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Nuclear
Operations

10CFR50.73

May 29, 1991
NRC-91-0071

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

Reference: Fermi 2
NRC Docket No. 50-341
NRC License No. NPF-43

Subject: Licensee Event Report (LER) No. 90-003-02

Please find enclosed LER No. 90-003-02, dated May 29, 1991, for a reportable event that occurred on April 10, 1990. A copy of this LER is also being sent to the Regional Administrator, USNRC Region III.

If you have any questions, please contact Terry Riley, Supervisor, Compliance and Special Projects, at (313) 586-1684.

Sincerely,

Enclosure: NRC Forms 366, 366A

cc: A. B. Davis
J. R. Eckert
R. W. DeFayette
W. G. Rogers
J. F. Stang

Wayne County Emergency
Management Division

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LICENSEE EVENT REPORT (LER)

FACILITY NAME (1) Fermi 2 DOCKET NUMBER (2) 0 5 0 0 0 3 4 1 1 OF 0 8

TITLE (4) Relay Failure Causes Loss of RPS Power and MSIV Closure

EVENT DATE (5) MONTH DAY YEAR 0 4 1 0 9 0 9 0 LER NUMBER (6) SEQUENTIAL NUMBER 0 0 3 REVISION NUMBER 0 2 REPORT DATE (7) MONTH DAY YEAR 0 5 2 9 9 1 OTHER FACILITIES INVOLVED (8) FACILITY NAMES DOCKET NUMBER(S) 0 5 0 0 0 0 0 5 0 0 0 0

OPERATING MODE (8) 1 THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 5 (Check one or more of the following) (11) 20.402(b) 20.405(e) X 50.73(a)(2)(v) 73.71(b) 20.405(a)(1)(i) 50.38(a)(1) 50.73(a)(2)(v) 73.71(c) 20.405(a)(1)(ii) 50.38(a)(2) 50.73(a)(2)(vi) OTHER (Specify in Abstract below and in Text, NRC Form 306A) 20.405(a)(1)(iii) 50.73(a)(2)(i) 50.73(a)(2)(vii)(A) 20.405(a)(1)(iv) 50.73(a)(2)(ii) 50.73(a)(2)(vii)(B) 20.405(a)(1)(v) 50.73(a)(2)(iii) 50.73(a)(2)(ix) 20.405(a)(1)(vi) 50.73(a)(2)(iv) 50.73(a)(2)(x)

LICENSEE CONTACT FOR THIS LER (12) NAME Terry L. Riley, Supervisor of Compliance and Special Projects TELEPHONE NUMBER AREA CODE 3 1 3 5 8 6 - 1 6 8 4

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13) CAUSE SYSTEM COMPONENT MANUFACTURER REPORTABLE TO NRCDS CAUSE SYSTEM COMPONENT MANUFACTURER REPORTABLE TO NRCDS X JIC RILY G 10 8 10 Y

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

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

On April 10, 1990 at 0156 hours, the Reactor Protection System (RPS) motor-generator (MG) set "A" tripped due to a coil failure in the K1 relay. The appropriate isolations and actuations occurred as a result of the MG set trip. While the operators were verifying plant response and preparing to restore power, the inboard Main Steam Isolation Valves (MSIVs) closed. This resulted in a reactor scram and subsequent turbine trip.

The RPS MG set relay failed when its coil termination failed. Closure of the MSIVs is attributed to loss of pneumatic pressure due to pneumatic supply isolations. Leakage within the isolated system was traced to two sources: (1) leakage through the Traversing In-core Probe (TIP) indexer boxes and (2) additional leakage through the TIP purge system which had been added to the drywell pneumatic system loads during the first refueling outage.

As corrective action, the failed relay and the identical relay on MG set "B" were replaced. The failed relay was further analyzed to confirm its failure mechanism. Five of the six relief valves on the TIP purge system were gagged. Also the pressure regulator of the purge system was set lower to allow more than fifteen minutes for operators to restore the pneumatic supply following its isolation.

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ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

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TEXT (If more space is required, use additional NRC Form 365A's) (17)

Initial Plant Conditions:

Operational Condition: 1 (Power Operation)
Reactor Power: 100 percent
Reactor Pressure: 1005 psig
Reactor Temperature: 525 degrees Fahrenheit

Description of Occurrence:

On April 10, 1990, at 0156 hours, the Reactor Protection System {(RPS)(JC)} motor-generator {(MG)(88)} set "A" was observed by a Nuclear Supervising Operator to be releasing a small amount of smoke. The MG set tripped a few moments later and the smoking ceased almost immediately. Various isolations and actuations were experienced due to this condition including the following:

Reactor Building Heating, Ventilating and Air Conditioning System {(RBHVAC)(VA)} tripped. Division I of Standby Gas Treatment System (BH) started.

Control Center Heating Ventilating and Air Conditioning System {(CCHVAC)(VI)} shifted to the recirculation mode.

Division I primary containment isolation valve groups (JM) 1 (main steam), 2 (reactor water sample), 10 (reactor water cleanup), 12 (torus water management), 13 (drywell sumps), 17 (recirculation pumps and primary containment radiation monitoring) and 18 (primary containment pneumatic supply) isolated.

Plant response to the loss of the MG set was being verified, to ensure the appropriate isolations and actuations occurred, and preparations were being made to restore power to RPS "A" from the alternate supply when a reactor scram occurred due to closure of the inboard Main Steam Isolation Valves {(MSIVs)(SB)(ISV)} at 0202 hours. A reactor vessel low water level 3 signal was received in a matter of seconds. As a result, primary containment isolation valve groups 4 (Residual Heat Removal (RHR) shutdown cooling and head spray) and 15 (Traversing In-core Probe {(TIP)(IG)}) received an isolation signal, but were already isolated. The Division II group 13 valves isolated. The operator promptly entered Emergency Operating Procedure (EOP) 29.000.01, "RPV Control" due to the transient. Entry was

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consistent with the given plant conditions in that an MSIV closure would immediately result in a low reactor vessel water level signal. The appropriate immediate operator actions were properly carried out. The main turbine-generator {(TA)(TRB)} tripped at 0204 hours.

The operators began placing RHR suppression pool cooling in service. At 0209 hours, RPS channels B1 and B2 tripped on high reactor pressure. Pressure reached a maximum of approximately 1100 psig. Safety Relief Valves {(SRVs)(RV)} A, C, D, F, G and K lifted in response to the rise in pressure at 0211 hours. SRV P also appeared to lift per the sequence of events recorder. Based upon the small increase in tailpipe temperature and the fact that the alarm cycled, it was concluded that SRV P was chattering. It is located on the same steam line as SRV A, which was open.

Following the scram, water level decreased to a minimum of 130 inches. The operators used Standby Feedwater to maintain vessel inventory initially. Subsequently, the Reactor Core Isolation Cooling System {(RCIC)(BN)} was used for pressure and level control starting at 0220 hours. The High Pressure Coolant Injection System {(HPCI)(BJ)} was not needed to maintain vessel inventory during this event.

While the power was being restored to RPS "A" and provisions made to reopen the inboard MSIVs, the operators controlled pressure with SRV A. This decision was made based upon torus cooling being in service which assured adequate thermal mixing, loss of pneumatics due to the isolations and the subsequent knowledge that SRV A was operating satisfactorily and would be the first valve actuated by the lo-lo set automatic logic. This was contrary to the Emergency Operating Procedures which direct cycling the SRVs per a matrix provided in the procedure. This action was a non-critical decision by the plant operator. Use of the SRV to control pressure, along with operators resetting the scram signal even though plant conditions were not stabilized, resulted in scram signals and isolation signals being generated on several occasions during this transient. This was due to level fluctuating between the high level 8 and the low level 3 setpoints.

At 0223 hours, RPS "A" was restored to service using its alternate power supply and recovery from the isolations commenced.

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Radiation Protection personnel reported the discovery of contaminated water in the north RHR heat exchanger room at 0231 hours. The source of the water was the venting of the scram discharge volume (SDV). The system's vent line exhausts to the RBHVAC ductwork in this room. During plant recovery from the scram, the operators reset the scram signal several times leading to additional venting of the SDV.

At 0240 hours, the drywell pneumatic supply was restored. EOP 29.000.02, "Primary Containment Control", was entered at 0310 hours because of high torus water level. In the full flow test mode, RCIC takes a suction from the condensate storage tank (CST) and discharges back to the CST. In an attempt to control reactor pressure and minimize the number of SRV lifts, the operators initially attempted to use the CST-to-CST mode of RCIC. This was attempted without first venting the RCIC discharge piping in the CST test line and with the RCIC turbine still operating. One of the discharge valves, E41-F011, subsequently tripped on its thermal overload at 0314 hours and would not open. Once the line was vented, additional attempts to open valve E41-F011 were unsuccessful due to thermal overload trips and eventually this led to a loss of the valve actuator motor from a winding short.

At 0440 hours, the EOPs were exited. The scram signal was reset for the last time at 0453 hours. At 0607 hours, discovery of a significant amount of spilled water (approximately 60,000 gallons) was reported in the turbine building. This was due to a weld failure on the relief valve line on the 5 north feedwater heater. Time line reconstruction led to the estimation that this failure occurred at 0212 hours.

Cause of Event:

The RPS MG set tripped due to the failure of the coil termination in the K1 relay. This is a normally energized relay, and it is possible that the failure of the coil termination was due to a poor electrical connection which over an extended time could have caused excessive heating at the connection. This caused the MG set to trip and the subsequent isolations to occur.

Investigation of the MSIV closure led to the conclusion that they closed due to a loss of nitrogen pressure upon isolation of the drywell pneumatic supply. Due to the RPS MG set trip, the Division I Drywell Pneumatic Supply was isolated. Leakage of nitrogen within the isolated system was traced to two sources: leakage through the TIP indexer boxes and additional leakage through the TIP purge system which had been added to the drywell pneumatic system loads during the first refueling outage.

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The amount of leakage through the TIP indexer boxes had not been quantified previously and there is no acceptance criteria for leakage established for this system. It was recognized at the time the modification was conceived that leakage would be increased, but it was not expected that the introduction of this amount of leakage would adversely impact other equipment supplied by the pneumatic system. This leakage caused the MSIVs to close sooner than anticipated. The increased leakage through the outlet relief valves of the indexer boxes only marginally affected the bleed down time of the pneumatic system and the closure time of the MSIVs.

Analysis of Event:

Response of the equipment to the loss of the RPS MG set was as designed. All of the expected isolations and actuations occurred as a result of the loss of power.

A review of the scram by the post scram investigation team determined that this event is bounded by events described in section 15.2.4, "Main Steam Isolation Valve Closures", contained in the Updated Final Safety Analysis Report. The effects of this scram were less severe since all the MSIVs did not close at the same time, which allowed the main turbine-generator to act as a heat sink for several seconds.

This event did not challenge the health and safety of the public. The plant was safely shutdown using the systems available. While the HPCI test line valve was not functioning, HPCI could have performed its safety function had it been required in order to maintain reactor vessel water level.

A few minutes after the scram, the pressure in the 5 north feedwater heater increased to the point that the thermal relief valve lifted allowing feedwater to spill upon the floor and into the turbine drain system. The continuous discharge of feedwater through the relief valve overstressed a relief valve piping weld causing total separation of the piping and some insulation from the heater shell.

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Corrective Actions:

The following corrective actions were taken:

- (1) RPS and other CR120A Relays - The "A" and "R" RPS MG set K1 relays were replaced, both MG sets were run successfully and they were returned to service. The cause of the failed relay was investigated by the RPS MG Set system engineer. It was suspected that the failure was due to the age of the relay based on the fact that it is normally energized. A failure analysis performed by Detroit Edison's Technical Engineering Services (TES Report 90C92-29) concluded that a poor electrical connection coupled with a normally energized relay for an extended period of time could have caused excessive heating at the connection and subsequent failure of the coil termination in the K1 relay.

Preventive Maintenance (PM) events were created to replace the K1 relays (C7102S001A&B) every 5 years. Normal life expectancy for the GE CR120A relay is 7 to 12 years. The CR120A relays utilized in RPS MG Sets A&B were in service for approximately 7-8 years. Replacement of the K1 relays before the end of their expected life ensures that they will not fail prematurely.

A review of the Nuclear Plant Reliability Data System showed that there have been numerous failures of GE CR120A relays due to coils opening up or being at the end of expected life. Other experiences at Fermi 2, e.g., a Reactor Water Cleanup System isolation due to a CR120A relay failure from non-conductive foreign deposits found on the relay contacts (refer to LER 88-034-01) shows that other problems have been noted with these relays. Replacement of similar relays, that are normally energized, in other safety related applications commenced during the Second Refueling Outage (i.e., 17 CR120A relays were replaced during this outage). Continued assessments of the replaced GE CR120A relays are underway as part of the actions being taken for LER 88-034-01.

- (2) Feedwater Heater Leak - The 5 north feedwater heater was isolated, stopping the leak and contaminated areas in the turbine building were posted and cleaned. The spilled water was contained within the power block and processed as radwaste. Also, the 5 north relief valves line was repaired. Procedures were revised to require checking of the heater rooms for relief valve lifting after events that could cause a feedwater pressure transient.

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- (3) Nitrogen Leakage through TIP Purge - In order to address the nitrogen leakage through the TIP purge system, five of the six relief valves (one was already gagged) were required to be gagged as part of an approved modification. Also, the pressure regulator for this system was reset to a lower pressure. Based upon testing after implementation of the modification, this will allow approximately twenty minutes for operator actions to restore drywell pneumatics prior to the MSIVs closing due to low nitrogen pressure.

The pertinent alarm response procedures were revised to direct the operators to restore drywell pneumatic pressure within the allotted time in the event of an isolation.

- (4) SDV Vent Discharge Design - A catch basin was installed where the SDV vent is located. Liquid discharged was routed to the radwaste system as an interim measure. The design of the SDV vent was modified under Engineering Design Package (EDP) 11563 during the second refueling outage. EDP 11563 added a "catch system" to collect and drain water from the SDV vent discharge to RBHVAC, to the Div. I RHR Heat Exchanger Room floor drain.
- (5) Valve E41-F011 Operation - A ground in the motor for E41-F011 was discovered and the motor was replaced during the subsequent shutdown. Potential problems with the sizing of the motor for E41-F011 and with the design of this valve when it is needed to open against HPCI or RCIC discharge pressure were identified from this event. In addition, a verification of the HPCI and RCIC operating procedure sections for operation in the test mode (CST to CST) has been performed. Training on use of HPCI and RCIC was provided to licensed personnel as part of the requalification cycle. Additional concerns are being evaluated to determine if design modifications to enhance the use of HPCI and RCIC in the reactor pressure control mode are necessary.
- (6) Operator Training - Prior to startup from this event, operations personnel received training on this event and appropriate response to the challenges experienced during the event. This training included re-emphasizing the EOP entry conditions, SRV cycling, the use of multiple indications when taking EOP actions or monitoring the plant and the use of valve E41-F011 for pressure control.

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Previous Similar Events:

This is the first scram that occurred due to loss of nitrogen pressure to the inboard MSIVs. While previous events have been reported due to the loss of a RPS MG set, this is the first time the loss has been attributed to the failure of a K1 relay. LER 88-034-01 describes the failure of a CR120A relay due to the presence of foreign non-conductive substances found on the relay contacts.

Failed Component Data:

RPS MG set relay: General Electric CR120A01102AC