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)

Isolation Condenser Makeup Water Temperature Below Design Basis Limit

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
01	09	96	96	009	01	05	19	97	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)		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)
POWER LEVEL (10)		20.2203(a)(1)	20.2203(a)(3)(i)	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)

C	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE).	☒ NO				

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

On January 9, 1996, with the plant shutdown and the reactor in the COLD SHUTDOWN condition, the Millstone Unit No. 1 design basis verification team determined that the isolation condenser may have been operated with makeup water colder than that permitted by the design basis. On February 5, 1996, after an extensive review of the design basis involving the structural integrity of the isolation condenser, it was determined that makeup water as cold as 50 degrees F has been used. This is contrary to the design basis makeup water temperature of 70 degrees F.

This event is reportable pursuant to 10CFR50.73(a)(2)(ii)(B) as a condition outside the design basis of the plant. Additionally, this event was promptly reported pursuant to 10CFR50.72(b)(2)(ii)(B) as a condition outside the design basis of the plant.

No immediate operator actions were required at the time of discovery. 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 January 9, 1996, with the plant shutdown and the reactor in the COLD SHUTDOWN condition, the Millstone Unit No. 1 design basis verification team determined that the isolation condenser may have been operated with makeup water colder than that permitted by the design basis. On February 5, 1996, after an extensive review of the design basis involving the structural integrity of the isolation condenser, it was determined that makeup water as cold as 50 degrees F has been used. This is contrary to the design basis makeup water temperature of 70 degrees F.

This event is reportable pursuant to 10CFR50.73(a)(2)(ii)(B) as a condition outside the design basis of the plant. Additionally, this event was promptly reported pursuant to 10CFR50.72(b)(2)(ii)(B) as a condition outside the design basis of the plant.

No immediate operator actions were required at the time of discovery. There were no safety consequences as a result of this event.

II. Cause of Event

The cause of this event is an inadequate design specification. Since the make-up water source is specified to be either the condensate storage tank or the fire protection system, the design specification should have specified an isolation condenser makeup water temperature limit consistent with the Condensate Storage Tank temperature or the potable water supply temperature in Connecticut. A temperature lower than 50 degrees F would have been appropriate. Additionally, inadequate operating procedure at Millstone Unit No. 1 did not properly ensure that the 70 degrees F design limit on the make-up water temperature design limit was met.

III. Analysis of Event

A systematic design basis verification is being performed to provide assurance that the plant is being operated within its design basis. As part of this effort, on January 9, 1996, it was determined that the isolation condenser may have been operated outside its design basis. Following an evaluation and a review of the plant equipment operator (PEO) logs, it was determined that makeup water as cold as 50 degrees F has been used for the shell (secondary) side of the isolation condenser. The plant design basis is a makeup water temperature of 70 degrees F. This event is reportable pursuant to 10CFR50.73(a)(2)(ii)(B) as a condition outside of the design basis of the plant. Additionally, this event was promptly reported, pursuant to 10CFR50.72(b)(2)(ii)(B) as a condition outside the design basis of the plant.

Preliminary analysis (Calculation 96-SDS-1445M1, Rev. 0) showed that there is no apparent degradation of the isolation condenser due to this design inadequacy. The use of colder, 50 degree F water does not pose a non-ductile failure concern. The fatigue analysis performed on the affected shell (secondary) side components of the isolation condenser shows that the use of lower temperature makeup water (as low as 40 degrees F) does not have an adverse effect on compliance with the original ASME III fatigue design requirements.

It must be noted, however, that the external piping loads were not included in this preliminary evaluation of 40 degree F makeup water because they were not included in the original design basis analysis of record for

the make-up nozzle. The makeup water piping is low pressure and low temperature piping which had not been rigorously analyzed previously.

The existing isolation condenser make-up piping has been since analyzed rigorously (Calculation 96-SDS-1520M1, Rev. 0) to demonstrate compliance with Millstone Unit No. 1 piping design bases. The analysis results showed that this piping was not operable. LER 96-051-01, "Seismic Qualification Deficiencies Found in Safety Related Piping," reported this deficiency in the isolation condenser piping (3" IC-12). Additional piping supports were required to demonstrate compliance with Millstone Unit No. 1 piping design bases.

The nozzle loads determined from this rigorous piping analysis with additional supports were used in the analysis of the isolation condenser shell/nozzle region. The design basis stress and fatigue analysis of the makeup nozzle has been revised to include a lower bound makeup water temperature of 32 degrees F as well as the piping imposed loads.

The stress analysis of the isolation condenser makeup nozzle has been completed using the ANSYS finite element computer code. A 2-D axisymmetric model representing the geometry of the shell makeup nozzle including sufficient region of the isolation condenser vessel shell is created. A sufficient length of the shell is modeled as a flat plate. Since the curvature of shell is much larger than the makeup nozzle (132 inch Vs 3.5 inch) the flat plate approximation is considered appropriate.

Heat transfer coefficients are calculated for the nozzle inside and outside diameters to simulate the makeup flow addition at 32 degrees F and used in determining the transient temperature distribution in the nozzle and the shell. Transient temperature distributions due to a step change from 250 degrees F (shell side maximum operating temperature) to 32 degrees F are calculated and used to perform thermal stress analysis at several time steps. The nozzle and shell are analyzed for nominal as well as corroded wall thickness and for the design as well as throttle condition flow rates. The cross-section, flow rate and time step with the largest nodal stress intensity is selected to be combined with other loading conditions such as pressure and external mechanical loads.

In addition to internal pressure, the axisymmetric and non-axisymmetric external loads are applied to the nozzle using harmonic functions as unit load cases as discussed in ANSYS Users Manual.

The stresses are categorized based on Table N-413 in ASME Section III, Subsection A, 1965 Edition. Accordingly, the membrane stresses due to nozzle external loads are categorized as P_L for the nozzle and shell. All Q category stresses are categorized as secondary stresses for the nozzle and the shell. The stresses due to through the thickness thermal gradient in the vessel wall are considered peak stresses to be included in the fatigue assessment.

The nodal stresses from ANSYS analysis are converted into P_m and P_b stress categories as defined in ASME Code. Automated conversion feature of ANSYS post processing routine is used at several cross-section slices to determine these stresses. Note that the cross-section has to pass through free surface at both extremities for appropriate results.

The ASME Code stress check is performed for the design condition (including faulted) as well as for the operating conditions. Fatigue usage factor for 800 design number of cycles (as specified in General Electric Design Specification 21A1609) for the addition of makeup water at full power is also calculated and shown to be below 1.0.

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Brittle fracture of the nozzle/shell region due to thermal shock from makeup water addition at 32 degrees F was addressed qualitatively. Both the nozzle and shell material are suitable for service up to -20 degrees F per ASME Section VIII, 1965 Edition, (Para. UCS-65), with no fracture toughness (RT_{NDT}) testing requirements. Additionally, the thickness of the components involved is less than 0.625 inch and the maximum expected pressure is only 15 psig. Based on relatively thin cross-section thickness of the nozzle and shell, material suitability to service temperature as low as -20 degrees F, and minimal pressure and service loads, a failure due to thermal shock is believed to be highly unlikely.

With new support installation, the isolation condenser shell side make-up piping will be restored to full compliance with Millstone Unit No. 1 design basis.

IV. Corrective Action

A preliminary assessment of non-ductile failure of the isolation condenser system was performed in 1996 without identifying any concerns. Additionally, a fatigue analysis was also performed on the affected isolation condenser components, which confirmed that 50 degree F makeup water has had no adverse effect on compliance with the original ASME III fatigue design requirements. However, neither the original analysis for 70 degrees F make-up water nor the preliminary analysis with 40 degrees F make up water include any nozzle loads because these loads were unavailable.

The nozzle loads have been since determined from rigorous piping analysis. This analysis concluded that the existing piping in as-is condition was in-operable. LER 96-051-01 was issued to report this deficiency.

The LER 96-051-01 committed to restore the piping system to design basis requirements prior to startup for operating Cycle 16.

The isolation condenser shell/nozzle junction analysis has been completed using the augmented nozzle loads and 32 degrees F makeup water. This analysis shows that the nozzle complies with applicable ASME Code requirements provided new supports are installed as designed such that nozzle loads are not impacted.

The Updated Final Safety Analysis Report will be revised to incorporate 32 degrees lower bound for the isolation condenser makeup water temperature, based on the results of the isolation condenser shell analysis prior to startup for operating Cycle 16.

Since the makeup water temperature of 32 degrees F has been found to be acceptable, procedural controls are not necessary.

V. Additional Information

Similar Events

None.

Manufacturer Data

None