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SUBJECT: LER 90-006-00:on 900510,fuel movement w/inoperable source
range monitor.
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June 11, 1990

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

Subject: Docket No. 50-362
30-Day Report
Licensee Event Report No. 90-006
San Onofre Nuclear Generating Station, Unit 3

Pursuant to 10 CFR 50.73(d), this submittal provides the required 30-day written Licensee Event Report (LER) for an occurrence involving core alterations. 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. 90-006

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
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LICENSEE EVENT REPORT (LER)

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

Title (4)

UNIT 3 FUEL MOVEMENT WITH AN INOPERABLE SOURCE RANGE MONITOR

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 5	1 0	9 0	9 0	0 0 6	0 0	0 6	1 1	9 0	NONE	0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9): 6

POWER LEVEL (10): 0 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10CFR (Check one or more of the following) (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)	X 50.36(c)(2)	__ 50.73(a)(2)(vii)	__ Other (Specify in Abstract below and in text)
__ 20.405(a)(1)(iii)	X 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, Vice President and Site Manager	AREA CODE 7 1 4 — 3 6 8 - 9 4 7 0

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS

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)

On May 10, 1990, with Unit 3 in Mode 6, contrary to the requirements of Technical Specifications (TS) 3.9.2, core alterations were initiated with one source range detector operable. TS 3.9.2. requires that two source range detectors be operable for fuel movement. At that time, Excore Safety Log Channels "C" and "D" were being used as source range monitors. At 0740 on May 11, 1990, a control room engineer observed that channel "C" did not meet the acceptance criteria for Signal-to-Noise-Ratio (SNR) and fuel movement was secured. Further investigation revealed that a high noise level in channel "C" had resulted in a SNR not meeting the operability acceptance criteria specified in procedure SO23-X-7, "Nuclear Fuel Movement." At 0640 on 5/12/90, following verification that excore channel "A" met the operability acceptance criteria specified in procedure SO23-X-7, core reload was resumed.

The root cause of this event was the failure to determine the inoperability of excore channel "C" prior to core reload due to personnel error. Contributing causes included procedural deficiencies and training weaknesses. Corrective actions include appropriate disciplinary action, procedure revisions, and reviewing the event with appropriate personnel.

At the time that core alterations were secured, 17 fuel assemblies were loaded in the core. The core configuration (core reload pattern) of these fuel assemblies was such that a criticality condition was not possible. As such, this event has no safety significance.

Plant: San Onofre Nuclear Generating Station
Unit: Three
Reactor Vendor: Combustion Engineering
Event Date: 05-10-90
Time: 1925

A. CONDITIONS AT TIME OF THE EVENT:

Mode: 6, Core Alterations
RCS Temperature: Approximately 72 Degrees F.

B. BACKGROUND INFORMATION:

1. Excore Neutron Flux Monitoring System:

The excore neutron flux monitoring system [IG] includes neutron detectors [DET] located around the reactor core [AC] and signal conditioning equipment located in the containment building [NH], control area [NA], and in the penetration area. Neutron flux is monitored from source levels through full power operation, and signal outputs are provided for reactor control, reactor protection [JC], and information display. A total of eight channels of instrumentation are provided; two are source range channels, two are control channels (which were not involved in this event and will not be discussed), and four are safety channels.

The two source range channels provide source level neutron flux information from 1E-1 to 1E+5 counts per second (cps) to the reactor operator for use during extended shutdown periods, initial reactor startup, and startup after extended periods of reactor shutdown, such as core refueling operations. Each channel consists of a fission chamber - type detector, one amplifier [AMP], a signal processor, logarithmic amplifier, and test circuitry. These channels provide readout and audio count rate information but have no direct control or protective functions.

The four safety channels provide neutron flux information from routine startup neutron flux levels to 200% of rated power, covering a range of approximately 2E-8% to 200% power (10 decades). Each channel consists of three fission chambers, a preamplifier, and a signal processing drawer, a logarithmic amplifier, linear amplifiers, test circuitry, and a rate of change of power circuit. These channels input to the Reactor Protection System (RPS) and provide information for rate of change of power display, Departure from Nucleate Boiling Ratio (DNBR), Local Power Density (LPD), and overpower protection.

2. Temporary Facility Modification (TFM):

A TFM is required for a facility structure, system, or component which, when used to perform its function as part of the facility, is in an other-than-as-designed condition.

The Source Range Excore Neutron Flux Monitor System was removed from service to resolve a previously identified Environmental Qualification (EQ) deficiency and was unavailable for refueling operations. A TFM was prepared and implemented which provided the excore safety channel log power indication and nuclear instrumentation drawer output to be used as an alternate source range monitoring system. In addition, the TFM provided an alternate boron dilution alarm by resetting the log high power pre-trip to a value that would provide ample warning to the operator prior to reactor criticality. This TFM was successfully utilized on Unit 2 last refueling outage (Unit 2, Cycle 5) to resolve the same EQ issue on Unit 2.

3. San Onofre Nuclear Generating Station (SONGS) Refueling Procedure Information:

SONGS Refueling Procedure, SO23-X-7, "Nuclear Fuel Movement," requires that a special response check of the excore detectors be performed prior to loading fuel into a defueled reactor vessel. The response check is referred to as a fuel bundle "wave" and is accomplished by moving a single fuel assembly with a neutron source into the core and passing ("waving") it near adjacent neutron detectors to establish a signal rate which is compared to a base "noise" rate. The noise rate is determined by measuring the neutron counts of the defueled core. A Signal-to-Noise-Ratio (SNR) is then computed based on these measurements. To ensure that the neutron flux measuring system is sensitive enough to detect changes in the reactivity condition of the core, a SNR of two or greater for each of the two required excore detectors is required by procedure SO23-X-7.

During refueling operations, a refueling engineer (utility, non-licensed) and a senior reactor operator (utility, licensed) are stationed in containment on the refueling machine [DF]. A control room engineer (utility and non-utility, non-licensed) and a reactor operator (utility, licensed) are stationed in the control room. The refueling engineer and senior reactor operator in containment perform the fuel bundle "wave" while the control room engineer and the reactor operator monitor neutron flux levels in the core, record "noise" counts, collect fuel bundle "wave" data, and calculate the SNR.

4. Technical Specification (TS) 3.9.2, "Refueling Operations, Instrumentation":

TS 3.9.2 requires that a minimum of two source range neutron flux monitors be OPERABLE and operating, each having continuous visual indication in the control room and one having audible indication in the containment and control room while in Mode 6. Action A states, "with one of the above required monitors inoperable or not operating, immediately suspend all operations involving CORE ALTERATIONS or positive reactivity changes."

TS 4.9.2 surveillance requirements require that each source range neutron flux monitor shall be demonstrated OPERABLE by the performance of:

a. A channel check at least once per 12 hours,

b. A channel functional test within 8 hours prior to the initial start of core alterations, and

c. A channel functional test at least once per 7 days.

The Basis of TS 3.9.2 states that the OPERABILITY of the source range neutron flux monitors ensures that redundant monitoring capability is available to detect changes in the reactivity condition of the core.

5. Portable Instrumentation Used In Refueling Operations:

A scaler [CTR] is a portable instrument with a digital display used in refueling operations. The scaler counts neutron pulses over a given time interval and then provides a digital display of the total counts for the given time interval.

A count rate plotter [PLOT] is a portable strip chart recorder that provides real time indication of neutron flux levels in the core which is used for trending neutron flux levels.

C. DESCRIPTION OF THE EVENT:

1. Event:

At 1925 on May 10, 1990, with Unit 3 in Mode 6, a fuel bundle "wave" commenced for excore channels "A," "B," "C," and "D" in preparation for core reload. Excore channels "C" and "D" (outputs were connected to a scaler and channel "D" output was connected to the count rate plotter) were selected to meet the requirements for two source range monitors operable in accordance with TS 3.9.2. These two excore channels had satisfied the operability requirements of TS 4.9.2. At approximately 2142 on May 10, 1990, core reload commenced with only one source range detector (channel "D") meeting the SNR acceptance criteria (SNR > 2). This continued until 0740 on May 11, 1990, when the day shift control room engineer observed that neutron counts on channel "C" were decreasing as fuel was being added to the core instead of remaining the same or slightly increasing. Further investigation revealed that a high noise level in channel "C" had resulted in a SNR of less than two during the fuel bundle "wave" and thus, did not meet the operability acceptance criteria specified in procedure SO23-X-7. At that time, core alterations were secured to investigate noise on channel "C." At 1040 on May 11, 1990, core alterations were re-initiated (fuel bundle "wave") to verify excore channels "C" and "D" response. At 1420 on May 11, 1990, channel "C" was declared inoperable and in accordance with TS 3.9.2, core alterations were secured. This represented a condition contrary to the requirements of TS 3.9.2 in that fuel movement had occurred with only one operable source range monitor. When this condition was discovered, 17 fuel assemblies had been loaded into the core. At 1720 on 5/11/90, channel "A" was verified to have an acceptable SNR. At 0640 on 5/12/90, core reload continued with both channels "A" and "D" meeting the SNR acceptance criteria specified in SO23-X-7.

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

   None.

3. Sequence of Events:

DATE	TIME	ACTION
5/10/90	1925	Unit 3 core fuel bundle "wave" commenced for excore channels A, B, C, and D. Channels "C" and "D" were selected for core reload.
5/10/90	~2142	Core reload commenced with only one operable source range monitor (channel "D").
5/11/90	0740	Unacceptable channel "C" SNR was discovered and core alterations secured to investigate noise in channel "C."
5/11/90	1040	Core alterations were re-initiated to verify excore channels "C" and "D" response.
5/11/90	1420	Excore channel "C" declared inoperable and core alterations secured.
5/11/90	1720	Excore channel "A" verified operable for use in core reload.

5/12/90	0640	Recommenced core alterations (core reload) with channels "A" and "D" meeting SNR acceptance criteria.

4. Method of Discovery:

A control room engineer observed that neutron counts on channel "C" were decreasing as fuel was being added to the core instead of remaining the same or slightly increasing. The observed decrease in counts for channel "C" was due to the noise level in the channel decreasing. Further investigation revealed that the SNR acceptance criteria (greater than or equal to 2) had not been achieved for channel "C" during the fuel bundle "wave."

5. Personnel Actions and Analysis of Actions:

Upon discovery that only excore channel "D" was operable during core reload, the control room engineer had core alterations secured in accordance with procedure SO23-X-7.

6. Safety System Responses:

Not applicable.

D. CAUSE OF THE EVENT:

1. Root Cause:

The root cause of this event was the failure to determine the inoperability of excore channel "C" (which was being used as a source range monitor) prior to core reload due to cognitive personnel error by control room personnel as described below:

a. The control room engineer did not adequately review and understand appropriate sections of Refueling Procedure SO23-X-7, for which he was responsible for performing. Specifically, he did not review and understand in sufficient detail Attachment 3 of SO23-X-7, which specifies the SNR acceptance criteria and the actions to be taken if an unacceptable SNR is calculated. The control room engineer failed to notify the refueling engineer of the unacceptable SNR for channel "C."

b. Operations personnel (utility, licensed) failed to associate the high noise that was exhibited by channel "C" with instrumentation operability.

2. Contributing Causes:

   a. Procedural Deficiencies:

      1) Refueling Procedure, SO23-X-7, "Nuclear Fuel Movement:"

         a) SO23-X-7 describes a complex activity and this event has shown that the procedure could be improved from a human performance standpoint.

         b) Data Sheet 3-1, "Monitoring Channel Response Check," of Attachment 3 did not require that the calculated SNR be independently reviewed and approved as meeting the stated acceptance criteria.

      2) Operations Procedure, SO23-3-3.25.1, "Once A Shift Surveillance (Modes 5-6)," channel check acceptance criteria for Mode 6 requires that the source range instruments be indicating and neutron count rate be heard via speakers in containment and the control room. This acceptance criteria was not sufficient to adequately determine the operability status of source range monitors with noise levels present. The effects of channel noise impacting operability is not tied to the acceptance criteria of the surveillance.

   b. Communication Deficiency:

      The control room engineer was concerned that channel "C" was exhibiting excessive noise but he failed to communicate that concern to the refueling engineer.

   c. Training Weaknesses:

      Qualified refueling engineers provided training to Operations and non-refueling group personnel. Although the training addressed neutron measurement and SNR requirements, it did not sufficiently emphasize the differences to be expected in neutron flux levels during refueling operations vs. the flux levels expected in a normal reactor startup. As a result, these personnel did not fully understand the importance of an acceptable SNR.

E. CORRECTIVE ACTIONS:

1. Corrective Actions Taken:

   a. Disciplinary action has been taken with appropriate control room personnel.

b. Following the event, the control room engineer position was upgraded temporarily such that only senior engineers qualified as refueling engineers, were used for the balance of the core reload.

c. SO23-X-7 has been enhanced as follows:

1. The data recorder and the control room engineer/reactor operator are required to review and sign the data sheet which computes the SNR (data sheet 3-1 of Attachment 3).

2. Adding/specifying functional response checks in 3 areas:

a. Response check of the detector channel(s) with a fuel assembly containing a source when the reactor vessel is empty.

b. Response check of the detector channel(s) when the reactor vessel has several fuel assemblies.

c. Response checks of the detector channel(s) for retest purposes.

3. Adding specific individuals to be contacted if a SNR is unacceptable.

d. This event was reviewed with appropriate Refueling personnel, stressing the importance of an acceptable SNR and the actions to be taken if an acceptable SNR is not achieved. The review also stressed the importance of good communications during refueling operations.

2. Planned Corrective Actions:

a. This event will be reviewed with appropriate Operations personnel. The review will stress the importance of the SNR with respect to channel operability.

b. Procedure SO23-X-7, will be revised to facilitate ease of use.

c. Operations Procedure, SO23-3-3.25.1, "Once A Shift Surveillance (Modes 5-6)," will be revised to incorporate adequate source range channel checks which will enable Operations personnel to determine the operability status of source range instruments.

d. Initial license operator training and operator requalification training will be enhanced to provide additional instruction in refueling operations. The training will cover in part, Operations involvement with SNR, expected neutron count rates during fuel bundle "waves," and in general terms, the effect of noise on detector instrumentation.

e. A Site Support Service Division Investigation Report (DIR) is being performed. Based on the results of the DIR, additional actions will be taken as appropriate.

f. A Human Performance Enhancement System (HPES) investigation is being performed. Based on the results of the HPES, additional corrective actions will be taken as appropriate.

g. As an enhancement to the channel functional test for the source range detectors, appropriate Maintenance procedures will be revised.

F. SAFETY SIGNIFICANCE OF THE EVENT:

This event has no safety significance. When the determination was made that only one source range channel was operable during fuel movement, core alterations were secured. At that time, 17 fuel assemblies were loaded in the core. Of the 17 fuel assemblies, seven were spent fuel assemblies and ten were new fuel assemblies. Of the ten new assemblies, two contained full length control element assemblies and two contained neutron sources. The core configuration (core reload pattern) of the 17 fuel assemblies was such that a criticality condition occurring in the core would not have been possible.

G. ADDITIONAL INFORMATION:

1. Component Failure Information:

   Not applicable.

2. Previous LERs for Similar Events:

   None.

3. Results of NPRDS Search:

   Not applicable.

4. Improper Voltage Setpoint Adjustments for the Boron Dilution Alarm:

   The boron dilution alarm is to provide warning to the operator in the event of a uncontrolled dilution of the reactor. The limiting condition for this event is during Mode 5 operation with 3 charging pumps providing dilution. Design analyses show that a boron dilution alarm would annunciate at least 15 minutes before criticality. The alarm is not credited to prevent other reactivity changes such as fuel misload.

The TFM that justified using the excore safety channel log power indication as an alternate source range monitoring system also provided boron dilution alarm capability. The boron dilution alarm was provided by resetting each excore channel's Log High Power pre-trip setpoint to either a fixed value (1.176+/-0.025 VDC) that would approximate the estimated detector output when K_{eff} is 0.95 or a variable value (0.275+/-0.025 VDC) above the current detector reading as observed over a 15-minute period. Either of these setpoint adjustment methods would meet the design requirements of the normal start up channel alarms. The initial (pre-fuel load) setpoint adjustments were based on alarm actuation when K_{eff} reached approximately 0.95.

At 1940 on May 10, 1990, due to high noise levels on channel "C" resulting in spurious boron dilution alarm actuations in the control room, Operations notified Maintenance to adjust the boron dilution alarm setpoint to prevent the spurious alarms. The intent was to reset the alarm setpoint 0.3 VDC above each detector's present reading. However, the highest reading detector (channel "C") was selected for calculating the setpoint of all four channels. This led to all four channel alarms being set at 0.3 VDC above channel "C" (which was later determined to be inoperable). The misadjustment of the boron dilution alarm setpoints remained in effect until 1600 on May 14, 1990, at which time the error was recognized and corrected. The cause of the setpoint misadjustment was that the TFM did not clearly convey what was expected (e.g., adjust the boron dilution alarm setpoint on a channel-by-channel basis). As a corrective action, this event has been reviewed with appropriate personnel involved with the development of the TFM and work plan.

The results of analysis performed to investigate the potential consequence of the improper settings indicate that the boron dilution alarm would have provided the necessary warning for Operations. Based on steady state, sub-critical multiplication ratios, all channels would have alarmed prior to exceeding a K_{eff} of 0.992. Thus, for a slow addition of reactivity, each excore safety channel log power detector would have provided ample notification to Operations to prevent criticality.