is unavailable, and makeup to the hotwell is via normal condensate transfer. As a result of this larger volume requirement for the CST, a Technical Specification change was processed and approved by the NRC to raise the minimum CST inventory requirement from 225,000 gallons to 250,000 gallons. This quantity of CST water is sufficient to account for at least 10 hours of decay heat removal via FWCI / safety/relief valve (SRV) operation, and to compensate for primary coolant leakage and shrinkage during cooldown to cold shutdown conditions. The 10-hour time frame allows for equipment repairs to restore isolation condenser operability for the worst case reactor building fire.

The calculations supporting this conclusion were reviewed, taking into account unusable volumes in the hotwell and CST, as well as instrument uncertainties. It was conservatively determined that a total of 265,000 gallons of usable water inventory is required to mitigate this scenario. In order to meet this requirement using the CST, in conjunction with an assumed condenser hotwell volume of 35,000 usable gallons, a level of 300,000 gallons, which is the low end of the range of normal CST level, is sufficient to mitigate this scenario. Having additional water in the condenser hotwell provides additional margin for mitigation of this accident scenario.

Evaluation of Small Break Loss of Coolant Accident (LOCA) and non-LOCA Scenarios:

The FWCI system was originally credited for accident mitigation in the Updated Final Safety Analysis Report (UFSAR) Chapter 15 accident analysis. However, the current accident analysis no longer credits the FWCI system for any accident mitigation functions, even though the system has

maintained its capability to mitigate small break LOCA scenarios. Small Break LOCAs are mitigated by the LPCI, core spray, isolation condenser and automatic pressure relief (APR) systems. For non-LOCA transients, such as an LNP scenario, the FWCI system could be used to recover reactor pressure vessel (RPV) level initially, and then to provide adequate make-up to account for subsequent reactor coolant system (RCS) boil-off and leakage. Water inventory in the condenser hotwell is sufficient to recover level initially. The CST inventory of 300,000 gallons, in conjunction with the ECT Pump is more than adequate to provide make-up for long term boil-off.

Analysis of Technical Specification 3.5.F.7(f) Compliance:

To meet the requirements of Technical Specification 3.5.F.7(f), a minimum of 489,000 gallons should have been maintained in the CST during refueling operations with the torus drained, if only one LPCI Pump is aligned to the CST to provide reactor cavity makeup. This is in excess of the tank's capacity of 460,000 gallons. Plant records indicate that the torus was drained during the 1980, 1982, and 1987 refueling outages. Therefore, it is concluded that, when accounting for pump vortexing as unusable volume, Technical Specification 3.5.F.7(f) was not able to be met during these three outages. However, in the event of a leakage path that would have resulted in significant loss of reactor cavity water inventory, the available CST volume would have been used to provide make-up water to the refueling cavity. Significant reactor cavity leakage would then drain to the torus and would be available for vessel make-up via the LPCI or Core Spray systems, once net positive suction head (NPSH) requirements are met and the systems are realigned. Therefore, the safety significance of this event is very low.

There were no safety consequences as a result of this event.

IV. Corrective Action

Design calculations will be revised to correctly identify the usable volume of the CST. In addition, a review of the calculations of unusable volume of all safety-related tanks is ongoing and will be completed prior to startup for operating cycle 16.

To ensure future compliance with Technical Specification 3.5.C.3, administrative procedures will be revised to ensure 318,000 gallons is available in the CST at all times FWCI is required to be operable. These procedure revisions will be completed prior to startup for operating cycle 16. Due to the inability to meet Technical Specification 3.5.F.7(f) during refueling operations with the torus drained, administrative controls have been put in place as short-term corrective action to ensure that neither fuel movement nor CRD work, as specified in Technical Specification 3.5.F.7(f), occurs when the torus is drained. Long-term corrective actions that were evaluated are the design and installation of anti-vortexing baffles at the CST suction nozzle, potential revision of the applicable Technical Specification, and possible procedural changes to provide guidance on flow throttling of emergency core cooling systems (ECCS) when lined up to the CST as a back-up method of providing make-up water to the reactor vessel cavity during refueling when the torus is drained.

Northeast Nuclear Energy Company (NNECO) has evaluated long-term corrective actions to resolve the Tech. Spec. 3.5.F.7(f) compliance issue. It has been determined that the CST usable volume requirement of 414,000 gallons can be met through throttling of the LPCI pump, if this pump is used to provide vessel make-up capability from the CST. Since vortexing is proportional to pump flow rate, the use of a Core Spray pump to provide make-up water from the CST to the vessel cavity causes less vortexing than a LPCI pump,

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and therefore would not require throttling to meet this CST usable volume requirement. However, since the ECCS pump alignment configuration as required in Tech. Spec. 3.5.F.7(f) provides far more flow capacity than would be needed to mitigate the worst case reactor cavity leak, throttling or cycling of any one of these ECCS pumps would be necessary anyway to control vessel cavity level and prevent a cavity overfill condition. Therefore, NNECO has determined that adding procedural guidance on the throttling of the ECCS pumps in the event of a reactor cavity leak is the most appropriate corrective action to resolving this issue. The procedural guidance will be completed prior to shutdown for refueling outage 16.

V. Additional Information

Similar Events

A similar event was recently reported as LER 96-010-00, "Emergency Gas Turbine Generator and Emergency Diesel Generator Inoperable Simultaneously Due to Lack of Available On-Site Fuel Oil Because of Pump Submergence Calculations."

Manufacturer Data

None