

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: 50.0 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.

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| FACILITY NAME (1) THREE MILE ISLAND, UNIT 1 | DOCKET NUMBER (2) 50-289 | PAGE (3) 1 OF 5 |
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TITLE (4)
REACTOR BUILDING FAN MOTORS' UNQUALIFIED CABLE TERMINATION DUE TO INCORRECT ENGINEERING GUIDANCE

| 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 |
| 04 | 24 | 97 | 97 | -- 006 | -- 00 | 05 | 23 | 97 | FACILITY NAME | DOCKET NUMBER |

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|--------------------|---------------------------|---|-------------------|------------------|---|--|--|--|--|--|
| OPERATING MODE (9) | POWER LEVEL (10) 100 % | THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 5: (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) | 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) | X 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)

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| NAME W. G. HEYSEK, TMI LICENSING ENGINEER | TELEPHONE NUMBER (Include Area Code) 717-948-8191 |
|--|--|

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

| CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO NPRDS | CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO NPRDS |
|-------|--------|-----------|--------------|---------------------|-------|--------|-----------|--------------|---------------------|
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| 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 April 24, 1997 following a review of the motor cable termination repair on the Reactor Building Air Recirculation & Cooling Unit AH-E-1A, GPU Nuclear concluded that the power lead connections on the redundant components, AH-E-1B and AH-E-1C, did not satisfy environmental qualification requirements for exposure to a post-LOCA harsh environment. As a result of the inadequate environmental qualification configuration, the AH-E-1B and AH-E-1C fans were considered inoperable.

The root cause of the event was identified as personnel error. During a cable modification in 1986, engineering provided improper guidance and documentation for the heat shrink installation at the motors' terminations. As a result, the connection did not satisfy environmental qualification criteria and was not sealed against impact from a harsh environment.

The event was reported to the NRC via the ENS and actions were initiated to provide an environmentally qualifiable covering over the exposed metal surfaces of the connection.

The event is being reported per 10 CFR 50.73(a)(2)(v).

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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 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.

The Reactor Building Air Recirculation & Cooling Units (AH-E-1A, AH-E-1B & AH-E-1C) [BK/FAN]*, backed up by the Reactor Building Spray system [BE], are used during emergency cooling periods. The systems are designed so that the heat removal capability required during the post-accident period can be attained by operating the spray system and cooling units in the emergency mode with the following combinations (TMI-1 Tech Spec 3.3 Bases):

| <u>Spray Systems</u> | <u>Emergency Cooling Units</u> |
|----------------------|--------------------------------|
| Two | None |
| One | One |
| None | Three |

As a condition for reactor criticality, TMI-1 Technical Specifications require that two Reactor Building Spray pumps and their associated spray nozzle headers, and two Reactor Building Air Recirculation Cooling fans and associated cooling units (one in each train) be operable. Technical Specifications allow one of the two required Reactor Building Cooling fans to be out-of-service for up to seven days. Evaluation of the system compensatory requirements determined that because of the unqualified motor connector configurations, all three fan/cooler units were inoperable for eleven years. This is a violation of Technical Specification 3.3 requirements.

From the time of the cable replacement modification to the cooling units fan motors on April 22, 1986, until the time that the cable splice connections were repaired on AH-E-1A on March 23, 1997 and the repairs were completed on AH-E-1B and AH-E-1C on April 25, 1997, the fan motors' terminations did not conform with established requirements and would not have been considered operable.

III. EVENT DESCRIPTION

During the repairs to Reactor Building Air Recirculation fan (AH-E-1A) motor fault on March 23, 1997 Engineering supported the repair of the failed motor lead connection by providing guidance to assure that an environmentally qualified configuration would exist following the work. Engineering specified the application of heat shrink insulation in a manner such that it would cover the entire connection. This recommendation was based upon generic guidance provided by the manufacturer, Raychem, and was contained in an engineering evaluation.

[The power cable connections to the motor are made through specially modified welding lead connectors. The connectors are threaded to six ceramic insulation terminals (spark plugs) that are mounted on a plate on the outside of the motor housing. The design provides a leak-tight connection that protects the motor during accident conditions in the reactor building. The location of the failure on the AH-E-1A motor was at the point where the power cable is fixed to the connector.]

Engineering identified that the other five connections on the AH-E-1A fan motor had exposed metal at the mechanical connection between the connector and spark plug. This led to questioning the previous heat shrink installation on AH-E-1A. Although the grouped connections were covered by conduit, they were not sealed. This arrangement would allow the reactor building atmosphere and containment environment to penetrate and potentially affect the termination.

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The documentation associated with the 1986 cable jumper installation has been reviewed. An approved engineering design change notice was issued on April 21, 1986 and implemented on April 22, 1986 to replace the jumpers from the motor termination to the terminal box for AH-E-1A, B & C fan motors. This action was required due to lack of qualification data for cable used as the installed jumpers. An interoffice memo from corporate engineering to site engineering, dated the same day as the engineering design change, provided two alternative methods of connecting the jumper to the motor terminal. The sketches included in the interoffice memo indicated the use of heat shrink tubing but did not provide detailed installation requirements for the heat shrink tubing however, the sketch shows a slight overlap on the ceramic.

The April 22, 1986 job specific maintenance procedure, prepared by a site engineer, provided direction to install the heat shrink tubing such that it "...must not go any further than the stud on the spark plug. Sleeving must not cover white porcelain material." When the jumpers were installed, a portion of the stud and locknut was left uninsulated. The maintenance procedure for installing the jumpers provided an exception to the overlap requirement for installing heat shrink tubing at the connection to the motor terminal. The maintenance procedure did not reference any engineering document that authorized the deviation from the generic procedure for installing heat shrink tubing.

Materials used in the 1986 cable replacement were reported by Field Change Notice. The job specific work request was referenced in the field change notice but was not attached. The exposed conductor configuration was not known or approved by the Environmental Qualification (EQ) group.

The concern is exposure of the metal conductors to a Design Basis Accident environment in the Reactor Building. Since review of EQ files and contacts with vendors and other utilities were unsuccessful in providing information to support a conclusion that the 1986 heat shrink configuration was environmentally qualified, GPU Nuclear concluded that the AH-E-1B & C fan motors were not operable in a post-accident environment. At 1515 on April 24, 1997, AH-E-1B & C were declared inoperable and a seven day time clock was initiated. The NRC was notified at 1646 under 10 CFR 50.72(b)(2)(iii)(D). AH-E-1A remained operable due to the March 1997 repair.

Subsequent to the inoperability declaration, on April 25, 1997, repairs were made to AH-E-1B & C. Tape was applied over the exposed metal of the existing connections consistent with the application described by test documentation supporting another utility's environmentally qualified splice. The tape application was reviewed by the EQ Engineer and determined to be acceptable for the 4.5 month period until the 12R outage. The motors were returned to service and Technical Specification time clock was suspended on April 25 at 1655.

The time between the discovery of the deficient condition and the declaration of inoperability is longer than appropriate (March 24 to April 24). Contributing factors to the delay were: 1) belief by site engineering that the configuration had been verified by walkdown following the 1986 repairs, 2) the lack of explicit communication from the site engineer to the EQ engineer and 3) based on the belief that appropriate direction was provided, supporting documentation was being pursued.

IV. COMPONENT FAILURE DATA

There was no component failure associated with the event being reported.

V. AUTOMATIC OR MANUAL INITIATED SAFETY SYSTEM RESPONSES

There were no safety system responses, automatic or manual associated with this event.

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VI. IDENTIFICATION OF ROOT CAUSE

The root cause of the 1986 installation of non-environmentally qualified cable terminations at the Reactor Building cooler unit fan motors is personnel error: inadequate engineering direction and documentation. The maintenance procedure, prepared by a site engineer, led to compromising the motor's operability during postulated accident conditions. An engineering document should have been prepared by engineering and reviewed by the EQ group to provide specific instruction on the method for insulating this connection.

V. AUTOMATIC OR MANUAL INITIATED SAFETY SYSTEM RESPONSES

There were no safety system responses; automatic or manual, associated with this event.

VII. ASSESSMENT: THE SAFETY CONSEQUENCES AND IMPLICATIONS OF THE EVENT

A scoping analysis of the complete loss of fan coolers was performed in 1986, as part of LER No. 86-009. The analysis showed that peak pressure is unaffected by the fan coolers (the containment passive heat sinks are the principal heat sinks in the short term). Even though one train of Reactor Building Spray (BS) and one train of Decay Heat Removal (DH) may be assumed out-of-service, the remaining train of BS and DH were determined sufficient to provide adequate cooling during the initial phase. Accordingly, the loss of all three RB Fan Cooler Units would not have an adverse affect on the peak pressure/temperature following a Design Basis Accident (DBA), but it would adversely affect long term post accident cooling. Environmentally qualified equipment would be subjected to conditions beyond what was previously evaluated and may not remain operable.

Therefore, until environmental testing of the cable terminations, which existed at the AH-E-1A/B/C motors from 1986 to 1997, proves the fans' motors were operable during the time period, all three Reactor Building Cooler Units are considered to have been inoperable during that period. This violates TMI-1 Technical Specification 3.3, and is in violation of the design basis of the Reactor Building Emergency Cooling system as described in the Technical Specifications and the FSAR.

VIII. PREVIOUS EVENTS OF A SIMILAR NATURE

Licensee Event Report No. 86-009 "Environmental Qualification of Reactor Bldg. Emergency Cooling Fans Cable", documented the replacement of non-EQ cable at the AH-E1A/B/C motors in 1986. It was during this cable replacement modification that the non-EQ cable connections were made which are the subject of this LER.

IX. CORRECTIVE ACTIONS

Short term corrective actions taken to restore the fans to an operable status and prevent recurrence of a similar event involved the following:

1. The potential for this type installation on other motors was evaluated, and it was determined that at TMI-1, the spark plug configuration is unique to the Reactor Building fan motors: AH-E-1A, B and C.
2. A qualifiable repair of the AH-E-1A fan motor termination was installed on March 23, 1997. The repair included the installation of Raychem heat shrink tubing over the bare conductors and an overlap of the ceramic material on the spark plug. The appropriate EQ file is being revised to incorporate the current configuration.

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3. A qualifiable repair was installed on AH-E-1B and AH-E-1C on April 25, 1997. The repair involved the use of insulating tape over the bare conductor at the motor spark plug termination. It provides a configuration that restores equipment operability. This repair was approved by EQ Engineering. There are 4.5 months prior to the upcoming 12R refueling outage, which limits the exposure of this temporary configuration.

Long term corrective actions include:

1. Engineering and Administrative Procedures will be reviewed to verify that configuration and material changes for environmentally qualified (EQ) equipment are appropriately reviewed and documented. This action will be completed by July 31, 1997.
2. The EQ file for the repair to the AH-E-1A fan motor termination shall be revised to incorporate the current configuration. This will be completed by July 31, 1997.
3. Procedures will be reviewed to assure timely reporting, documentation and resolution of EQ issues. Training will be provided to Engineering groups on the procedural requirements and GPU Nuclear's expectations, regarding timeliness of operability determinations. These actions will be completed by August 30, 1997.
4. The tape applied to the AH-E-1B & C fan motor connections will be replaced with Raychem heat shrink tubing prior to the TMI-1's return to power operation following the 12R outage.
5. Review planned 12R outage work on EQ components and perform Engineering walk down of selected components to assure that the configuration is consistent with Environmental Qualification requirements.
6. Review the list of EQ components and identify candidate components for further Engineering review to determine whether Engineering direction for installation may have been miscommunicated. Those components that are identified as candidates where the installation instructions may have been miscommunicated will be inspected by the end of the 12R outage.

NOTE: Testing of the fan motor termination configuration is planned. Testing will include the configuration which existed at AH-E-1A, B & C from 1986 to 1997, and connections insulated with heat shrink tubing. The test will simulate accident conditions at an independent test facility during June 1997. This data may show that the fans were operable during the time period.

* 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).