

10 CFR 50.73

5928-01-20103  
April 11, 2001

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

Dear Sir or Madam:

**SUBJECT: THREE MILE ISLAND NUCLEAR STATION, UNIT 1 (TMI-1)  
OPERATING LICENSE NO. DPR-50  
DOCKET NO. 50-289**

**LICENSEE EVENT REPORT (LER) NO. 2000-004-01, SUPPLEMENT  
"DISCOVERY OF A CONDITION OUTSIDE THE PLANT DESIGN BASIS FOR  
THE SMALL BREAK LOSS OF COOLANT ACCIDENT ANALYSIS OF  
RECORD FOR THE CORE FLOOD TANK (CFT) LINE BREAK CASE"**

This letter transmits supplemental LER No. 2000-004-01, regarding the discovery of a condition which is outside the plant design basis for the CFT Line Break analysis. For a complete description of the evaluated condition, refer to the text of the report provided on Forms 366 and 366A. This supplement summarizes the results of additional analyses completed by Framatome ANP, Inc. (see Report No 51-5009856-00, dated March 31, 2001) and provides TMI's final resolution of this matter.

This condition did not adversely affect the health and safety of the public. For additional information regarding this LER contact Mr. Gregory M. Gurican of the TMI-1 Regulatory Engineering Department at (717) 948-8753.

Sincerely,



George H. Gellrich  
Plant Manager

ATTACHMENT: LER 200-004-01, Supplement 1

GHG/gmg

cc: Mr. H. Miller, Administrator, Region I, NRC  
Mr. D. Orr, NRC Senior Resident Inspector  
Mr. T. Colburn, NRC Project Manager  
File No. 00106

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**LICENSEE EVENT REPORT (LER)**

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

Estimated burden per response to comply with this mandatory information collection request: 50 hrs. Reported lessons learned are incorporated into the licensing process and fed back to industry. Forward comments regarding burden estimate to the 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. If an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

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TITLE (4)  
Discovery of a Condition Outside the Plant Design Basis for the Small Break Loss of Coolant Accident Analysis of Record for the Core Flood Tank Line Break Case

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
09	11	2000	2000	004	01	04	11	2001	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9) N	POWER LEVEL (10) 100	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)		X 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 Gregory M. Gurican, TMI Regulatory Engineer	TELEPHONE NUMBER (Include Area Code) (717) 948-8753

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

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 September 11, 2000, a condition potentially outside the design basis of the plant was discovered by AmerGen Energy Co. L.L.C. (AmerGen). Previously accepted analysis assumptions in the small break portion of the loss of coolant accident (LOCA) evaluation model (EM) related to the Core Flood Tank (CFT) line break were found to be non-conservative. This condition was reported by (Framatome ANP Inc.) in the Preliminary Safety Concern Report No. PSC 2-00. Analysis of the CFT line break with offsite power available yields an acceptable (peak clad temperature) PCT only when (1) reduced analysis margin for operator action is assumed, or (2) additional injection flow is provided to the reactor. Current abnormal transient procedure ATP 1210-10 requires tripping of the reactor coolant pumps (RCPs) as an immediate manual action upon loss of sub-cooling margin (LSCM); therefore, the procedural guidance remains unaffected by the analysis. AmerGen's final resolution will require updating TMI-1's response to NUREG-0737, II.K.3.5. This event was reported to the NRC by one-hour notification pursuant to 10 CFR 50.72(b)(1)(ii)(B).

The root cause of this event, as determined by AmerGen, was the failure to consider that the CFT Line Break with offsite power available could be the most limiting event in the small break LOCA spectrum. Additionally, some analysis assumptions were not verified before application to the new EM. There were no adverse safety consequences from this event, and the event did not affect the health and safety of the public as the event is one of an error in analysis rather than an event related equipment failure, or an actual accident/operating transient.

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I. Plant Operating Conditions Before The Event:

TMI-1 was operating at 100 percent power at the time of the event.

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:

Preliminary Safety Concern (PSC) Report No. 2-00 initiated by Framatome ANP Inc. on July 28, 2000 identified that a potentially limiting break had not been considered in the small break loss of coolant accident (SBLOCA) analyses spectrum.

Following subsequent investigation, on September 11, 2000 AmerGen was formally notified by Framatome ANP Inc. of two separate non-conservatisms in the SBLOCA analyses that contributed to this event:

- The core flood tank (CFT) line break with offsite power available was more limiting than the CFT line break with loss of offsite power event, but this had not been identified in the analysis; and,
- The RCP flow degradation sub-model under two-phase fluid conditions is not conservative.

This event was reported by immediate notification to the NRC per 10CFR50.72(b)(1)(ii)(B).

Framatome ANP Inc. has completed detailed analyses of various LOCA events for TMI-1, including sensitivity studies for (1) the RC pump 2-phase flow sub-model, (2) the time credited for RC pump trip following LSCM, and (3) Core Flood tank inventory and pressure with additional HPI at 10 minutes into the event. The following constitute a summary of the key results :

- Analyzing a CFT line break at 2772 MWt with offsite power available, with RCPs tripped at two minutes after LSCM and using the more conservative two-phase pump degradation sub-model produced PCTs in excess of 2200 degrees F.
- Analyzing a CFT line break at 2568 MWt (the TMI-1 licensed power level) with offsite power available, with RCPs tripped at two minutes after LSCM, and using the more conservative two-phase pump degradation sub-model produced PCTs still in excess of 2200 degrees F.
- Analyzing a CFT line break at 2568 MWt with offsite power available, with tripping the RCPs at one-minute after indication of LSCM, and using the more conservative two-phase pump degradation sub-model, the predicted PCT did not exceed 750 degrees F.
- Analyzing a CFT line break at 2568 MWt with offsite power available and various combinations of CF tank pressure and level limitations, tripping the RCPs at two minutes after indication of LSCM and additional HPI at 10 minutes into the event, and using the more conservative two-phase pump degradation sub-model, the predicted PCTs ranged from 1424 to 1582 degrees F.

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In view of this information, TMI-1's SBLOCA analysis must credit an earlier RCP trip following LSCM. Framatome ANP Inc.'s detailed review of the problem also included an investigation into other LOCA scenarios that could be non-conservative due to the delayed RC Pump trips. The result was that the larger Cold-Leg Pump Discharge breaks were less conservative for the non-LOOP conditions, but still yielded PCTs well below those associated with the limiting SBLOCA for the worst-case LOOP scenario

IV. Assessment of Safety Consequences & Implications of the Event:

There were no direct adverse effects from this condition. Information on the potential reduction in analytical margin related to tripping of the RCPs following indication of LSCM was promptly briefed to control room personnel.

The effect of this event on nuclear safety and safe plant operations is minimal because:

- The emergency operating procedure (EOP) requirement is to trip the RCPs immediately on indication of LSCM. TMI-1 has had 15 years of operator training experience with a variety of LOCA scenarios which indicates that the RCPs have consistently been tripped within one-minute of recognition of the LSCM condition.
- The length of piping under consideration for the CFT line break is relatively small. For each of the 2 CFT lines, this portion of the piping extends from the reactor vessel to the first check valve, which is just outside the primary shield wall.
- A more realistic scenario than that of 10 CFR 50, Appendix K, would not involve the failure of high and low pressure injection, and thus would provide sufficient ECCS flow such that the core would remain covered.

The implications of the event (i.e., using the SBLOCA analysis of record for the CFT line break, with offsite power available, the RCPs tripped at two-minutes following LSCM, and application of the 10 CFR 50 Appendix K required single-failure assumption) are that the upper portion of the fuel would be uncovered resulting in excessive clad temperatures. The Reactor Coolant System would ultimately be vulnerable to fission product release, but the containment barrier would not be challenged. The guidance, training, and management expectation in this scenario is that, even with the ECCS failures, the operators would trip the RCPs immediately. Framatome ANP Inc. analysis of this case credit tripping the RCPs at one minute after LSCM and result in PCTs of less than 750 degrees F.

V. Previous Events & Extent of Condition:

- A. Several related events are similar in that these are cases where the plant was outside of its design basis, or may not have been bounded by the original analysis. However, these previous instances are not considered to reflect a programmatic failure of the current engineering analysis process. This conclusion was reached on the basis of the small number of similar events identified and the fact that most of these design analyses were performed many years ago. It is recognized that improvements made in the state of the art of accident modeling, in

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conjunction with a larger bank of industry experience, have improved the ability to identify new challenges to design bases.

- During development of the Davis-Besse LBLOCA RELAP5 input model by Framatome ANP Inc., an RCP modeling question led to the discovery that all previous EM analyses may not have used the appropriate RCP type in the LBLOCA analyses. In Framatome ANP Inc.'s Preliminary Report of Safety Concerns, PSC No. 1-99, addressed this event.
- Framatome ANP Inc. discovered that input data assumed that mixing-vane grids were used in the hot channel for the heatup portion of the LOCA analyses. None of the fuel types in the TMI-1 Cycle 12 core included mixing-vane grids. Preliminary evaluation by Framatome ANP Inc. indicated that the peak clad temperatures (PCT) would increase when input data assumes that standard grids are used in the LOCA analyses. The Framatome ANP Inc. re-analysis showed that the maximum PCT will be higher than previously predicted but was still below the 10 CFR 50.46 limit and thus there is no adverse affect on operability. This condition was not reportable under the requirements of 10 CFR 50.72 or 10 CFR 50.73, however 10 CFR 50.46 required a 30 day report be made to the NRC since the calculated change in PCT was significant, i.e., >50 degrees F.
- NRC Information Notices: IN 97-15: "Reporting of Errors and Changes in LBLOCA Evaluation Models of Fuel Vendors and Compliance with 10 CFR 50.46(a)(3)." Changes and errors in Siemens Power Corporation (SPC, formerly Exxon Nuclear) and General Electric (GE) LBLOCA analysis models led to a series of 30-day reports and 10 CFR 50.72 reports as required by 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors." This reinforced the importance of the Licensee's role in ECCS analysis development and acceptance.

B. With regard to the extent of condition for this event, Framatome ANP Inc has investigated the potential impacts on the entire SBLOCA break spectrum. It was determined that tripping the RCPs within two minutes following the LSCM is appropriate for break sizes except the CFT line break. The result was that the larger Cold-Leg Pump Discharge breaks were less conservative for the non-LOOP conditions, but still yielded PCTs well below those associated with the limiting SBLOCA for the worst-case LOOP scenario.

#### VI. Identification of Root Cause

The root cause of this event, as determined by AmerGen, was the failure to consider that the CFT Line Break with offsite power available could be the most limiting event in the SBLOCA spectrum. This event was not identified at an earlier opportunity because Framatome ANP Inc.'s single failure evaluation assumptions and delayed RCP trip sensitivity studies were not well documented for the SBLOCA spectrum.

#### DISCUSSION

As a member of the B&W Owners' Group (BWOG), TMI-1 uses the services of Framatome ANP Inc. for its accident analysis modeling work. Framatome ANP Inc. has an approved 10 CFR 50 Appendix B program to ensure the quality of its work, and AmerGen (through the BWOG)

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conducted QA audits of the program and specific work products.

In the early 1980's, while attempting to resolve the issues surrounding NUREG 0737 Action Item II.K.3.5, the CFT line break case with offsite power available was not identified as a limiting event. This led to a subsequent assumption that there was no benefit to refining the RCP degradation sub-model for 2-phase flow. These decisions were made by Framatome ANP Inc. as part of the analysis work.

VII. Corrective Actions:

Immediate & Short Term Actions:

"Night Orders" were written to reinforce the expectations and existing procedural guidance pertaining to immediate shutdown of the RCPs on indication of LSCM. **This action has been completed.**

Long Term Corrective Actions:

1. Framatome ANP Inc. has completed detailed analyses and issued a report for resolution of PSC 2-00. This report verified the preliminary results and also documented the results of additional analyses to verify that the current SBLOCA spectrum results are still valid and applicable to TMI-1. The licensee has reviewed this report and concurs with the portions of its content that apply to TMI-1. **This action has been completed.**
2. After evaluating TMI-1's ECCS margin, the Licensee has determined that there is no immediate need to improve ECCS capability as discussed in the original LER submittal. TMI's emergency procedures (ATP-1210-10) and operator training will continue to require immediate trip of the RC pumps if the 25F subcooling margin (SCM) is lost. AmerGen intends to revise the TMI-1 licensing basis to incorporate the 1-minute RCP trip on loss of SCM for SBLOCA analysis, and to address associated revisions to the previous licensing basis commitments to NUREG-0737, Item II.K.3.5 as addressed in the TMI-1 Updated FSAR. **This revision to the existing TMI-1 licensing basis will be evaluated in accordance with 10 CFR 50.59 by August 31, 2001.**

\*The Energy Industry Identification System (EIS), 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).

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### **ABBREVIATIONS AND ACRONYMS**

10 CFR	Title 10 of the Code of Federal Regulations
ATP	Abnormal Transient Procedure
B&W	Babcock and Wilcox
BWOG	B&W Owner's Group
CAP	Corrective Action Process (or Program)
CFT	Core Flood Tank
CRAFT2	An Framatome ANP Inc. Evaluation Model (computer code)
ECCS	Emergency Core Cooling Systems
EM	Evaluation Model
EOP	Emergency Operating Procedure
HPI	High Pressure Injection
IN	NRC Information Notice
LBLOCA	Large Break Loss of Coolant Accident
LER	Licensee Event Report
LPI	Low Pressure Injection
LOCA	Loss of Coolant Accident
LSCM	Loss of Sub-Cooling Margin
MWt	Megawatts Thermal (t)
NRC	Nuclear Regulatory Commission
PCT	Peak Clad Temperature(s)
PSC	Preliminary Safety Concern
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RELAP5	An Evaluation Model (Computer Code)
SBLOCA	Small Break LOCA
SG	Steam Generator
TMI-1	Three Mile Island Unit 1
UFSAR	Updated Final Safety Analysis Report