NRC FORM 366 (6-1998) U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

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

APPROVED BY OMB NO. 3150-0104 EXPIRES 06/30/2001

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.

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Three Mile Island, Unit 1	05000289	1 OF 5

TITLE (4)

LER 98-010 Potential Violation of Design Criteria During Single Auxiliary Transformer Operation

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	25	98	98	-- 010 --	00	10	09	98		05000
									FACILITY NAME	DOCKET NUMBER
										05000

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)			
POWER LEVEL (10)	100	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)	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)
William Heysek, TMI Licensing Engineer	(717) 948-8191

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).	N NO				

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

On August 25, 1998, while the plant was operating at 100% power, a review of new preliminary calculation results identified problematic issues with the original calculation supporting the voltage regulation study, performed in February 1990. It was identified that due to the use of non-conservative impedance values, the plant's Engineered Safeguards buses could separate from the grid during single auxiliary transformer operation with loss of coolant accident loading. To correct the condition, a procedure change was implemented to reduce balance of plant loading during single auxiliary transformer operation by restoring the separation voltage and bus current levels to within design basis limits. In addition, it was discovered that the bus duct sections immediately downstream of the auxiliary transformers could be subjected to currents in excess of their normal rating, but the short term overload condition would be within the capability of the bus duct.

On September 16, 1998 further review of the preliminary calculation results identified that normal plant operation with concurrent low grid voltage, heavy balance of plant loads and loss of one auxiliary transformer could also cause the plant's Engineered Safeguards buses to separate from the grid. No immediate corrective action was required because heavy balance of plant loading only occurs during the winter.

Longer term actions include finalizing the calculation results and implementing an action plan based on an evaluation of those results.

The condition was reported per 10 CFR 50.72(b)(1)(ii)(B) and 10 CFR 50.72 (c).

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Three Mile Island, Unit 1	05000289	98	-- 010 --	00	2 OF 5

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

I. PLANT OPERATING CONDITIONS BEFORE THE EVENT

The plant was operating at 100% power at the time the condition was determined to be reportable and was not changed as a result of that determination.

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

No systems, structures or components were out-of-service that contributed to the condition.

III. EVENT DESCRIPTION

The event is the discovery of an analytical error identified during the review of preliminary computer generated calculation results. The calculation was performed to support the updating of the degraded voltage analysis. The preliminary results revealed three issues which involve auxiliary transformer [EA/XFMR] operation which are outside the plant design basis.

Grid Separation Voltage

The existing alternating current voltage regulation study, Technical Document Report (TDR 995), is non-conservative due to use of an incorrectly assumed impedance value for the 5000V bus duct [EB/DUCT]. As a consequence of that error, the grid separation voltage during single transformer operation with worst case balance of plant (BOP) and loss of coolant accident (LOCA) loading, may occur above the minimum expected voltage.

The impedance value used previously has minimal effect on the normal lineup with two auxiliary transformers. With regard to grid separation voltage, System Design Description (SDD) T1-000, established the minimum expected TMI-1 230 kV substation voltage as 232 kV for purposes of analyzing single transformer operation in paragraph 3.10.2 of the Section 700 Voltage Criteria discussion. This value was supported by TDR 995, which demonstrated that grid separation would not occur in the unlikely event of minimum expected voltage concurrent with a LOCA during single transformer operation. SDD T1-000, Section 700 Voltage Criteria, paragraph 3.9.2 requires periodic analysis of TMI-1 230 kV substation voltage records to assure that the minimum expected voltage does not occur for more than 1% of the readings over a 24 month period.

The difference between the TDR 995 results and the current updated calculation result is due primarily to the use of more accurate impedance data for the non-isolated phase bus duct connecting the auxiliary transformers and the 4160V buses [EB/DUCT]. TDR 995 utilized assumed data, whereas the preliminary calculation uses design verified data from Calculation C-1101-700-E510-008, which was not available at the time TDR 995 was issued. Field voltage readings from panel meters performed on 8/21/98 support the accuracy of the data in Calculation C-1101-700-E510-008.

5000V Bus Duct Rating

While investigating the voltage issue, a second issue which deals with the rating of the 5000V Bus Duct became apparent. A review of DAPPER computer runs for both TDR 995 and preliminary Calculation C-1101-700-E510-010 indicates that the 5000V bus duct sections immediately downstream of Auxiliary transformers could be subjected to currents in excess of their nominal rating of 4000 amperes, during single transformer operation with worst case BOP and LOCA loading. The condition was not recognized

previously since this specific information was an interim calculated value and not one of the results of the calculation.

The preliminary calculation shows that bus current could reach steady state values as high as 4255 amperes immediately following Block Load Sequencing. BOP bus loading assumptions for preliminary Calculation C-1101-700-E510-010 are the same as were used in TDR 995, and ES bus loading was based on draft Calculation C-1101-741-E510-005. This current will decrease below the bus rating following reactor trip due to the decreasing BOP load required for supplying feedwater to the steam generators. If the event occurs, this short term overload condition is within the capability of the bus duct.

Winter Plant Loads

Further investigation of the preliminary calculation results identified the possibility of the early separation of the 4kV engineered safeguards (ES) buses from their offsite power source in the event of a sudden loss of an auxiliary transformer with heavy BOP loads during winter operation concurrent with minimum expected grid voltage. The second ES bus may be separated from the grid due to action of the degraded grid voltage relays if a grid voltage drops to 232kV at the switchyard and BOP loads reach 24.7 MVA.

The scenario for this event assumes that Bus 1C fast transfers to Auxiliary Transformer 1A and that the resulting transient may cause the voltage on Bus 1E to drop below the degraded voltage relay dropout setting. Voltage may not return to a value sufficient to reset the degraded grid voltage relays and may cause the 1E ES bus [EB/DUCT] to separate from the grid.

IV. AUTOMATIC OR MANUAL INITIATED SAFETY SYSTEM RESPONSES

Since there was no physical plant event involved with the item being reported herein, there were no safety system response, automatic or manual.

V. FAILURES AND ERRORS

A failure to adequately define job performance standards was determined to be the root cause of this problem. Standard assumptions included in the original analysis were not questioned during later revisions of TDR 995 since this was not an expectation of the analysis process at the time. As a result, each revision of the Degraded Grid Analysis incorporated this impedance assumption without a check being made to determine if it was still the most accurate information available. Although the impedance assumption was reasonable at the time the calculation was developed, its continued use was not warranted based upon improvements made in electrical modeling. The procedure governing the up-dating of studies, Engineering Procedure (EP) -001, lacked the degree of rigor needed to question assumptions used in the studies. Thus, during the updating of the Degraded Voltage Study, the validity of some of the assumptions was not addressed.

The calculation process has undergone significant programmatic improvements to revise and strengthen the program as a result of issues identified through NRC and TMI internal assessments. With regard to the extent of the condition, process changes and revisions to EP-006, the calculation procedure, have already addressed the issues of verification of calculation inputs and maintaining the calculation of record.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Three Mile Island, Unit 1	05000289	98	-- 010 --	00	4 OF 5

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

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

There were no safety consequences associated with any of the three issues identified during the review of the preliminary results of Calculation C-1101-700-E510-010. The plant conditions requisite for each of the issues (operation with only one auxiliary transformer with LOCA loading conditions, over current on the 4kV buses, or the loss of both auxiliary transformers with ES buses separating from the grid) never occurred. The implication of the event is that separation from the offsite power source could have occurred and could have put the plant in a condition in which it would be necessary to rely on the backup power supply to respond to the LOCA event. The safety related buses would be operable on the onsite source and be able to bring the plant to a safe shutdown condition.

VII. PREVIOUS EVENTS OF A SIMILAR NATURE

Plant records were reviewed for previous similar events. Errors relating to the development and revision of calculations were found to be a recurring event. Prior programmatic concerns with the GPUN calculation process were identified through both NRC inspection and GPU Nuclear assessment activities. The NRC identified issues as a result of its Architect Engineer Team Inspection number 96-74 and Inspection number 89-80. Quality Assurance activities resulted in the issuance of Quality Deficiency Report (QDR) 972001 which identified 108 discrepancies with engineering procedural controls.

Two previous LERs were found to address self identified calculational errors:

- LER 97-002 was written as a result of the use of a non-conservative assumption in MOV thrust calculations.

- LER 96-002 was written as a result of a problem with a setpoint in a LOCA procedure resulting from errors in a 1994 calculation.

An Engineering Self-Assessment of the calculation process resulted in the initiation of CAP T1998-0705 on 08/21/98. It identified discrepancies in 14 calculations sampled. These self identified discrepancies are being dealt with through the corrective action process.

VIII. CORRECTIVE ACTIONS

The root cause of this event is a failure to define job performance standards within the calculation process pertaining to a reuse of assumptions. Corrective actions to address preventing recurrence of this and similar events in the future have already been established through improvements in the calculation process, revisions to the calculation procedure (EP-006), and engineering training on revisions to EP-006. Efforts to improve individual calculations, based on the strengthened process are continuing. The deficiencies identified with TDR 995 are a result of those efforts.

Corrective actions to address the specific error associated with this LER are as follows:

Immediate Corrective Actions:

1. A Temporary Change Notice was issued to procedure 1107-1 "Normal Electric System" to formalize instructions placed in Operations Night Orders which provide guidance with regard to BOP Bus loading for single auxiliary transformer operation (manually reduce to no more then five CWP's in service). This

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Three Mile Island, Unit 1	05000289	98	-- 010 --	00	5 OF 5

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

action also eliminates the bus duct overload condition.

Long Term Corrective Action:

1. Procedures 1105-10A "Plant Computer Alarm Attributes" and 1203-41 "Low System (Grid) Voltage" will be revised to reflect the correct low voltage setpoint and maximum BOP load values and associated corrective actions. These revisions will be completed by October 31, 1998.

2. Activities necessary to finalize and design verify Calculation C-1101-700-E510-010 (which replaces TDR 995) including validation of loading assumptions will be completed by December 31, 1998.

3. Any recommendations resulting from this calculation will be evaluated by the System Performance Team (SPT). An action plan based on the SPT's evaluation results will be issued on March 31, 1999.

*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).