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November 17, 1999

1920-99-20606

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

Gentlemen:

Subject: Three Mile Island Nuclear Station, Unit I (TMI-1)  
Operating License No. DPR-50  
Docket No. 50-289  
LER 99-012-00, "Main Steam Isolation Valve, MS-V-1B, Valve Operator Motor Failure due to the Manufacturing Process"

This letter transmits Licensee Event Report (LER) 99-012-00 regarding the failure of a Main Steam Isolation Valve (MSIV) valve operator motor. Operation without remote closing capability for MS-V-1B was determined to be outside of the Updated Final Safety Analysis Report (UFSAR) design basis and reportable in accordance with the notification requirements of 10 CFR 50.72(b)(1)(ii)(B).

This LER is being submitted pursuant to 10 CFR 50.73(a)(2)(ii)(B), using the required NRC forms (attached). NRC Form 366 contains an abstract that provides a brief description of the evaluated condition. For a complete understanding of the evaluated condition, refer to the text of the report provided on Form 366A.

This condition did not adversely affect the health and safety of the public. For additional information regarding this LER contact Mr. Major R. Knight of TMI Nuclear Safety & Licensing at (717) 948-8554.

Sincerely,

James W. Langenbach  
Vice President and Director, TMI

MRK  
Attachment

cc: Administrator, Region I  
TMI Senior Resident Inspector  
TMI-1 Senior Project Manager  
File No. 99163

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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)**  
**Main Steam Isolation Valve, MS-V-1B, Valve Operator Motor Failure due to the Manufacturing Process**

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	
10	19	99	99	-- 012	-- 00	11	17	99	FACILITY NAME	DOCKET NUMBER	
<b>OPERATING MODE (9)</b>			<b>THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)</b>								
N			20.2201(b)	20.2203(a)(2)(v)			50.73(a)(2)(I)		50.73(a)(2)(viii)		
<b>POWER LEVEL (10)</b>			20.2203(a)(1)	20.2203(a)(3)(I)			X 50.73(a)(2)(ii)		50.73(a)(2)(x)		
2.5			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)**

<b>NAME</b> Mr. Major R. Knight, TMI Sr. II Licensing Engineer	<b>TELEPHONE NUMBER (Include Area Code)</b> (717) 948-8554
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**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
B	SB	MO	Electric Apparatus Co.	Y					

**SUPPLEMENTAL REPORT EXPECTED (14)**

<b>YES</b> (If yes, complete EXPECTED SUBMISSION DATE).	<input checked="" type="checkbox"/> <b>NO</b>	<b>EXPECTED SUBMISSION DATE (15)</b>	MONTH	DAY	YEAR
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**ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)**

During a plant startup on October 19, 1999 Main Steam Isolation Valve (MSIV) MS-V-1B failed to open completely and the valve operator motor was found to be inoperable. With no Technical Specification (T.S.) operability requirements or allowable outage time (AOT) guidance specified, MS-V-1B was opened manually and plant startup was resumed. The following day on October 20, 1999, the Plant Review Group (PRG) concluded that operation without remote closure capability for MS-V-1B was reportable in accordance with 10 CFR 50.72(b)(1)(ii)(B), as a condition outside of the design basis. The motor was replaced on October 25, 1999.

The root cause of the motor failure was insulation breakdown in the stator windings due to a lack of end turn bracing during the manufacturing process. The root cause of the incorrect reportability determination was over-reliance on individual knowledge. Planned actions include a review to determine if other safety significant motor operated valves (MOV's) are affected, communication of the lessons learned from this event, and providing additional guidance. Public health and safety were unaffected. MSIV closure is not credited in the accident analyses, except for the stop-check function, which was unaffected throughout this event. Based on a Probabilistic Risk Assessment (PRA) evaluation, the safety significance of this event was low.

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**I. Plant Operating Conditions before Event:**

TMI-1 was starting up following the Cycle 13 Refueling (13R) Outage making preparations for turbine roll at approximately 2.5 % reactor power.

**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:**

On October 19, 1999, during a normal plant startup to begin the TMI-1 Operating Cycle 13, reactor power was approximately 2.5 percent and preparations were being made to roll the turbine. The Main Steam Isolation Valves (MSIVs), MS-V-1A, 1B, 1C, and 1D were opened to the 10% position during startup to heat the main steam lines. The operating crew was performing step 3.3.5 "Open or verify open MS-V1A, B, C, and D" in Operating Procedure 1106-1, "Turbine Generator." At approximately 11:00 a.m., MS-V-1B failed to respond to the open command from the remote pushbutton in the control room. It was recognized that the valve operator motor supply breaker had tripped, since the remote pushbutton indicating lights, which are powered from the Motor Operated Valve (MOV) breaker, went out. After one unsuccessful attempt to reset the breaker and open the valve, the Shift Supervisor (SS) requested electrical maintenance to help trouble shoot the problem. At approximately 12:50 p.m. motor windings were determined to be shorted to ground. Until the motor failed, MS-V1B had successfully met all of its surveillance test criteria.

At approximately 2:00 p.m., the Operations Director and the SS discussed the implications of the valve failure, operability, reportability, and how to proceed. Since MS-V-1B is designed to be operated manually by means of a socket connection that engages the valve stem through reduction gears, the SS directed the electrician to open MS-V-1B using this alternate means. Within approximately 30-40 minutes, the valve had been opened and plant start up resumed.

In accordance with the Corrective Action Process (CAP), CAP T1999-1082 was initiated at 4:23 p.m. to document the MOV failure and at 5:45 p.m. the Shift Supervisor documented in the CAP the basis for his conclusion that the event was not reportable.

Upon review of the CAP the following morning on October 20, 1999 the Management Review Team (MRT) questioned the Shift Supervisor's determination that the failure of MS-V-1B was not reportable. Questioning arose from consideration of the design basis remote operation and time to close features described in T.S. Section 4.8 and Updated Final Safety Analysis Report (UFSAR) Section 10.3.1.2. The Plant Review Group (PRG) met to review the reportability

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determination. The PRG concluded that this event was reportable as a condition outside the plant design basis and that plant operation was acceptable since contingency methods were in place to manually close the valve and the stop-check feature of the valve was unaffected. At 12:10 p.m. a one hour report was made to the NRC via the Emergency Notification System (ENS) telephone line in accordance with 10 CFR 50.72 (b)(1)(ii)(B).

That afternoon on October 20, 1999, an additional CAP was initiated (CAP No. T1999-1086) to evaluate shift management actions taken in response to the failure. A report, entitled "Continued plant operation without MS-V-1B remote closing capability," was prepared to support the Maintenance Non-Conformance Report (MNCR) conditional release justification, and a root cause team was assembled to evaluate both the component failure and the human performance issues associated with this event.

GPU Nuclear removed the failed motor and had it rebuilt. The re-built motor was re-installed on October 25, 1999. Post-maintenance testing of MS-V-1B included bench testing of the motor and partial stroke testing to 10% of the full open position.

**IV. Component Failure Data:**

The failed component was the [SB/MO]\* motor associated with the motor operator for MS-V-1B. The motor is a 3600 RPM, 350 ft-lb, random wound, alternating current, electric motor manufactured by Electric Apparatus Co. In random-wound motors the stator winding end-turns, jumpers, connections, and motor leads are formed and tied/braced by using various types of insulating tie cord or tapes. This bracing helps the end-turns retain a compact and stronger shape. The tie cords, blocking, and tapes further increase winding structural strength and rigidity when the winding varnish is applied. During disassembly of the failed motor at the off-site laboratory, it was discovered that the end turns were not tied or braced. At the time that MS-V1B was manufactured, end turn bracing was not always applied.

The failed motor had been in service since the plant was constructed (prior to 1974) with no previous history of winding problems.

**V. MSIV Component Description:**

The Main Steam Isolation Stop Check Valves (MSIV), MS-V-1A, B, C, and D, are located in the Intermediate Building. Each MSIV isolates one of the four 24" main steam lines that supply steam from the two Once Through Steam Generators (OTSGs) to the main turbine, main feedwater pumps, Emergency Feedwater pump turbine, turbine bypass valves, and the atmospheric dump valves. The MSIVs [SB/ISV]\* are used to isolate the main turbine, main feedwater pump turbines, turbine gland seal steam and some steam traps. These components are also isolated by other means during accidents.

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The MSIVs:

- 1) are stop-check valves, capable of preventing backflow through the valve automatically. This ensures that loss of pressure in one OTSG will not cause a loss of pressure in the other OTSG.
- 2) are isolation valves capable of being remotely operated from the control room or operated locally. There are also provisions for manual operation. They are closed after certain accidents to prevent containment leakage and minimize long-term releases. There is no time requirement for closure associated with these events.
- 3) are powered from a Class 1E source (1C ES Valves).
- 4) are Type III containment isolation valves as defined in Section 5.3 of the FSAR.
- 5) do not receive any automatic signals to open or close and they have no interlocks.
- 6) have local open/close/stop capability for low steam flow conditions used during plant startup and shutdown.
- 7) they have a "test" position that enables the valve to travel approximately 10% for periodic movement verification.
- 8) are within the scope of the GL 89-10 Motor Operated Valve program to ensure that they can close to support the remote closure function.
- 9) are required by Technical Specification section 4.8 to be tested periodically to verify that the valves are capable of closing in less than 2 minutes. This testing was established to ensure that potential degradation of the valve is discovered and repaired. The surveillance acceptance criteria was based on standard travel speeds for large motor operated valves. No T.S. LCO or AOT are provided; there is only a T.S. surveillance specification.
- 10) are not credited in the accident analysis for any of the FSAR Chapter 14 accidents.

**VI. Identification of the Root Cause:**

Failure of the MS-V-1B motor was determined by an off-site laboratory to be the direct result of a short in the stator coil of the valve operator motor. Laboratory analysis concluded that the Root Cause of the winding failure was a lack of end turn bracing during the manufacturing process, "Material or fabrication deficiency." On a two-pole 3600 RPM motor of this design, the end turns are especially long and the starting duration has an extended time. Since the existing motor coils were not tied or braced, this probably allowed significant relative motion. Over time, this relative motion caused the insulation to break down and the coil to fail.

The Root Cause of the initial incorrect conclusion by the Shift Supervisor that operation without a valve operator motor for MS-V-1B was not reportable was an over-reliance on individual knowledge that resulted in a failure to review the design basis references or utilize available technical assistance; "Overconfidence / highly successful past experience." This failure resulted in the SS deciding upon a course of action (opening the valve manually and classifying the condition as not reportable) without consulting Engineering or the PRG.

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**VII. Assessment of the Safety Consequences and Implications of the Event:**

The existence of this deficiency in other valve motors has the potential to decrease their useful life due to insulation wear from the increased relative motion of the coils. Based on the absence of other similar motor failure events, the problem does not appear to be widespread at this time. However, as a corrective action, an "extent of condition" review is planned to identify any other motors in the MOV program that may experience a similar failure. Based on the limited number of previous similar events, the problem of shift supervision making incorrect decisions does not appear to be a recurring deficiency.

The Probabilistic Risk Assessment (PRA) was evaluated to determine the safety significance of not having remote close capability for MS-V-1B. The Core Damage Frequency (CDF) for steam generator tube rupture (SGTR) is currently  $8.94e-07$  per year from the TMI-1 (Individual Plant Evaluation) IPE submittal. The total CDF in the IPE for internal events is  $4.19e-05$  per year. MS-V-1B is modeled in the PRA as a valve used for isolation of the steam generator, top event IG, after a SGTR initiating event. A PRA model run was performed with top event IG failed to simulate the impact of a failure of MS-V-1B to close. The CDF result from that run is  $5.233e-06$  per year for SGTR, and results in a total calculated CDF of  $4.62e-05$  per year. This calculated increase is approximately 10% of the yearly CDF.

Regulatory Guide 1.174, "An Approach For Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," dated July 1998, Section 2.2.4, "Acceptance Guidelines," Figure 3 was reviewed to determine the significance of a 10% increase in CDF. A 10% increase places the plant in "Region II" which is an allowed area, provided the CDF is tracked.

A large early release frequency (LERF) calculation was not performed because (1) current ATPs adequately isolate the OTSGs during a SGTR even if MS-V-1B remains open, (2) compensatory actions are in place to manually shut MS-V-1B, and (3) the valve was expected to be restored to full capability in a short time.

Based on the above evaluation, the safety significance of plant operation without remote closure capability for MS-V-1B is low.

**VIII. Previous Events of a Similar Nature:**

A review of the machinery history over the last 10 years found no motor problems associated with MS-V-1A, B, C, or D. Valve operator (Limitorque) history was also checked and there were no similar motor problems found on any valves.

A review of past reportability determinations found a similar error where the SS misclassified an event for internal reporting purposes by reliance on his memory of a procedure, Administrative

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Procedure (AP) 1044, "Event Review and Reporting Requirements." However, that event did not involve NRC reportability.

**IX. Corrective Actions:**

**A. Corrective Actions Taken:**

1. The motor operator for MS-V-1B was rebuilt with a superior end turn bracing design, upgraded insulation system (Class F) and a better varnish finish. The motor was reinstalled, tested and declared operable on October 25, 1999 at 8:30 p.m.
2. The Director of Operations placed instructions in the night orders on October 27, 1999 requesting that, when making operability and reportability determinations: a) resources such as the T.S., the UFSAR, and personnel in other departments be consulted rather than relying solely on memory, and b) the rationale behind the decision making process be documented.
3. A temporary change was made to Operating Procedure 1106-14, "The Main Steam System," to incorporate guidance on manual closure of MS-V-1B as might be required prior to completion of repairs to the valve operator motor.

**B. Corrective Actions Planned:**

1. By November 1999, the MOV program will be reviewed to identify other motors in safety significant applications with the potential for similar fabrication deficiencies.
2. By January 2000, management will communicate the lessons learned from this event to the Licensed Operators and Shift Engineers.
3. By March 2000, Operating Procedure 1106-14, "The Main Steam System," will be revised to provide guidance for manual operation of the MSIVs.
4. By May 2000 AP 1029, "Conduct of Operations," will be evaluated to determine the need for additional guidance in part 4.24, "Guidance for Hand Cranking Motor Operated Valves (MOV)" regarding manual operation of MOVs; e.g., MS-V-1A, 1B, 1C, and 1D.
5. By June 2000, an evaluation will address the need for additional guidance on the handling of operability and reportability issues related to the Type III Containment Isolation Valves.
6. By August 2000, AP 1044, "Event Review and Reporting Requirements," will be revised to include the following additional guidance on performing reportability determinations:

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- a. Management expectations for the Shift Supervisor to utilize all available resources such as T.S. and UFSAR references, consulting with the engineering personnel and/or the PRG, utilizing the STA, etc.
  - b. A logic chart flow path for use as guidance to the Shift Supervisor in making a reportability determination.
7. Prior to startup following the next refueling outage, the Cycle 14 Refueling (14R) Outage, which is scheduled to begin in September 2001, the 3 remaining MSIV valve operator motors will be inspected to identify any problem that could cause a motor failure similar to the failure of MS-V-1B. Based on the inspection results the need for motor replacement will be evaluated.

\* 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).