Southern California Edison Company

SAN ONOFRE NUCLEAR GENERATING STATION

P. O. BOX 128

SAN CLEMENTE, CALIFORNIA 92674-0128

R. W. KRIEGER
STATION MANAGER

TELEPHONE
(714) 368-6255

April 9, 1991

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

Subject: Docket No. 50-361
30-Day Report
Licensee Event Report No. 91-003
San Onofre Nuclear Generating Station, Unit 2

Pursuant to 10 CFR 50.73(d), this submittal provides the required 30-day written Licensee Event Report (LER) for an occurrence involving an automatic reactor trip. Neither the health nor the safety of plant personnel or the public was affected by this occurrence.

If you require any additional information, please so advise.

Sincerely,

R W Krieger

Enclosure: LER No. 91-003

cc: C. W. Caldwell (USNRC Senior Resident Inspector, Units 1, 2 and 3)

J. B. Martin (Regional Administrator, USNRC Region V)

Institute of Nuclear Power Operations (INPO)

IE22
1/1

9104150330 910409
PDR ADOCK 05000361
S PDR

LICENSEE EVENT REPORT (LER)

Facility Name (1)	Docket Number (2)	Page (3)
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 2	0 5 0 0 0 3 6 1	1 of 0 7

Title (4)

UNIT 2 AUTOMATIC REACTOR TRIP DUE TO FAILED CONTROL ELEMENT DRIVE MECHANISM CONTROL SYSTEM (CEDMCS) MOTOR GENERATOR (MG) OVER/UNDEREXCITATION PROTECTION RELAY

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)
									NONE	0 5 0 0 0
0 3	1 0	9 1	9 1	0 0 3	0 0	0 4	0 9	9 1		0 5 0 0 0

OPERATING MODE (9)	1
POWER LEVEL (10)	0 7 7

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10CFR (Check one or more of the following) (11)

___ 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)
___ 20.405(a)(1)(iii)	___ 50.73(a)(2)(i)	___ 50.73(a)(2)(viii)(A)	
___ 20.405(a)(1)(iv)	___ 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 AREA CODE
R. W. Krieger, Station Manager	7 1 4 3 6 8 - 6 2 5 5

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
X	A A	R L Y	L 1 8 5	Y					

SUPPLEMENTAL REPORT EXPECTED (14)	Expected Submission Date (15)	Month	Day	Year
___ Yes (If yes, complete EXPECTED SUBMISSION DATE)	XX NO			

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

At 1206 on March 10, 1991, with Unit 2 at 77% power and CEDMCS #1 MG set out of service for maintenance, the output contactor for the redundant MG set opened, causing de-energization of the CEDMCS bus and an automatic reactor trip. During recovery from the trip, both main feedwater bypass valves (MFBVs) opened unexpectedly. Control room operators attempted to throttle closed both MFBVs, but MFBV 2HV-1105 failed to respond to demand. As a result, steam generator (SG) E-089 level increased above that anticipated. Control room operators closed the associated main feedwater isolation valve to stop main feedwater flow to E-089. The plant was stabilized in Mode 3 at approximately 1230. During the post trip review, it was noted that SG level Channel C responded more slowly than the other three channels.

Failure of the CEDMCS #2 MG set ammeter (AMR) relay underexcitation contact caused the #2 MG set output contactor to open. The AMR relay was sent to an offsite laboratory for failure analysis. A low proportional band setting of the Feedwater Control System controller caused the MFBVs to open unexpectedly during recovery following the trip, causing the excursion in SG level. The investigation is continuing into the cause for 2HV-1105 anomalous operation. The slow response of the SG level Channel C was attributed to sediment in the transmitter sensing lines; evaluation of the SG level channel sluggish response is continuing.

The AMR relay for the CEDMCS #2 MG set was replaced. The proportional band of the FWCS controller was increased, and a minimum value determined. MFBV 2HV-1105 was stroke tested satisfactorily, demonstrating its proper operation. SG E-089 level Channel C sensing lines were blown down, and the instrument returned to within tolerance of the other three channels. Corrective actions will be implemented as necessary based on the results of the continuing cause investigations into the AMR relay failure, 2HV-1105 response failure, and the SG level Channel C sluggish response.

Plant: San Onofre Nuclear Generating Station
Unit: Two
Reactor Vendor: Combustion Engineering
Event Date: 03-10-91
Time: 1206

A. CONDITIONS AT TIME OF THE EVENT:

Mode: 1, 77% power

B. BACKGROUND INFORMATION:

1. Control Element Drive Mechanism Control System (CEDMCS):

Two CEDMCS [AA] Motor Generator (MG) sets [MG] are normally operated in parallel to provide power to the CEDM coils [CL] via the CEDMCS electrical bus [BU]. Each MG set is capable of supplying the full power requirements of the CEDMs. Overexcitation and under-excitation protection of each MG set is provided by an ammeter (AMR) relay [RLY]. The AMR relay contacts open upon sensing over- or underexcitation, causing the MG set output contactor [CNTR] to open, interrupting power from the MG set to the CEDMCS bus.

2. Feedwater Control System (FWCS) [JB]:

The FWCS provides signals to the main feedwater pumps (MFPs) [P], main feedwater regulating valves (MFRVs) [FCV], and main feedwater bypass valves (MFBVs) [FCV] (2HV-1105 and 2HV-1106) to maintain level in the steam generators (SGs) [SG]. During normal operation, the FWCS incorporates a proportional plus integral (PI) controller to provide an output based on the difference between compensated SG level and SG level setpoint. (The compensated level signal is comprised of sensed SG level, offset by a function of the mismatch between feedwater flow rate and steam flow rate.)

On a reactor trip, the FWCS generates a Reactor Trip Override (RTO), which causes the following: 1) MFPs decrease speed to their minimum control speed setting, 2) MFRVs fully close, and 3) MFBVs throttle to approximately 50% open. During RTO, approximately 5% of full feedwater flow is delivered to the SGs.

In addition, a signal loop is established whereby the output of the PI controller is fed back into its input; this feedback loop is provided to prevent "reset windup" of the controller. (Reset windup can result in an excessive time for a controller to respond properly to its input.) RTO automatically resets when the controller flow demand signal decreases below the value corresponding to approximately 5% of full feedwater flow. After RTO resets, normal automatic operation of the controller is re-established. The commonality of 5% flow results in a smooth transition between RTO

and automatic controller operation (i.e., the transition does not cause an abrupt change in MFBV position).

C. DESCRIPTION OF THE EVENT:

1. Event:

At 1206 on March 10, 1991, with Unit 2 at 77% power and CEDMCS #1 MG set out of service (OOS) for maintenance, the output contactor for CEDMCS #2 MG set opened, causing de-energization of the CEDMCS bus and an automatic reactor trip. Plant control systems initially responded as designed, including generation of RTO by the FWCS. Approximately 5 minutes after the trip, control room operators (utility, licensed) adjusted the SG level setpoint from the normal full power setting (67%) to the Mode 3 setting (55%). At this time, RTO reset and the MFBVs fully opened.

Control room operators attempted to throttle closed both MFBVs to 50% closed using manual control. MFBV 2HV-1106 responded properly, but MFBV 2HV-1105, which controls main feedwater to SG E-089, failed to respond and remained fully open. As a result, E-089 level increased above the high level trip setpoint, causing reactor protection system (RPS) channel actuations. Control room operators then closed the associated main feedwater isolation valve (MFIV) [ISV] to stop main feedwater flow to E-089. Level in E-089 returned to normal with normal blowdown flow.

The plant was stabilized in Mode 3 at approximately 1230.

2. Inoperable Structures, Systems or Components that Contributed to the Event:

None

3. Sequence of Events:

TIME	ACTION
1206	Unit 2 automatic reactor trip occurred.
1212	Operators adjusted SG level setpoint; RTO reset and MFBVs fully opened. 2HV-1105 would not respond to demand to throttle closed.
1217	SG E-089 level increased above the RPS actuation setpoint.
1217	Operators closed MFIV 2HV-4052.
1230	Unit 2 stabilized in Mode 3.

4. Method of Discovery:

Control room alarms and indications alerted the operators that a reactor trip had occurred.

5. Personnel Actions and Analysis of Actions:

Control room operators responded properly to the reactor trip, implementing the Emergency Operating Instructions to stabilize the plant in Mode 3.

Operator action to reduce the SG level setpoint was in accordance with normal operating practice. That action should not have caused RTO to reset (see section D, Cause).

The operators also responded properly to the opening of the MFBVs by taking manual control of the valves. When 2HV-1105 failed to respond, the operators properly closed the associated MFIV. After SG E-089 level returned to normal, the operators properly maintained E-089 level with auxiliary feedwater.

6. Safety System Responses:

The RPS operated as designed. However, when level in SG E-089 increased to the high level trip setpoint, level instrumentation channel "C" actuated approximately 2 minutes later (and approximately 3% higher) than the other three channels. (This was identified during a review of the post trip data.)

D. CAUSE OF THE EVENT:

1. Immediate Cause:

The output contactor of the CEDMCS #2 MG set opened, interrupting power from that MG set to the CEDMCS bus. With #1 MG set OOS for maintenance, a loss of power occurred on the CEDMCS bus, resulting in a reactor trip.

2. Root Cause:

The CEDMCS #2 MG set AMR relay underexcitation contact was found to have a high resistance. This condition is concluded to have resulted in the opening of the MG set output contactor.

Upon subsequent testing of the relay, the contact failed open. The AMR relay was sent to an offsite laboratory for failure analysis.

E. OTHER CAUSES:

1. MFBVs Opened Following Adjustment to SG Level Setpoint:

Testing was performed on the FWCS to determine why the MFBVs opened when the SG level setpoint was decreased from 67% to 55%. During this testing, oscillations in the output of the PI controller were observed during RTO operation. These oscillations were determined to be caused by a low FWCS controller proportional band setting (which caused a higher controller output) in combination with the signal feedback loop established during RTO. When the control room operator decreased the SG level setpoint, the oscillations shifted downward, although the average controller output signal remained well above the normal reset value for RTO. During the decreasing leg of the oscillations, the minimum controller output signal was reduced below the RTO reset setpoint, causing the controller to return to the automatic mode. The controller automatic output signal then stabilized at the average value, causing the MFBVs to open.

2. MFBV 2HV-1105 Failed to Respond to Demand Signal:

Approximately 2 hours after the plant was stabilized in Mode 3, another attempt to close 2HV-1105 was made. A full closed demand signal was input using manual control; this attempt was successful, and the valve closed.

An inspection of the FWCS, including the actuator for 2HV-1105, was performed in an attempt to determine why 2HV-1105 did not throttle closed in response to demand following RTO reset; no FWCS abnormalities were identified that could have caused the condition. The valve was stroked over its full range and checked for overtravel both in Mode 3 and again at power. No abnormalities were noted during any of the testing, nor were any observed during similar tests on 2HV-1106.

MFBV 2HV-1105 will be further tested at the end of cycle. The intent of this testing is to determine if the failure of the valve to respond was related to the unlikely possibility of stem binding (e.g., potential loss of stem lubrication) due to extended time with no valve movement.

3. SG E-089 Level Instrumentation Channel "C" Response:

The RPS bistable for Channel C SG E-089 high level trip was tested; no abnormalities were noted. The level instrument sensing lines for Channel C were then blown down through a filter; approximately 50 cc of a black sediment was collected. Following the blowdown, the Channel C indication returned to within specified tolerance of the other indicators. In addition, a comparison of the four SG E-089 level channels before and after the trip indicates that a step

deviation between Channel C and the other three channels occurred at the time of the trip. Therefore, it is believed that an abnormal accumulation of sediment in the Channel C E-089 level sensing lines occurred as a result of the trip transient and caused the level discrepancy.

Evaluations of previously observed sluggish response of SG level instrumentation found sediment which was comprised of corrosion products from expected interaction of the SG with secondary water. SCE had implemented action to blow down the sensing lines each refueling outage to remove the corrosion products. This action was apparently not sufficient to prevent recurrence.

F. CORRECTIVE ACTIONS:

1. Corrective Actions Taken:

The AMR relay for the CEDMCS #2 MG set was replaced, and #2 MG set was tested satisfactorily and returned to service prior to restart of the plant. Maintenance on MG set #1 was completed, and it was also returned to service.

The proportional band of the PI controller was increased such that controller output oscillations were no longer observed. In addition, this event has been reviewed with appropriate Operations personnel, emphasizing the FWCS response during RTO and providing direction in the event that FWCS controller output oscillations recur.

Stroking MFBV 2HV-1105 demonstrated its proper operation, and 2HV-1105 was returned to service.

As discussed earlier, the SG E-089 level Channel "C" instrument sensing lines were blown down during the investigation into the cause of its unsatisfactory response. This action cleared the sensing lines of foreign material. The instrument was satisfactorily tested, calibrated, and returned to service.

2. Planned Corrective Actions:

Appropriate corrective actions will be determined and implemented based on the results of the failure analysis of the AMR relay. These actions may include replacement of the AMR relay with a different kind of relay or installation of a parallel over/underexcitation protection circuit, incorporating a two out of two logic for actuation.

Minimum proportional band setting requirements will be established in accordance with the design program. Appropriate procedures which govern gain adjustments on the FWCS PI controller will be amended accordingly.

As mentioned earlier, MFBV 2HV-1105 will be further tested at the end of cycle. Corrective actions will be implemented as necessary based on the results of this testing.

SCE will perform a survey of other Combustion Engineering plants regarding sluggish SG level response and corrective actions taken to prevent or minimize recurrence. Following the survey, SCE will implement appropriate corrective actions to prevent or minimize recurrence, which may include modifying the blowdown process and modifying the sensing lines to minimize the impact of the sediment accumulation.

This event will be included in the licensed operator requalification program for 1992.

G. SAFETY SIGNIFICANCE OF THE EVENT:

There is no safety significance to this event since the RPS operated in accordance with design.

H. ADDITIONAL INFORMATION:

1. Component Failure Information:

The AMR relay is manufactured by LFE, model no. 1967.

2. Previous LERs for Similar Events:

LER 89-006 (Docket No. 50-362) describes a Unit 3 reactor trip which was initiated by the spurious opening of the CEDMCS #1 MG set output contactor. The cause of the spurious opening of the output contactor could not be determined; however, the proper function of the AMR relay was verified. Also, in that event, the cause of the trip was attributed to the limited capability of one MG set to pick up the CEDMCS load following a trip of the other MG set. Therefore, corrective actions from that event could not have prevented this (LER 91-003, Docket No. 50-361) event.