NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Fermi 2	0 5 0 0 0 3 4 1	1 OF 0 6

TITLE (4)
Group 2 Control Rod Receive Scram Signal Due to Contactor Termination Failure

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 NAMES	DOCKET NUMBER(S)
0 8	0 2	8 8	8 8	— 0 2 9	— 0 0	0 9	0 1	8 8	N/A	0 5 0 0 0
									N/A	0 5 0 0 0

OPERATING MODE (9)	4	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	0 0 0	20.402(b)	20.405(c)	X 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 (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		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
Patricia Anthony, Compliance Engineer	AREA CODE 3 1 3 5 8 6 - 1 6 1 7

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

On August 2, 1988, at 0507 hours, with a trip condition of the Reactor Protection System (RPS) 'B' logic present as expected during a plant test, 24 Hydraulic Control Unit Scram inlet and outlet valves opened due to de-energization of their associated RPS 'A' side scram pilot solenoid valves. This condition was immediately noticed by Control Room personnel on duty. A de-coupled field cable at the RPS 'A' scram contactor output terminal for these 24 rods caused a loss of power to the 'A' scram pilot solenoid valves. At the time the unit was in cold shutdown (Operational Condition 4) with all control rods fully inserted. Hydraulic pressure applied to the 24 control rod drives bumped the control rods in beyond their full in positions causing illumination of the multiple rod drift lamps. RPS scram logic was re-set and troubleshooting began.

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Initial Plant Condition:

Operational Condition: 4 (Cold Shutdown)
Reactor Power Level: 0 percent
Reactor Temperature: 123 degrees Fahrenheit
Reactor Pressure: 0 psig
Reactor Coolant Level: 231 inches
Control Rod Configuration: All Control Rods Full In.

Description of Event:

At 0507 hours on August 2, 1988, during transfer of the Reactor Protection System (RPS) (JC) Division II power source in accordance with a required surveillance, an expected RPS half scram occurred. At the same time, Control Room personnel on duty noticed that 24 of the 185 full core display blue lamps (IL) accompanied by the associated control rod drift red lamps (IL) had suddenly illuminated. The full scram condition for the 24 control rods (AA) and the half scram condition for the remaining 161 control rods were reset within 1 minute following the event. The control rod drift alarm (ZA) was not reset at that time. The operator made an identification of those control rods which had scrammed by using the full core display drift lamps which had remained on.

The partial scram condition was caused by a field cable (CBL) which had separated from its compression clamp termination. This field cable provides RPS power to 24 RPS Division I electrically operated solenoid air pilot valves (ASV) which de-energized the 24 'A' valves, placing then in their safety mode.

With the 24 'A' air pilot valves already de-energized and all 185 of the 'B' air pilot valves being de-energized, the control rod scram inlet and outlet valves (V) associated with these 24 rods opened resulting in the rods being scrammed. These 24 control rods which were already inserted to their 'full in' position were bumped beyond the full in notch position which illuminated the control rod drift lamps for each of the 24 control rods. Since this event constituted an unplanned automatic actuation of an engineered safety feature, the event is reportable pursuant to 10CFR50.72(b)(2)(i) and 10CFR50.73(a)(2)(ii) and (iv) and was initially reported as an unanalyzed condition.

Cause of Event:

The root cause for this event is an improper termination of RPS field cable 232019-21 at RPS scram contactor C71-K14G (CNTR) terminal 1T by an unknown electrician (non-licensed). Terminal 1T is a compression type clamp terminal which when tightened down will provide sufficient junction ampacity. Field cable 232019-21 was not fully inserted into the clamp terminal as evidenced by the overheated and eroded clamp. The termination experienced high current density at the cable to clamp terminal surface area where contact was made. Although evidence shows that the clamp screw was bottomed out, the lack of cable surface area contact with the clamp resulted in overheating and slow degradation of the junction. The junction finally degenerated to the point where the contact area of the clamp eroded away, releasing the cable. The cable which feeds down through a floor penetration in the panel had separated from the clamp, de-energizing the 24 solenoid air valves ('A' channel). All 185 of the "B" scram solenoid pilot valves de-energized as a result from the half scram caused by the RPS Division II surveillance. As a result, both the 'A' and 'B' solenoids were de-energized and caused the 24 rods to be scrammed. Had the control rods been withdrawn from their full in position they would have been driven in to their full in position.

Safety Analysis:

There were three separate instances where RPS Division II logic established a half scram condition on July 31, 1988; one of which was caused by plant testing of the RPS Division II logic which took place at 0945 hours. On July 31, 1988 the plant was in Operational Condition 4 with all control rods fully inserted. The available data recorded on the plant Sequence of Events Recorder indicates that a control rod drift alarm did not develop at any time when a Division II half scram took place.

This July 31, 1988 data supports that cable 232019-21 was still terminated to the scram contactor at that time. Had the cable not been terminated there would have been a control rod drift alarm produced at the time when the RPS Division II trip system tripped.

Plant testing during a 3 hour and 45 minute period on August 1, 1988 is known to have cycled this scram contactor ten times. Field cable 232019-21 may have de-coupled from the scram contactor termination during this period since the contactor off/on cycle frequency was high.

Since the RPS logic is a fail safe design the failure of the field cable to scram contactor termination does not prevent the RPS from performance of its safety function.

Following this event, General Electric performed an analysis to determine the consequences of the partial scram in relation to fuel design limits, the Rod Drop Accident, and the potential for scram from other parameters if this had occurred at power.

With respect to the consequences on fuel design limits, for operation at high power levels (defined as conditions that will result in final power levels > 25% of rated thermal power following the partial scram), the appropriate limits are the Minimum Critical Power Ratio (MCPR) and Linear Heat Generation Rate (LHGR). The most likely result is a full core scram on vessel low water level (Level 3) caused by the rapid power reduction. Assuming that the partial scram does not result in a full core scram on low water level, the resultant power distribution will be dependent on the final control rod pattern. For the "1/8 core scram" experienced at Fermi 2, the scrammed control rods are distributed within one half of the core. With the partial scram, the total core power is reduced, while the power distribution shifts towards the half of the core with no scrammed control rods. These two effects tend to compensate with the total core power reduction being the dominant factor. Calculations of partial scram configurations (including the "1/8 core scram" configuration) have demonstrated that the event does not result in violating MCPR or LHGR limits and in fact results in an increase in margin to limits primarily due to the reduction in power.

Below 25% of rated thermal power, significant margins to MCPR and LHGR limits exist, even with unusually peaked power distributions. Therefore, even with increased peaking from the partial scram below 25% of rated thermal power, sufficient margins exist to fuel limits.

If the partial scram results in operation below the Low Power Setpoint (LPSP) of the Rod Worth Minimizer (RWM) and Rod Sequence Control System (RSCS) the resultant control rod configuration will not be in compliance with the Group Notch Sequence of the RSCS. This sequence is designed to minimize control rod worths during startup for mitigation of the Control Rod Drop Accident (CRDA). This sequence and the scram group arrangements were specifically designed to minimize the number of control rods common to a Group Notch group and a scram group. This requirement ensures adequate scram reactivity during startup should a scram group fail to insert and also minimizes the impact of an inadvertent partial scram on control rod worths. Evaluations of out of sequence control rod configurations (e.g., fully inserted inoperable control rods) have demonstrated that the impact of these partial scram configurations is not significant and therefore the CRDA analysis is not adversely affected.

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Therefore, the one-eight core scram taking the plant below the LPSP is not in itself a safety concern. However, the resultant control rod configuration would not be in compliance with any sequence that has been analyzed for the CRDA. As designed, the RWM and RSCS will prevent the operator from attempting to move any control rods except by initiating a scram when in this condition below the LPSP. This prevents the operator from attempting to correct an out of sequence condition and in doing so, create a more limiting configuration.

With respect to the effects on other plant parameters, as discussed above, a partial scram from high power conditions may very well result in a low water level scram due to void collapsing from the rapid power reduction. The Scram Discharge Volume (SDV) high level may also provide a scram initiation even if the process water in the volume flashes to steam as the result of the open SDV valves. Before scram, ambient temperature water is in the piping between the control rod drive and the SDV. During a scram, this water will be forced into the volume. As a minimum, the "not drained" alarm should be present alerting the operator.

Corrective Actions:

The vendors specification for wire size application to the contactor wire clamp was reviewed to verify that the field cable and panel wire sizes are appropriate. All field cable and panel wire terminations, which are made to all RPS Division I and Division II automatic and manual scram contactors were de-terminated and examined for satisfactory cable/wire preparation (strip gap and no strands broken) then fully re-inserted into the contactors compression clamp terminals and tightened down. In addition, an infrared examination of the affected terminations was conducted to check for heat stress embrittlement of the wire insulation. No additional problems were found.

The eight RPS panel fuses, which fuse the RPS Division I and Division II source power routed to the scram pilot solenoid valves, were replaced (since the original fuses may have experienced high current loads during this event).

As a preventative maintenance measure, an infrared examination of all scram contactor terminations is being planned for an eighteen month cycle. Maintenance Instruction MI-M253 was revised to include specific acceptance criteria. An examination such as this will play a great part in identifying panel wire or field cable terminations that are beginning to degrade.

Operations personnel were required to complete urgent required reading material which related to this incident prior to plant restart. The reading material included a revision to the Abnormal Operating Procedure 20.106.07, "Control Rod Drift". The revision includes immediate action measures to be taken by Control Room personnel for a condition where two or more control rods are found drifting in or out of the reactor core. The Operator is now required to place the reactor mode switch to its shutdown position upon the occurrence of such an event. The reactor will scram when the reactor mode switch is placed into shutdown. The Drift Alarm Response Procedure, ARP 3D109, was also revised to reflect the same basic instructions to the operator.

Licensee Event Report 88-010-00 issued by Grand Gulf Nuclear Station Unit 1 which describes a similar event which occurred on March 15, 1988 was also included in the required reading packet.

Discussions with the NSSSS vendor were held to evaluate if a design change for detection of these conditions to the RPS would be beneficial from a system reliability standpoint. Based on the vendor's recommendation, it was decided not to pursue this design change.

Previous Similar Experiences:

This is the only Licensee Event Report describing a partial scram due to a group of rods scramming.

Failed Component Data:

There are no failed components which contributed to this event. The root cause is a workmanship problem which was an improper cable termination to a scram contactor terminal. The scram contactor in itself suffered a degradation of one of its interface terminals which was replaced, leaving the original scram contactor in service.

William S. Orser
Vice President
Nuclear Operations

Detroit Edison

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10CFR50.73

Nuclear Operations

September 1, 1988
NRC-88-0209

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

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

Subject: Licensee Event Report (LER) No. 88-029-00

Please find enclosed LER No. 88-029-00, dated September 1, 1988, for a reportable event that occurred on August 2, 1988. A copy of this LER is also being sent to the Regional Administrator, USNRC Region III.

If you have any questions, please contact Patricia Anthony at (313) 586-1617.

Sincerely,

Enclosure: NRC Forms 366, 366A

cc: A. B. Davis
J. R. Eckert
R. C. Knop
T. R. Quay
W. G. Rogers

Wayne County Emergency
Management Division

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