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

Dear Sir:

Three Mile Island Nuclear Station Unit I, (TMI-1)
Operating License No. DPR-50
Docket No. 50-289
LER 90-005-00

This letter transmits Licensee Event Report (LER) No. 90-005-00 which was a Plant Shutdown Due to a Steam Generator Tube Leak. Public health and safety were unaffected.

This LER is being submitted pursuant to 10 CFR 50.72, using the required NRC forms (attached). NRC Form 366 contains an abstract which provides a brief description of the event. For a complete understanding of the event, refer to the text of the report which appears on Form 366A.

Sincerely,

H. D. Hukill
H. D. Hukill

Vice President & Director, TMI-1

HDH/WGH
Attachment
cc: R. Hernan
T. Martin
J. Stolz
F. Young

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LICENSEE EVENT REPORT (LER)

FACILITY NAME (1) THREE MILE ISLAND, UNIT 1

DOCKET NUMBER (2) 050002891 OF 06

TITLE (3) PLANT SHUTDOWN DUE TO STEAM GENERATOR TUBE LEAK

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)
03	06	90	90	005	00	04	03	90			050000

OPERATING MODE (9)	TH. REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 5 (Check one or more of the following) (11)									
POWER LEVEL (10)	20.402(b)	20.402(c)	60.736(2)(iv)	73.71(b)						
	20.406(a)(1)(i)	60.736(2)(v)	73.71(c)							
	20.406(a)(1)(ii)	60.736(2)(vi)	Y OTHER (Specify in Abstract below and in Text, NRC Form 306A)							
	20.406(a)(1)(iii)	60.736(2)(vii)(A)								
	20.406(a)(1)(iv)	60.736(2)(vii)(B)								
20.406(a)(1)(v)	60.736(2)(viii)	60.736(2)(ix)								

LICENSEE CONTACT FOR THIS LER (12)

NAME W.G. HEYSEK, TMI-1 LICENSING ENGINEER

TELEPHONE NUMBER 717 948-8191

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)				
CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRC

SUPPLEMENTAL REPORT EXPECTED (14)

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

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

On March 6, 1990 at 08:23 an alert alarm on a radiation monitor for the "A" Once Through Steam Generator steam lines was received. Radioactivity increases on the Main Condenser Vacuum Pump Exhaust radiation monitors were also observed. The combined radioactivity increases were indication of a primary-to-secondary tube leak in a steam generator. Plant shutdown commenced at 09:12 at a rate of 2% per minute and normal plant cooldown commenced at 14:32. Cold shutdown was achieved on March 7 at 07:30.

Pressure testing identified and eddy current inspection results confirmed one tube in the "A" OTSG cracked circumferentially near the bottom of the upper tube sheet. The tube was stabilized and plugged.

The event was reported per 10CFR50.72(b)(1)(i)(A).

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED DATE NO. 0100-0100

EXPIRES 8/31/95

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TEXT IF MORE SPACE IS REQUIRED. USE ADDITIONAL NRC Form 366A's (17)

PLANT SHUTDOWN DUE TO STEAM GENERATOR TUBE LEAKI. PLANT OPERATING CONDITIONS BEFORE THE EVENT

TMI-1 was operating at 75% power during the power escalation for Cycle 8 operation. The plant had reached 75% power at 20:34 the previous day and was to remain at 75% power for thirty hours as part of the normal sequence.

II. STATUS OF STRUCTURES, COMPONENTS OR SYSTEMS THAT WERE INOPERABLE AT THE START OF THE EVENT AND THAT CONTRIBUTED TO THE EVENT.

None.

III. EVENT DESCRIPTION

At 08:23 on 3/6/90, the alert alarm was received in the Control Room for RM-G26, the radiation monitor associated with the "A" Once Through Steam Generator (OTSG) [AB/SG] steam lines. Observation of RM-A5 and RM-A15, Main Condenser Vacuum Pump Exhaust monitors [IL/RI], confirmed an increase in radioactivity. RM-G27, associated with the "B" OTSG, did not show increased radioactivity. Makeup tank level did not immediately show a decreasing trend.

At 08:34, the Plant Operations Director, the Plant Engineering Director and the Director, TMI-1 were called to the Control Room and were briefed on all the indications of primary-to-secondary leakage. By 08:41, an offsite dose projection by Radiological Controls supervision indicated that no radiological Emergency Action Level criterion had been met.

At 08:43, an RCS mass balance leak rate calculation was initiated on the plant computer by normal methods. The OTSG Tube Leak Rate Determination method in the Shift and Daily Checks was not used, since it relies on Xe-133 activity, which was less than the Lower Limit of Detection in the RCS sample taken at 00:45 that day. Manual calculations of the rate of decrease of the RCS inventory based on RCS temperature changes, and pressurizer [AB/PZR] and makeup tank [BP/TK] level changes had been started at about 08:30.

At 08:53, a grab sample was obtained from RM-A5. To avoid disturbing the RCS mass balance calculation begun at 08:43, no RCS sample was taken at this time.

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED: OMB NO. 3150-0106
EXPIRES: 03/96

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By 09:00, the manual RCS inventory loss calculations indicated that the RCS leakage rate was less than 0.5 gpm. The rate of level decrease in the makeup tank was estimated to be 0.5 to 0.75 gpm. Based on the available information, it was concluded that the leak rate was less than the limit of 1 gpm specified by Technical Specification 3.1.6.3, and that no Emergency Action Level of the Emergency Plan had been reached, either for leakage rate or for radioactive release. However, since it was clear that the steam generator tube was leaking, and there was a small release of radioactivity, management decided that the plant should be shutdown and cooled down without undue delay. Accordingly, at 09:12, shutdown was begun at a rate of about 2% power per minute.

At approximately 09:30, data from the 08:53 RM-A5 grab sample and from the 00:45 (most recent) RCS sample was used to calculate the primary-to-secondary leakage rate. Using Xe-135 and Kr-88 radioactivity ratios yielded leakage rates of 2.2 gpm and 1.8 gpm respectively. These calculated leak rates were considered to be inaccurately high by an unknown amount due to the time difference between the RM-A5 and the RCS samples. During the 8 hours between these samples, Xe activity in the RCS was increasing toward the equilibrium value at 75% power. An under estimate of the Xe RCS activity results in a calculated primary-to-secondary leak rate which is higher than actual. The RCS Xe concentration was also below the procedurally-stated minimum of $3E^{-1}$ μ Ci/ml total equivalent Xe-133 activity. These results were conveyed to the Director, TMI-1 and the Plant Engineering Director with the recommendation to wait for the next RCS sample results (the next RCS sample was taken at 10:20). At 09:43, the plant computer RCS mass balance calculation results were noted as invalid (negative) due to the plant shutdown. Manual calculations of RCS inventory loss were stopped at the time of shutdown, since transient conditions lead to inaccurate results. At 10:42, the reactor was subcritical and radiation monitor readings were continuing to decrease.

At approximately 11:30, results for RCS gas radioactivity were available from the 10:20 sample. Radionuclide ratio calculations showed 0.8 gpm and 1.3 gpm based on Ar-41 and Xe-135 respectively. The initial RCS results did not identify a Xe-133 concentration. Leak rate calculations up to this time, both by RCS inventory loss rate and by radionuclide concentration ratios were discussed with plant management. It was also noted that leak rate calculations using radionuclide ratios had not been performed using Xe-133, because this radionuclide was below LLD

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U.S. NUCLEAR REGULATORY COMMISSION

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for the RCS sample results received so far. The only radionuclide ratio calculation in the TMI-1 procedure is based on the use of Xe-133, although other noble gases with sufficient half-life technically could be used.

By 13:00, the results of a subsequent count of the 10:20 RCS sample provided a Xe-133 concentration. By using these results and the 08:53 RM-A5 sample Xe-133 results, a primary-to-secondary leak rate of 1.1 to 1.2 gpm was calculated. However since the reactor shutdown had begun between the RM-A5 sample and the RCS sample, it was recognized that the RCS Xe-133 concentration at 10:20 was not representative of the concentration at 08:53. That difference could not be quantified.

At 14:33, a normal RCS cooldown commenced, and by 07:30 on 3/7/90, the RCS was in cold shutdown.

IV. COMPONENT FAILURE DATA

Bubble testing in the "A" OTSG revealed the leaking tube to be A77-1, which is a periphery tube next to the open inspection lane. The failure was identified as a circumferentially oriented approximately 360° crack at the point where the tube exits the bottom of the upper tube sheet. The crack is believed to be the result of environmentally assisted high cycle fatigue (HCF).

This is based on eddy current testing data, visual examination of the tube, and on a comparison of the A77-1 failure with prior industry experience with environmentally assisted HCF cracking of OTSG tubes.

V. AUTOMATIC OR MANUAL INITIATED SAFETY SYSTEM RESPONSES

The nature of the event did not require actuation of any safety system. The plant was manually shut down, cooled down, and depressurized in a controlled manner by normal means.

VI. ASSESSMENT OF THE SAFETY CONSEQUENCES AND IMPLICATIONS OF THE EVENT

A. Safety Function of the OTSG Tubes

The OTSG tubes provide the primary-to-secondary barrier to prevent fission and activated corrosion products from entering the steam system. Defective tubes are plugged in accordance with the requirements of Tech Spec 4.19.

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

U.S. NUCLEAR REGULATORY COMMISSION

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B. Discussion of Safety Consequences and Implications

Because of the care taken during the recent refueling outage to ensure no leaking fuel pins were included in the new core, noble gas activity in the RCS was approximately three orders of magnitude below that at the end of the previous fuel cycle. Although no activity was detectable offsite, a site boundary whole body dose was calculated as 1.74E^{-3} millirem.

The extremely low RCS radioactivity coupled with the prompt decision to shut down created a great deal of uncertainty in calculating the primary-to-secondary leakage rate using radionuclide ratios. On 3/7/90, follow-up evaluations using theoretical radionuclide concentrations in the RCS to "normalize" the actual primary sample results to the time the secondary sample was taken concluded that the leak rate through the tube crack was probably 1.1 to 1.8 gpm prior to initiating the shutdown. This was communicated to plant management who then concluded that the leak rate prior to the shutdown was greater than 1 gpm rather than less than 1 gpm as calculated by RCS inventory loss rate at the time of the event. Accordingly, ENS notification to the NRC was made within one hour of this conclusion in accordance with 10 CFR 50.72(b)(1)(i)(a), "the initiation of any nuclear plant shutdown required by the plant's Technical Specifications." The ENS notification included the information that Technical Specification 3.1.6.3 requires plant shutdown if the primary-to-secondary leakage through the steam generator tubes exceeds 1 gpm total for both steam generators. Although the leak rate was believed to be less than 1 gpm prior to the shutdown, the plant was placed in cold shutdown less than 24 hours from the detection of the leak. It was also noted via ENS that had the leak rate been known at the time of the event to be greater than one gpm, an Unusual Event would have been declared in accordance with the Emergency Plan. Although no formal emergency declaration was made, radiological assessment personnel and the technical support personnel had provided support during the event. The Pennsylvania Bureau of Radiation Protection and the five TMI area counties were notified as would have been done had an Unusual Event been declared.

VII. PREVIOUS EVENTS OF A SIMILAR NATURE

None.

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U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OME NO. 3150-0104

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VIII. CORRECTIVE ACTION PLANNED

Eddy current inspections of all tubes in the "lane wedge" area of the "A" OTSG were performed. The leaking tube, A77-1, was plugged and stabilized. Although no eddy current indications relevant to the HCF failure were found, one tube, A78-28, was also preventively plugged.

Technical Specification 4.19.3.c.1 would require eddy current testing of 6% of the tubes in the affected steam generator, since the tube leak was considered to be greater than 1 gpm. Due to the nature of the failure, such an inspection was not considered to be warranted, and a temporary Waiver of Compliance was requested from the NRC to allow inspection of all tubes in the "lane wedge" area down to the 14th support plate in lieu of the more general 6% inspection. The Waiver of Compliance was granted by the NRC orally on 3/10/90 and confirmed in writing on 3/14/90. It will remain in effect until the associated Technical Specification Change Request No. 199 is issued as a license amendment.

* The Energy Industry Identification System (EIIS), System Identification (SI) and Component Function Identification (CFI) Codes are included in brackets, "[SI/CFI]", where applicable, as required by 10 CFR 50.73(b)(2)(ii)(F).