NRC FORM 366 (5-92) U.S. NUCLEAR REGULATORY COMMISSION

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EXPIRES 5/31/95

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), 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

# LICENSEE EVENT REPORT (LER)

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

| FACILITY NAME (1) | DOCKET NUMBER (2) | PAGE (3) |
|---|---|---|
| Limerick Generating Station, Unit 1 | 05000 352 | 1 OF 12 |

TITLE (4) Control Room Emergency Fresh Air System Inoperable Requiring Entry into Tech Spec 3.0.3 as a Result Of Flow Switch Coordination Deficiency

| 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 |
| | | | | | | | | | Limerick, Unit 2 | 05000 353 |
| 02 | 07 | 96 | 96 | -- 006 -- | 02 | 04 | 19 | 96 | FACILITY NAME | DOCKET NUMBER 05000 |

| OPERATING MODE (9) | 5 |
|---|---|
| POWER LEVEL (10) | 0 |

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

| | | | | | |
|---|---|---|---|---|---|
| 20.402(b) | | 20.405(c) | | 50.73(a)(2)(iv) | 73.71(b) |
| 20.405(a)(1)(i) | | 50.36(c)(1) | | 50.73(a)(2)(v) | 73.71(c) |
| 20.405(a)(1)(ii) | | 50.36(c)(2) | | 50.73(a)(2)(vii) | OTHER |
| 20.405(a)(1)(iii) | X | 50.73(a)(2)(i) | | 50.73(a)(2)(viii)(A) | (Specify in Abstract below and in Text, NRC Form 366A) |
| 20.405(a)(1)(iv) | X | 50.73(a)(2)(ii) | | 50.73(a)(2)(viii)(B) | |
| 20.405(a)(1)(v) | | 50.73(a)(2)(iii) | | 50.73(a)(2)(x) | |

LICENSEE CONTACT FOR THIS LER (12)

| NAME | TELEPHONE NUMBER (Include Area Code) |
|---|---|
| J. L. Kantner - Manager, Experience Assessment | (610) 718-3400 |

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 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)

During the performance of the 6th Unit 1 refueling outage in 02/96, both trains of the normal Main Control Room (MCR) ventilation (HVAC) system concurrently tripped off several times resulting in loss of the flow path needed to support the operability of the Control Room Emergency Fresh Air System (CREFAS). As a result, Units 1 and 2 entered a condition prohibited by Technical Specifications (TS) Section 3.7.2 for CREFAS. Also the MCR HVAC system was not within the design basis of the plant. The standby MCR HVAC subsystem was not fully capable of automatically starting in the event of a failure of the running subsystem due to a coordination problem in the starting of the supply and return fans. When both subsystems of the MCR HVAC system were out of service and not capable of automatically starting, the CREFAS was not capable of performing its safety function to mitigate an accident. The event dates for these events are February 7, 18, 23, and 28, 1996. The actual consequences of these events were minimal since an accident or toxic chemical release did not occur. Startup testing did not verify simultaneous fan starting and an incorrect written station position that did not adequately account for the interface between the MCR HVAC system and the CREFAS. Flow switches were adjusted and plant staff training is being performed.

Conditions Prior To The Event

Unit 1 was in Operational Condition (OPCON) 5 (Refuel) prior to the first event. Various refueling outage activities were accomplished during the outage including surveillance testing and minor maintenance on the power supplies and logic associated with the A and B trains of the normal and emergency Main Control Room (MCR) heating, ventilation, and air conditioning (HVAC) systems (EIIS: VI). Unit 1 started up from the refueling outage at 0221 hours on February 28, 1996.

Unit 2 was in OPCON 1 (Run) prior to and throughout the events described in this report.

Description of the Event

During the performance of the sixth Unit 1 refueling outage in February 1996, both trains of the normal MCR HVAC system concurrently tripped off several times resulting in loss of the flow path needed to support the operability of the Control Room Emergency Fresh Air System (CREFAS). As a result, Unit 1 and Unit 2 entered a condition prohibited by Technical Specifications (TS) Section 3.7.2 for CREFAS. This TS Section does not contain an action statement for the loss of both trains of CREFAS while in OPCONS 1 (RUN), 2 (Startup), or 3 (Hot Shutdown) and therefore the affected unit entered TS Section 3.0.3. TS Section 3.0.3 requires the initiation of a plant shutdown within one hour. Each time the operators were able to quickly restore one of the MCR HVAC trains, thereby restoring one train of CREFAS to an operable status and the unit exited TS Section 3.0.3. A plant shutdown was not initiated as a result of any of these events since one of the trains was restored within one hour following each event.

During the investigation into the events, station personnel determined that the MCR HVAC system was not within the design basis of the plant. The MCR HVAC subsystem that was aligned in the standby mode was not capable of automatically starting in the event of a failure of the running subsystem due to a coordination problem in the starting of the supply and return fans.

The Limerick Generating Station Updated Final Safety Analysis Report (UFSAR) states that the active components of the safety related MCR HVAC system are designed to meet the single failure criteria. The MCR HVAC system provides the flowpath and recirculation of air

through the MCR and provides a flow path for this air to be filtered by the CREFAS filters in the event of an accident involving a radioactive release. Without the automatic start capability of the standby MCR HVAC subsystem, the CREFAS would not be fully capable of mitigating the consequences of an accident with a failure of the other train of CREFAS or a support system or component. Although not discussed in the UFSAR, the MCR operators did have the capability to manually start a MCR HVAC train in such an event.

Additionally, it was determined that the automatic start feature of the MCR HVAC had never been fully tested resulting in a condition not covered by procedures. The preoperational testing did verify that a trip of a single MCR HVAC fan did result in an automatic start of the corresponding fan in the other train.

On February 27, 1996, at 1029 hours, the NRC was notified of this condition per the requirements of 10CFR50.72(b)(1)(B) and 10CFR50.72(b)(1)(C).

This report is being submitted in accordance with the requirements of 10CFR50.73(a)(2)(i)(B) and 10CFR50.73(a)(2)(ii)(B). These events are being reported in the same report since the events involve the same result, the events were the result of common causes, the events occurred over a short period of time, and the events are being investigated collectively by a cross disciplinary team.

Below is a brief description of each of the events.

Event 1

On February 7, 1996, station personnel were performing undervoltage testing of the Unit 1 D13 4kV safeguard bus. This 4kV bus provides safeguard power to the A train of the MCR HVAC and the A CREFAS subsystem. The A train of the MCR HVAC supply and return fans were in operation prior to the test. A supply fan and a return fan are required to be in service to provide a complete flow path through the MCR. At 0210 hours, the bus was de-energized and then automatically re-energized from the second offsite AC source per the test. When the A supply and return fans attempted to restart, the fan motor breakers tripped off due to inadequate coordination in the starting of the A train supply and return fans. The A return fan started and tripped on low flow several times before the supply fan received a start signal. The A train return fan motor breaker tripped on

thermal overload before the A train supply fan started. The supply fan also tripped on thermal overload after several attempts to automatically start without a return fan in operation. With the breaker thermal overload heaters tripped, the breaker remained tripped until the operators reset the breaker relay.

The B train supply and return fans are each automatically started on a low flow condition by separate flow switches located in the discharge of the corresponding fan in the A train (i.e., a trip of the A train supply fan will result in a start of the B train supply fan). Due to inadequate coordination in the starting of the B train supply and return fans, the B return and supply fans started and tripped on thermal overload conditions just as the A train fans had done. At this point, both trains of the MCR HVAC system were out of service and there was no flowpath through the MCR for the CREFAS.

The operators reset the thermal overload heater trips and restarted the A train supply and return fans at 0215 hours. The operators recognized that with no MCR HVAC subsystem in service, both trains of the CREFAS were inoperable and that Unit 2 was in TS 3.0.3 for five (5) minutes. Since Unit 1 was in the refuel mode with no core alterations being performed, there were no TS actions required for Unit 1.

An investigation concluded that the flow switches may need recalibration and maintenance work requests were initiated for the switches. With the A supply fan and the A return fan in service the CREFAS was declared operable and the undervoltage test was completed.

Event 2

Later on February 7, 1996, the D13 LOCA/LOOP testing was being performed. At 1349 hours, the D13 safeguard bus was de-energized to prepare for a monitored Emergency Diesel Generator (EDG) start and LOCA/LOOP loading sequence per the test. With a low flow condition in the A supply and A return fan discharge ducts the B supply and return fans received a start signal. However, the B return fan started and tripped on a thermal overload condition before the B supply fan started. The B supply fan then also tripped on a thermal overload condition. The D13 4kV safeguards bus was re-energized as part of the LOCA/LOOP testing but not before the B trains fans had tripped off. With power restored to the D13 bus, the A supply and return fans automatically restarted at 1353 hours. The operators

recognized that for a short period of time both trains of the MCR HVAC were out of service and that Unit 2 was in TS 3.0.3 again for less than four (4) minutes. There were no TS actions required for Unit 1.

With the A train of the MCR HVAC back in service, the operators considered both trains of CREFAS operable. The calibration of the flow switches was again believed to be the cause of the tripping of the B train fans and that the A and B trains of CREFAS were operable with the A train of the MCR HVAC system in service.

Event 3

On February 16, 1996, the B CREFAS train was declared inoperable and the B train of the MCR HVAC was out of service due to planned maintenance on the associated DC electrical power bus. On February 18, 1996, under the direction of a licensed reactor operator, a non-licensed equipment operator adjusted the water flow of the Control Enclosure Chilled Water (CECW) system to the A MCR HVAC supply fan cooling coils. This action was taken to increase the temperature in the MCR. When the operator opened the cooling coil bypass valve, the temperature control valve did not respond quickly enough and the air temperature increased in the supply fan discharge duct. The air temperature reached the fan trip setpoint of 70 Degrees F. at 0744 hours and the A supply fan tripped per design. The A return fan then tripped on low flow. The operators restored the A supply and return fans to service by 0746 hours. With the A train of the MCR HVAC tripped and the B train of the MCR HVAC out of service for the DC electrical power bus work, both trains of CREFAS were inoperable. The operators recognized that Unit 2 was in TS Section 3.0.3 for two (2) minutes. Since Unit 1 was in the refuel mode with no core alterations being performed, there were no TS actions required for Unit 1.

When the A supply and return fans were returned to service the operators declared the A CREFAS train operable and TS Section 3.0.3 was exited. A maintenance work request was written for the temperature control valve.

Event 4

On February 23, 1996, operators were preparing for the performance of the D14 LOCA/LOOP test. At 0504 hours the operator secured the A

train of the MCR HVAC train by placing the handswitches for the supply and return fans to the OFF position, and attempted to start the B train. The B supply fan tripped on a false high air temperature signal due to a malfunctioning temperature transmitter. The operator started the A supply and return fans but the A return fan tripped on a thermal overload condition due to a low setting on the thermal overload heater. The operator then attempted to start the B supply and return fans but the B return fan tripped on a thermal overload condition. With no MCR HVAC trains in service, Unit 2 entered TS Section 3.0.3. At 0523 hours, the operators were successful at restarting the A supply and return fans and Unit 2 exited TS 3.0.3. Since Unit 1 was in the refuel mode with no core alterations being performed, there were no TS actions required for Unit 1.

A maintenance work request was written to repair the temperature transmitter. On February 26, 1996, an Engineering Change Request was initiated to review the thermal overload heater settings.

Event 5

On February 23, 1996, during preparations for the D14 LOCA/LOOP, the operators successfully started the B MCR HVAC train with the A train off. The A train supply and return fan handswitches were placed in OFF (rather than in AUTO) because, 1) the flowswitch coordination problem did not affect the manual start capability of the associated train, and 2) a written station position considered a train of CREFAS to be operable with the MCR HVAC train fan handswitches in the OFF position provided that the train was available. During the D14 LOCA/LOOP test, the D14 4kV safeguard bus was de-energized and re-energized per the test. During the automatic restarting of the B MCR HVAC train, the B return fan tripped on a thermal overload condition at 1825 hours. The B supply fan then tripped on low flow. The operator immediately placed the A MCR HVAC train in service by taking the fan handswitches to RUN.

On February 27, 1996, it was realized that the Limerick Generating Station Updated Final Safety Analysis Report (UFSAR) specified that the MCR HVAC system was to be capable of starting automatically and that the MCR HVAC system should be considered a support system required for the operability of the CREFAS. This includes the capability to automatically start following the loss of the running MCR HVAC supply and/or return fans (due to equipment failure or loss

of power). With a MCR HVAC fan's handswitch in the OFF position, the associated train was not capable of starting automatically, and the associated CREFAS train should be declared inoperable. Additionally, it was discovered that the automatic fan start was tested with a loss of a single fan at a time and was not tested for a simultaneous trip of the supply and return fans (as would occur with a loss of power). The NRC was then notified that the plant had been operated in a condition outside of the design basis and in a condition not covered by testing procedures.

As a result of the revised station position regarding the operability of the CREFAS subsystem with a MCR HVAC fan handswitch in the OFF position, the event on February 23, 1996, was considered to be another entry into TS Section 3.0.3 when the B MCR HVAC train tripped.

Unit 1 Start Up

On February 27, 1996, the setpoints for the MCR HVAC fan motor flow switches and thermal overload heaters were adjusted and testing showed that the MCR HVAC trains were capable of automatically starting as a back up to the running train. A review of the safety related HVAC systems was performed to determine if a similar fan flow switch coordination problem existed. The review identified that the Auxiliary Equipment Room (AER) HVAC system was susceptible to the same problem. A review of the flow switch settings revealed that the supply and return fan start up coordination problem should not exist. Additionally, the review concluded that the AER HVAC system is not required to be capable of starting automatically to support the operability of any TS equipment. With the potentially generic issues resolved and both trains of the CREFAS and the supporting MCR HVAC trains operable, Unit 1 entered OPCON 2 and started up from the refueling outage at 0211 hours on February 28, 1996.

Event 6

Later on February 27, and several times on February 28, 1996, the B MCR HVAC supply fan spuriously started with the A train in service. Troubleshooting was being performed to determine if a flow switch was malfunctioning. A technician was checking the flow switch that trips the A MCR HVAC supply fan on low flow when a spurious trip signal occurred and tripped the A supply fan at 1858 hours on February 28, 1996. The B supply fan started but the operators secured the fan

because the B Control Enclosure (CE) Chiller was out of service. With the B CE Chiller out of service, the B supply fan would eventually trip on high air temperature. The A supply fan low flow trip signal was jumpered out and the A supply and return fans were restarted at 1943 hours.

With no MCR HVAC train in service, both trains of CREFAS were inoperable. As a result, Unit 2 had entered TS Section 3.0.3. Since Unit 1 had entered OPCON 2 on February 28, 1996, at 0211 hours, Unit 1 had also entered TS Section 3.0.3. Both units were in TS Section 3.0.3 for forty-five (45) minutes. Both units exited TS Section 3.0.3 at 1943 hours when the A supply and return fans were restarted.

To avoid future spurious automatic starts of the B supply fan, the B CE Chiller was restored and the B supply and return fans were placed in run with the A fans in auto.

Event 7

With the realization that the MCR HVAC trains need to be capable of starting automatically and the flow switch coordination prevented this capability, it was recognized that Unit 1 and Unit 2 had been operating outside of the design bases since issuance of the operating licenses (i.e., August 26, 1984 for Unit 1 and June 22, 1989 for Unit 2). Additionally, with the standby train of the MCR HVAC not capable of automatically starting, one train of CREFAS was inoperable. This condition also existed since issuance of the operating licenses resulting in operation prohibited by TS Section 3.7.2.

Analysis of the Event

The actual consequences of these events were minimal since an accident or toxic chemical release did not occur requiring the CREFAS to perform its safety function. Potential consequences include the loss of the CREFAS safety function if a condition existed requiring a MCR isolation and CREFAS initiation with a concurrent single active failure. The consequences of this type of transient would have been mitigated by the ability of the MCR operators to restore operation of a CREFAS train and the support systems (e.g., MCR HVAC) either within the MCR or in locations within the CE. Additionally, with no MCR HVAC fans running, there is no addition of toxic gas or radioactive gases or particulates from the outside areas into the MCR thereby limiting the exposure of the operators.

Cause of the Event

The primary causes of these events are:

1) The startup testing of the MCR HVAC system did not verify that the standby MCR HVAC train was fully capable of automatically starting on failure of the operating train. As a result, the coordination problem with the flow switches and the undersized thermal overload heaters was not discovered and corrected prior to startup.

2) A written station position did not consider single failure criteria and incorrectly concluded that a train of MCR HVAC did not need to be capable of automatically starting. The station position considered that the availability of a supply and return fan was adequate to support the operability of the CREFAS, irrespective of the AC power supply. The startup testing actually performed supported this conclusion. The UFSAR also did not clearly state that the MCR HVAC system was needed for the operability of the CREFAS. This established an incorrect understanding of the MCR HVAC system and its relationship to the CREFAS on the part of the station staff. As a result, CREFAS operability and TS actions were not considered during decisions to work on or test the MCR HVAC system.

A brief discussion of the cause(s) for each event is provided below:

Event 1:

This event occurred because the MCR HVAC flow switches were not properly coordinated to allow the simultaneous start of a MCR HVAC supply and return fan and the thermal overload heaters were undersized.

Event 2:

This event also occurred due to the flow switch and thermal overload heater equipment problems. Additionally, the station staff did not recognize the full impact of the lack of the standby start capability due to the incorrect understanding created by the startup test and the station position. Corrective actions to resolve the flow switch and thermal overload heater concerns were not fully completed since the impact on the operability of the CREFAS was not recognized.

Conscious decisions were made regarding the ability of the MCR HVAC system to provide a flow path for the CREFAS and that immediate corrective actions were considered sufficient to maintain the CREFAS operable.

Event 3:

This event occurred as a result of; 1) a lack of procedural guidance for operating the CE cooling coil bypass valve, 2) a design deficiency in the adequacy of the temperature control subsystem, 3) an inadequate knowledge of the MCR HVAC trip functions on the part of the operators, 4) an incorrect understanding of the relationship between the MCR HVAC system and the CREFAS. If the operators or the operations shift supervision knew that manipulation of the bypass valve could result in a trip of the MCR HVAC train and that the remaining train of CREFAS would be affected, the task would not have been performed.

Event 4:

This event occurred as a result of a failed temperature transmitter as well as the same causes for event 2.

Event 5:

This event occurred as a result of the same causes as event 2.

Event 6:

This event occurred as a result of: 1) a defective flow switch that prompted troubleshooting of the flow switches, 2) a failure of the flow switch during connection of a test recorder, and 3) a less than adequate assessment of the potential impact of the troubleshooting on the MCR HVAC system, the CREFAS and the CE chilled water system. If the technicians, the technicians supervision, or the operations shift supervision knew that the troubleshooting could result in a trip of the MCR HVAC train and that the remaining train of CREFAS would be affected, the task would not have been performed.

Event 7:

This condition occurred as a result of the inadequate startup testing of the MCR HVAC system and a less than adequate review of the support

function of the MCR HVAC system on the part of the station staff prior to startup. As a result, the coordination problem with the flow switches and the undersized thermal overload heaters was not discovered and corrected prior to startup.

Corrective Actions

Below is a description of the corrective actions taken or planned with the associated event listed at the end of the action.

On February 27, 1996, the flow switch and the thermal overload heater setpoints were adjusted and testing showed that the MCR HVAC trains were capable of automatically starting as a back up to the running train. These actions were accomplished prior to the restart of Unit 1 following the refueling outage. (Events 1, 2, 4, and 7)

The UFSAR section describing the MCR HVAC system and the CREFAS will be reviewed and revised as necessary to increase the clarity of the information. (Events All)

The written station position regarding the MCR HVAC system was deleted and the appropriate station personnel, including the licensed operators, were informed that the position was deleted. The operators were informed that a train of MCR HVAC is a support subsystem required for the corresponding train of CREFAS to be considered operable. (Events 2, 3, 4, 5, 6, and 7)

Similar written station positions will be reviewed for accuracy and revised as necessary. (Events 2, 3, 4, 5, 6, and 7)

The appropriate station personnel will be informed of the correct relationship between the MCR HVAC system and the CREFAS and other aspects of the operation and trip functions of the MCR HVAC system and the CREFAS. (Events All)

The procedure for operating the CE cooling water bypass valve will be reviewed and revised as necessary to provide steps for manual operation of the temperature control function. (Event 3)

An evaluation is being performed to consider replacing the high temperature trip of the MCR HVAC supply fan with an alarm. (Events 3 and 4)

The defective temperature transmitter on the B MCR HVAC supply fan was replaced on February 23, 1996. This failure is considered to be a random failure and no additional actions are planned. (Event 4)

The defective flow element for the automatic start function of the B MCR HVAC supply fan was replaced on April 3, 1996. This failure is considered to be a random failure and no additional actions are planned. (Event 6)

The defective flow switch for the A MCR HVAC supply fan was replaced on February 29, 1996, and will be evaluated for the failure mechanism. This failure is considered to be an isolated failure and no additional actions are planned. (Event 6)

A review of the HVAC systems was performed and determined that only the AER HVAC system could have a similar problem and the appropriate corrective actions were taken. This concern had no impact on the operability of TS equipment. (Events 1, 2, 4, 5, and 7)

The CREFAS support equipment, the startup testing, and current testing requirements will be performed to ensure the appropriate equipment is identified and appropriate testing was and is being performed. This will include a review of the CREFAS support systems to ensure that these systems are being properly maintained to support the operability of the CREFAS. A supplement to this report will be provided if additional support system concerns are identified resulting in the inoperability of the CREFAS. (Events 1, 2, 4, 5, 6, and 7)

A review of other thermal overload heater setpoints is being performed. (Events 1, 2, 4, 5 and 7)

A revision to the UFSAR was evaluated and approved to allow for operator actions under specific conditions in considering the operability of the CREFAS system. This evaluation utilized the guidance of NRC Generic Letter 91-18, Information Regarding NRC Inspection Manual on Operability. (Events 5 and 7)

Previous Similar Occurrences

None