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 FACIL: 50-362 San Onofre Nuclear Station, Unit 3, Southern California 05000362
 AUTH. NAME AUTHOR AFFILIATION
 MORGAN, H. E. Southern California Edison Co.
 RECIPIENT NAME RECIPIENT AFFILIATION

SUBJECT: LER 89-006-01: on 890407, automatic reactor trip due to voltage transient on CEDMCS.

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 TITLE: 50.73/50.9 Licensee Event Report (LER), Incident Rpt, etc.

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Southern California Edison Company

SAN ONOFRE NUCLEAR GENERATING STATION

P. O. BOX 128

SAN CLÉMENTE, CALIFORNIA 92672

November 27, 1989

H. E. MORGAN
STATION MANAGER

TELEPHONE
(714) 368-6241

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

Subject: Docket No. 50-362
Supplemental Report
Licensee Event Report No. 89-006, Revision 1
San Onofre Nuclear Generating Station, Unit 3

Reference: Letter, H. E. Morgan (SCE) to USNRC Document control Desk, dated
May 8, 1989

The referenced letter provided Licensee Event Report (LER) No. 89-006 for an occurrence involving an actuation of the Reactor Protection System. Enclosed is a revision to this LER, which provides a change to the corrective actions. Neither the health and safety of plant personnel or the public was affected by this occurrence.

If you require any additional information, please so advise.

Sincerely,

H E Morgan

Enclosure: LER No. 89-006, Revision 1

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)

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LICENSEE EVENT REPORT (LER)

| | | | | | | | | | | | | | | |
|--|--------|-----------|--|---------------------|-----------------|-------------------------------|-----------|-------------------------------|-------------------------------|--|--------|---|--------------|---------------------|
| Facility Name (1) | | | | | | Docket Number (2) | | | | | | Page (3) | | |
| SAN ONDRE NUCLEAR GENERATING STATION, UNIT 3 | | | | | | 0 5 0 0 0 3 6 2 | | | | | | 1 of 0 6 | | |
| Title (4) | | | | | | | | | | | | | | |
| AUTOMATIC REACTOR TRIP DUE TO VOLTAGE TRANSIENT ON CONTROL ELEMENT DRIVE MECHANISM CONTROL SYSTEM ELECTRICAL BUS | | | | | | | | | | | | | | |
| 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 4 | 0 7 | 8 9 | 8 9 | 0 0 6 | 0 1 | 1 1 | 2 7 | 8 9 | NONE | 0 5 0 0 0 | | | | |
| OPERATING MODE (9) | | | THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10CFR (Check one or more of the following) (11) | | | | | | | | | | | |
| POWER LEVEL (10) | | | 20.402(b) | | | 20.405(c) | | | X 50.73(a)(2)(iv) | | | 73.71(b) | | |
| 1 0 0 | | | 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 | | | | | | | | |
| H. E. Morgan, Station Manager | | | | | | AREA CODE | | | | | | | | |
| | | | | | | 7 1 4 | | 3 6 8 - 6 2 4 1 | | | | | | |
| 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 | CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO NPRDS |
| | | | | | | | | | | | | | | |
| SUPPLEMENTAL REPORT EXPECTED (14) | | | | | | | | | | Expected Submission Date (15) | | Month | Day | Year |
| <input type="checkbox"/> Yes (If yes, complete EXPECTED SUBMISSION DATE) | | | | | | | | | | <input checked="" type="checkbox"/> NO | | | | |
| ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16) | | | | | | | | | | | | | | |

At 0555 on 4/7/89, with Unit 3 at 100% power, an automatic reactor trip on Loss of Load (LOL) occurred in response to a turbine trip caused by spurious deenergization of the Control Element Drive Mechanism Control System (CEDMCS) bus undervoltage (UV) relays. Plant conditions were stabilized, and recovery proceeded normally. The Emergency Feedwater Actuation System (EFAS) for both steam generators (SGs) actuated as a result of the expected decrease in SG level below the actuation setpoint. At 0630, levels of both steam generators were verified to be above the reset setpoint, and EFAS was reset. There is no safety significance to this event since the Reactor Protection System (RPS) operated in accordance with design, and all EFAS components were verified to have actuated as required.

Following the trip, the CEDMCS motor-generator (MG) set #1 load contactor was found to be open, contrary to its normal, expected position. The CEDMCS bus is powered by two parallel and fully redundant MG sets, via output circuit breakers and load contactors. Subsequent testing demonstrated that under certain conditions, the opening of one MG set load contactor could result in a drop in CEDMCS bus voltage of sufficient magnitude to cause the CEDMCS bus undervoltage (UV) relays to deenergize.

Monitoring equipment was installed on the MG sets to establish possible cause and corrective actions for the spurious opening of the MG set load contactor. To minimize the potential of a reactor trip from the opening of an MG set load contactor or output breaker: 1) the UV relay trip setpoint, which was determined to be excessively conservative, was decreased; 2) the procedure governing MG set operation has been amended; and 3) MG set load control circuitry will be modified.

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Plant: San Onofre Nuclear Generating Station
Unit: Three
Reactor Vendor: Combustion Engineering
Event Date: 04-07-89
Time: 0555

A. CONDITIONS AT TIME OF THE EVENT:

Mode: 1, Power Operation

B. BACKGROUND INFORMATION:

Two Control Element Drive Mechanism Control System (CEDMCS) (AA) motor-generator (MG) sets (MG) provide power to the CEDM coils (CL) via the CEDMCS electrical bus (BU). Although each MG set is capable of supplying the full power requirements of the CEDMs, the two CEDM MG sets are normally operated in parallel in a "droop" mode. In this mode, the CEDMCS load is automatically picked up by the operating MG set(s) in the event of a drop in CEDMCS bus voltage. The system is designed such that with the two MG sets running in parallel, power should not be interrupted to the CEDMCS bus if one MG set trips. Each MG set provides power to the CEDMCS bus via its output circuit breaker (52) and a load contactor (CNTR).

The CEDMCS undervoltage (UV) relays (27), which sense the voltage on the CEDMCS bus, provide signals to various secondary plant control systems (JI and JB) and the main turbine protection system (JJ). A loss of voltage to the CEDMCS bus would result in the deenergization of the CEDMCS UV relays, which would cause a main turbine trip. A turbine trip causes a Loss of Load (LOL) reactor trip with reactor power greater than 55%.

C. DESCRIPTION OF THE EVENT:

1. Event:

At 0555 on April 7, 1989, with Unit 3 at 100% power, an automatic reactor trip on LOL occurred in response to a turbine trip caused by spurious deenergization of the CEDMCS bus UV relays. Plant conditions were stabilized, and recovery proceeded normally. The Emergency Feedwater Actuation System (EFAS) (BA) for both steam generators (SG) actuated as a result of the expected decrease in steam generator level below the actuation setpoint. All EFAS components were verified to actuate as required. At 0630, levels of both steam generators were verified to be above the reset setpoint, and EFAS was reset.

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

None

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3. Sequence of Events:

| <u>TIME</u> | <u>ACTION</u> |
|-------------|---|
| 0555 | Unit 3 automatic reactor trip. EFAS for both SGs automatically initiated. Standard Post Trip Actions (SPTA) procedure initiated. |
| 0615 | Completed verifications that plant conditions were stabilized, continued normal plant recovery utilizing Reactor Trip Recovery (RTR) procedure. |
| 0630 | EFAS reset. |

4. Method of Discovery:

Control room alarms and indications alerted the operators (utility, licensed) of the reactor trip.

5. Personnel Actions and Analysis of Actions:

The operators stabilized plant conditions utilizing the SPTA and RTR procedures. The operators also verified that all EFAS components actuated as required.

6. Safety System Responses:

The RPS operated in accordance with design, and all EFAS components were verified to have actuated as required.

Channel #1 of SG E089 low level trip actuated 2.1 seconds after Channel #2. This response is expected and the result of a hydrodynamic phenomenon previously described in LERs 89-001 (Docket No. 50-362) and 87-004 (Docket No. 50-361).

D. CAUSE OF THE EVENT:

1. Immediate Cause:

A momentary decrease in voltage on the CEDMCS bus occurred, which caused the CEDMCS UV relays to momentarily deenergize, resulting in a turbine trip. With reactor power at 100%, the turbine trip caused a LOL reactor trip.

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2. Intermediate Cause:

Following the trip, the load contactor for MG set #1 was found to be open (contrary to its normal, expected position), interrupting power from MG set #1 to the CEDMCS bus. In an attempt to duplicate the conditions which may have resulted in the momentary decrease in voltage on the CEDMCS bus due to the opening of the load contactor, a testing program was developed and initiated. The testing demonstrated that with the MG sets initially operating in parallel in the droop mode, opening the output breaker of one MG set results in a momentary voltage drop on the CEDMCS bus until the load is picked up by the other MG set. With one MG set carrying most (if not all) of the load, and the other MG set essentially unloaded, disconnection of the loaded MG set from the CEDMCS bus was demonstrated to result in a CEDMCS bus voltage decrease below the trip setpoint of the CEDMCS UV relays, deenergizing the relays; this would cause a turbine trip, which, in turn, would cause a reactor trip with power greater than 55%. It has been concluded that the reactor trip resulted from such a scenario.

3. Root Cause:

Additional testing was performed in an attempt to identify the root cause; however, the cause of the opening of the MG set #1 load contactor could not be determined. In addition, no cause for a possible mismatch in loads between the two MG sets could be determined, and operator readings taken a few hours before the trip indicated that load was balanced between the MG sets. It was noted, however, that the range and scale of the installed ammeters and voltmeters which are utilized to determine MG set load balance were not optimal for the specified operating values and tolerances.

Actions taken in an attempt to determine the root cause include:

- a. The protective devices for MG set #1 were verified to be calibrated and to function satisfactorily.
- b. The calibration of the MG set output voltmeters was verified.
- c. The droop settings for both MG sets were checked to be within specifications.
- d. The excitation/voltage regulation system for MG set #2 was tested and verified to be functional.
- e. Monitoring instrumentation was installed on the excitation system for MG set #2 to detect drift in the system. No drift has been detected to date.

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- f. Instrumentation was installed to monitor various parameters that provide input to automatically open the load contactor for each MG set. No abnormalities have been detected to date.
- g. MG set data was trended in an attempt to quantify the magnitude of voltage regulation drift between the MG sets. No drift was detected over a period of approximately 2½ months. This action has been discontinued.

E. CORRECTIVE ACTIONS:

1. Corrective Actions Taken:

The procedure regarding MG set operation has been amended to limit the amount of deviation permitted between the two MG sets' exciter field current, generator output current, and generator voltage; this will serve to increase the response of the MG sets to a voltage transient, thus minimizing the voltage drop on the CEDMCS bus due to an MG set trip or the opening of an MG set output breaker or load contactor.

A review of the setpoint history of the CEDMCS UV relays revealed that the UV relay trip setpoint had been increased during the last refueling outage to the middle of the Combustion Engineering (CE) specified setpoint band for conservatism. This action has now been determined to have been excessively conservative, and the trip setpoint of the CEDMCS UV relays was decreased to an appropriate value. This increases the magnitude of CEDMCS bus voltage drop necessary to cause the deenergization of the CEDMCS UV relays.

2. Planned Corrective Actions:

- a. The droop circuitry will be modified such that the loss of one MG set (trip, or opening of output breaker or load contactor) will result in the remaining, online MG set to revert to the isochronous mode. This will provide a faster response to voltage transients on the bus. This modification has been completed for Unit 2.
- b. The existing local control panel analog ammeters will be replaced with digital multi-function meters which display MG set output volts, amps, and other parameters. These multi-function meters will provide appropriate range and scale for parameters utilized to determine MG set load balance.

F. SAFETY SIGNIFICANCE OF THE EVENT:

There is no safety significance to this event since the RPS operated in accordance with design, and all EFAS components were verified to have actuated as required.

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G. ADDITIONAL INFORMATION:

1. Component Failure Information:

Not applicable

2. Previous LERs for Similar Events:

None

3. Results of NPRDS Search:

Not applicable

4. Additional Information

The digital multi-function meters were originally scheduled to be installed during the Unit 2 Cycle 5 refueling outage; however, the meters were received from the manufacturer late in the outage and contained scales which differed from what was specified. Meters with appropriate scales have been re-ordered and will be installed (after receipt of the correct meters) during the next refueling outage for Unit 3 and during the next outage of sufficient duration for Unit 2.