LICENSEE EVENT REPORT (LER)

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TITLE (4) EECW Make-Up Tank Inoperability Due to Design Issue Discovered During a Self-Assessment

EVENT DATE (5) MON	DAY	YR	LER NUMBER (6) YR	SEQUENTIAL NUMBER	REVISION NUMBER	REPORT DATE (7) MON	DAY	YR	OTHER FACILITIES INVOLVED (8) FACILITY NAMES	DOCKET NUMBER (S)
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OPERATING MODE (9)	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR: (11)
1	X 10 CFR 50.73(a)(2)(i)(A), 50.73(a)(2)(i)(B) & 50.73(a)(2)(ii)(A)
POWER LEVEL (10) 0 8 1	OTHER - (Specify in Abstract below and in text, NRC Form 366A)

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER AREA CODE	
Norman K. Peterson, Director, Nuclear Licensing	734	586-4258

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

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
[ ] YES (If yes, complete EXPECTED SUBMISSION DATE)	[X] NO				

ABSTRACT (16)

On March 26, 1996, during the performance of a service water system self-assessment, the Detroit Edison operations team member questioned the need for a pressurized nitrogen cover on the Emergency Equipment Cooling Water (EECW) system make-up tanks. During plant walkdowns to investigate this issue, small nitrogen leaks on the make-up tanks were identified. Due to postulated high dose rates in the vicinity of the EECW make-up tank following a design basis event, it is assumed that personnel would be unable to access the EECW system to provide long-term make-up water or nitrogen to the make-up tank.

On March 27, 1996, at 0135 hours, both divisions of the EECW system were declared inoperable and at 0212 hours, a Technical Specification required shutdown was commenced. An Unusual Event was declared in accordance with Fermi 2 Emergency Procedures. On March 28, 1996, at 1350 hours, the Unusual Event was terminated when the plant reached Cold Shutdown conditions.

The cause of this condition is attributed to the design basis for the EECW system not being completely defined.

Corrective actions include: A design modification was implemented to provide safety-related make-up sources for both make-up water and nitrogen to the EECW make-up tank; EECW System design basis documents will be revised to reflect the full post-accident design basis of the system for long term operation; and lessons learned from this event will be disseminated to Plant Support Engineering personnel.

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TEXT (17)

Initial Plant Condition:

Operational Condition:	1 (Power Operation)
Reactor Power:	81 Percent
Reactor Pressure:	1004 psig
Reactor Temperature:	535 degrees Fahrenheit

Description of the Event:

A. Background

Emergency Equipment Cooling Water (EECW) system [CC] operation in tandem with operation of the Emergency Equipment Service Water (EESW) system [BI] is an extension of the cooling provided by the Residual Heat Removal (RHR) system reservoir [BS][RVR] that serves as the Fermi 2 ultimate heat sink [BS]. EECW and EESW are designed to support the cooling requirements of systems and components whose operation is essential to accomplishing and maintaining plant safe shutdown following a design basis accident.

The EECW system divisional piping is interconnected with the Reactor Building Closed Cooling Water (RBCCW) system [KG] for normal cooling water supply to the essential equipment heat loads. The EECW system provides cooling to essential components upon loss of offsite power, high drywell pressure, or RBCCW high differential pressure. The EECW system is designed to be a closed loop cooling system with one make-up tank [CC][TK] in each division that provides an oxygen free thermal expansion/contraction volume and system make-up water to account for system miscellaneous minor leakage. The EECW pumps [CC][P] are normally shutdown and in standby mode with the make-up tanks isolated from the EECW system.

The EECW make-up tanks are normally pressurized with nitrogen to approximately 30 psig to minimize the pressure surge when the EECW make-up tanks are automatically aligned to the system. In addition, the make-up tank pressure ensures that make-up tank water has the necessary static head (approximately 5 psig) required to lift the make-up tank water into the associated division return piping (i.e., suction to the EECW pumps). Make-up water to the EECW make-up tanks is supplied from the demineralized water system [KJ]. The make-up water is controlled by automatic, air-operated (fail closed), level control valves[CC][KJ][LCV]. The demineralized water system and the nitrogen supply system [LK] are not safety-related.

Make-up tank instrumentation includes pressure [CC][PS] and level switches [CC][LS], and local pressure and level indication. Each pair of switches provides the signals for automatic make-up of nitrogen or demineralized water, and for actuating high and low alarms of tank pressure or level alarms. The tank instruments and switches are safety-related components. The alarm annunicators [IB][ANN] are designed as balance-of-plant equipment.

TEXT (17)

The EECW system has been the subject of design reviews in the past: The High Pressure Core Coolant Injection (HPCI)[BJ] safety-system functional inspection (SSFI) in February 1988; Design Basis Document Preparation in December 1989; Generic Letter 89-13 review and response in April 1990; and a Service Water System Review (SWSR) in March 1992. These reviews questioned the need for maintaining nitrogen pressure in the make-up tank. These reviews also questioned the ability of the make-up tank to accommodate thermal expansion and contraction of the EECW system inventory and the availability of Net Positive Suction Head (NPSH) to the EECW pumps. The Detroit Edison resolution to these questions, by analysis and by test, focused on whether the EECW pumps would start and provide design basis water flows and pressures to the associated essential heat loads upon demand. The Detroit Edison responses to these questions concluded that the system would perform this task without experiencing vapor binding or EECW water flashing at the highest elevations of the EECW system, even without nitrogen pressure in the make-up tank. As a result of the analysis and testing, plant personnel believed that the nitrogen cover pressure in the make-up tanks was not necessary for operability of the EECW system. The ability to supply make-up water to the EECW system, to account for minor pressure boundary leakage, without operator intervention for long-term operation (30 days post-accident) was not addressed in these reviews.

B. Event Description

On March 26, 1996, during a service water system self-assessment, the Detroit Edison operations team member questioned an operations training item stating that a nitrogen cover pressure on the make-up tanks was not necessary for operation of the EECW system. The need to not have a nitrogen cover pressure in the tank did not appear to be consistent with other documents that had been referenced during the self-assessment and with the EECW field configuration. In addition, the non-qualified nitrogen and demineralized water piping and valves to the EECW make-up tank were not included in the Fermi 2 leakage testing program.

During plant walkdowns to investigate this issue, small nitrogen leaks on the make-up tanks were identified. With the minor nitrogen leaks present, the nitrogen cover pressure in the EECW make-up tanks could have degraded following a design basis event. The EECW system would have operated initially in an emergency but may not have been available for long-term operation. Over time, sufficient pressure to provide the static head needed to successfully make-up to the EECW system to compensate for minor pressure boundary leakage may not have been available. Due to design basis postulated high dose rates in the vicinity of the EECW make-up tank following a design basis event, Fermi 2 personnel may not be able to access the EECW system to provide water or nitrogen to the make-up tank from other available sources. Therefore, Detroit Edison was unable to assure that the EECW system could perform its safety related function until the reactor building became accessible 30 days after a design basis accident.

On March 27, 1996, at 0135 hours, both divisions of the EECW system were declared inoperable. Technical Specification (TS) 3.0.3 was entered. Other TS action statements were also applicable, including the TS 3.7.2.b, "Control Room Emergency Filtration System," action statement since both redundant subsystems are supported by the EECW system. At 02!2 hours, a TS shutdown was commenced, and an Unusual Event was declared in accordance with Emergency Procedure 101, "Classification of Emergencies." At 0727 hours, a manual reactor scram was initiated from approximately 14 percent power, in order to comply with the TS 3.7.2.b six hour requirement to be in hot shutdown.

On March 28, 1996, at 1350 hours, the Unusual Event was terminated when the plant reached Cold Shutdown conditions.

At the beginning of the forced outage, with both divisions of EECW administratively inoperable, the action statement for TS 3.5.2, "ECCS - Shutdown," could not be met while in Operating Conditions 4 and 5. The action statement requires that secondary containment integrity be established within eight hours when both divisions of ECCS are inoperable. The action could not be met since the non-interruptible air system (NIAS)[LD] used to establish secondary containment [NH] integrity requires EECW to be operable. Therefore, secondary containment integrity was considered as not available since EECW was administratively inoperable. At least one division of the EECW and NIAS systems were maintained functional during this period. There were no core alterations in progress during the time that secondary containment could not be established. Other systems dependent on EECW were also administratively inoperable during the event until EECW operability was restored, or the plant was in a condition that no longer required the system to be operable.

Subsequent evaluation of the EECW system concluded that the functions of the EECW make-up tanks include: 1) allowing for thermal expansion and contraction of EECW system inventory; 2) providing make-up water, during normal plant operation and post-accident conditions, for EECW system inventory lost through minor pressure boundary leakage; and 3) Preventing oxygen leakage into the EECW make-up system to limit corrosion at the water/air interface. The EECW system make-up tank system resides completely within the reactor building. The reactor building [NG] is postulated to be radiologically uninhabitable for up to 30 days following a design basis accident. The EECW system supports RHR system operability, and should be capable of unattended operation for 30 days following a design basis accident so that plant conditions can be assessed and remedial actions can be implemented as necessary.

Cause of the Event:

The cause of this condition is attributed to the design basis for the EECW system not being completely defined. The incomplete design basis led to an inadequate EECW system design. Pressure boundary leakage and leak rate testing were not adequately addressed by the design. Long term operation (30 days) of the EECW System without qualified sources of nitrogen and make-up water were also deficiencies of the original design. Based on the make-up tank configuration with respect to the

EECW pump suction and the necessity of siphon action for make-up, this incompletely defined design basis is considered an isolated case.

Analysis of the Event:

The water level in each divisional EECW make-up tank is maintained approximately half full during normal operation. Also during normal operation, each tank is isolated from the associated divisional EECW system by a motor operated valve (MOV) and is pressurized by a nitrogen source to approximately 30 psig. Upon initiation of EECW, the isolation valve opens to establish a flow path between the make-up tank and the EECW system after other MOVs close to isolate the EECW system from the RBCCW system. The ability to replenish the make-up tank water level (demineralized water system) and nitrogen supply are assumed to be lost as they are not safety-related systems. Without the ability to replenish the water level, potential leakage out of the EECW system through boundary valves, valve packing, or EECW pump seals would slowly deplete the system fluid inventory, the EECW make-up tank level will decrease, and the make-up tank pressure will decrease. The nitrogen volume in the tank will increase since the volume of water in the make-up tank is not being replenished. A leak in the nitrogen supply system or the make-up tank itself will also result in a decrease in the nitrogen pressure in the tank. The make-up tank elevation is below the point in the system where the make-up tank discharge piping connects to the pump suction piping. Positive pressure in the make-up tank is required to ensure the ability to make-up water to the system is present. If make-up capability is not available, losses in the EECW system fluid inventory would eventually cause high point voiding such that cooling flow to essential components cannot be assured. In addition, since parts of the system could operate at negative pressures, there is a likelihood of air infiltration. The lower system pressure, due to loss of fluid inventory, would allow entrained gases to come out of solution adding to the possibility of the system developing a vapor lock/void in the higher elevation components and/or piping to the make-up tank.

There was no significant water leakage from the EECW pressure boundary evident at the time of discovery. Fermi 2 has an aggressive leakage detection program, and a review of historical EECW leakage indicates that any significant leakage has been promptly detected and corrected. The ASME Code design allowable leakage rate for the EECW system boundary valves has been determined to be approximately 0.0026 gallons per minute (gpm).

The as-found condition of the make-up tanks on March 27, 1996, was as follows: Division I make-up tank had a nitrogen leakage rate of approximately 0.094 scfm; Division II make-up tank had a nitrogen leakage rate of approximately 0.157 scfm. At these leakage rates, the make-up tank pressure necessary to ensure make-up flow to the EECW return piping would be lost in approximately 10.5 hours for Division II (greater than 10.5 hours for Division I).

Because the EECW system would have been fully operable in accordance with existing design basis assumptions for at least the first 10.5 hours of a design basis event for Division II (greater than 10.5 hours for Division I), General Electric has determined that, based on expected peak clad temperatures for the present Fermi 2 design configuration and alternate sources to prevent post-event reactor core [AC] boiloff, no fuel failure is expected.

Engineering evaluations demonstrate that at a leakage rate of 0.0026 gpm, the EECW system would have operated for approximately 10 minutes after losing EECW make-up tank capability before the first load, the Standby Gas Treatment System (SGTS) room cooler [VF][BH][CLR](677.5 foot elevation) would have been impacted. Approximately 1.0 hour after losing the SGTS room cooler, the control room heating, air conditioning, and ventilation system [VI] would have been impacted (677.5 foot elevation). The next loads that would have been impacted are the battery charger room coolers [F][EJ][CLR](651.5 foot elevation) and the switchgear room area coolers [VF][EB][CLR] (643.5 foot elevation). After losing the first several room cooler loads, plant personnel would have had sufficient information to determine that the EECW system was the common link to these systems. Because critical reactor core inventory support components that rely on the EECW system direct cooling or room cooler support cooling (i.e., core spray pumps [BM][P] and RHR pump motors [BO][P][MO]) are at the 540 foot elevation, considerable time would have been available before these loads would have been impacted.

Expected radiological dose rates in the areas of the reactor building indicate that Fermi 2 personnel would have had access to the EECW system to perform necessary venting and filling activities to restore the EECW system following a loss of coolant accident (LOCA). The area dose rates are expected to be less than 0.1 rad/hour on the refueling floor, and less than 1 rad/hour near the emergency core cooling (ECCS) piping. These dose rates would not preclude entry to perform essential functions. However, substantial airborne iodine might have been present and it is likely that plant personnel would have needed full breathing protection. Detroit Edison believes that the amount of time to detect and correct the EECW make-up source resulting from this condition, even with the need for donning full breathing protection, was sufficient to ensure the safe-shutdown of the plant.

Therefore, based on the sequence of loss of the room cooler loads, and since it is not expected that a design basis event would have resulted in radiological dose rates in the reactor building that would have prevented plant personnel from taking remedial actions, plant personnel would have had sufficient time to detect, evaluate, and take corrective action to remedy the EECW make-up tank supply problem without jeopardizing the principal plant safety barriers. No actual event occurred in which the EECW system was unable to perform its function due to the identified condition.

Therefore, the health and safety of the public were not adversely impacted by the condition described in this LER.

Corrective Actions:

A. Immediate Corrective Actions

A design modification was implemented that provides safety-related make-up sources for both make-up water and nitrogen cover gas to the EECW make-up tank. The safety-related nitrogen cover ensures that, at the start of an accident, adequate pressure will be available in the make-up tank to overcome the static head pressure in the make-up tank to EECW pump suction piping, thereby ensuring the existing make-up tank inventory is available if required. The safety-related make-up water is tapped off of the EESW system, through two locked closed manual valves in the auxiliary building, with a discharge into the EECW make-up tank. This make-up water supply ensures that upon a loss of inventory in the EECW system, operators will be able to provide make-up water to the EECW make-up tank. In the long-term, the EESW supply will provide the necessary minimum static head pressure by filling the EECW make-up tanks solid with water after the safety-related nitrogen supply is depleted. The EESW make-up supply is routed through the auxiliary building area, which remains accessible under all postulated plant conditions, to the EECW system. The appropriate make-up tank boundary valves have been included in the Fermi 2 leakage testing procedures.

Other similar closed loop safety-related cooling systems were reviewed to determine if make-up capability would be available under design basis accident scenarios. There are no similar concerns on other safety-related systems.

B. Corrective Actions to Prevent Recurrence

1. EECW System design basis documents will be revised to reflect the full post-accident design basis of the system for long term operation, including the design modification.

2. Lessons learned from this event will be disseminated to Plant Support Engineering personnel.

Additional Information:

Previous LERs on Similar Problems

LER 86-017: In June, 1986, the EECW system capacity was determined to be inadequate to remove drywell cooler heat loads during a small break accident inside the drywell. The drywell portion of the EECW system would not have automatically isolated on a LOCA, and thereby could have resulted in higher EECW temperatures. The added heat load of the components in the drywell during the small break event could limit the cooling effectiveness of the system and possibly result in damage to equipment required during and after a LOCA. An engineering design change was implemented to isolate the drywell cooling equipment from the EECW during a postulated event. This condition was discovered while the plant was in a scheduled maintenance

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and modification outage during a review of the heat removal capability of the EECW system. The corrective action was to perform a thermodynamic and hydraulic evaluation of the EECW system. The scope of the thermodynamic and hydraulic evaluation did not address long-term cooling water makeup capabilities, and therefore, did not consider the EECW make-up tank inoperability addressed under this LER 96-005.