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 9

Title (4)

TECHNICAL SPECIFICATION CRITERIA FOR CONTROL ELEMENT ASSEMBLY DROP TIME EXCEEDED DUE TO INCORRECT TESTING METHOD

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)
									SONGS, UNIT 3	0 5 0 0 0 3 6 2
0 8	1 5	8 8	8 8	0 3 1	0 1	0 7	1 2	8 9		0 5 0 0 0

OPERATING MODE (9): 1

POWER LEVEL (10): 1 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 (AREA CODE)
H. E. Morgan, Station Manager	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	MANUFAC-TURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)

___ Yes (If yes, complete EXPECTED SUBMISSION DATE)   XX NO

Expected Submission Date (15): Month ___ Day ___ Year ___

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

In May 1988, Arkansas Nuclear One (ANO) performed control element assembly (CEA) drop time testing using a new test method. From the test results, ANO discovered that the method for performing CEA drop time testing used for previous cycles had not accurately reflected the actual CEA drop time associated with a reactor trip (See LER 88-009, Docket No. 50-368). An inherent time delay factor of 250 milliseconds (ms) caused by the design of the electrical system for the CEA drive mechanisms was not recognized or accounted for during the development and implementation of the procedure specifying the test method to be used to measure CEA drop times. Since similar design and testing provisions existed at San Onofre Units 2 and 3, a Technical Specification (TS) amendment, revising allowable CEA drop time from 3.0 to 3.2 seconds, was requested and issued for Units 2 and 3 on 8/10/88.

On 8/15/88, with Unit 3 in Mode 3 operation following the Cycle 4 refueling outage, CEA drop time testing was conducted using the new method. From this testing, on 8/15, it was determined that a delay factor of about 400 ms was not accounted for during previous drop time tests, and that some CEAs in Units 2 and 3 may have exceeded the allowable TS drop time of 3.0 seconds during previous cycles. On 8/15, with Unit 2 in Mode 1 at 100% power, the TS amendment was implemented on Unit 2 by installing the appropriate Core Protection Calculator constants.

Further evaluation of plant data has determined that the increase in coil decay times for Units 2 and 3 is about 450 ms, resulting in several CEAs of both Units exceeding the 3.0 second TS criteria. Although all CEAs satisfy the current TS criteria of 3.2 seconds, a TS amendment will be submitted to provide more margin between test results and TS limits.

8907180483 890712
PDR ADOCK 05000206
S PNU

Plant: San Onofre Nuclear Generating Station
Units: Two and Three
Reactor Vendor: Combustion Engineering
Event Date: August 15, 1988

A. CONDITIONS AT TIME OF THE EVENT:

Unit 2: Mode 1 (Power Operation) at 100% reactor power.
Unit 3: Mode 3 (Hot Standby).

B. BACKGROUND INFORMATION:

Technical Specification (TS) 3.1.3.4 pertaining to Control Element Assembly (CEA) (EIIS Component Code ROD) (EIIS System Code AA) Drop Time currently specifies that the full length (shutdown and regulating) CEA drop time shall be less than or equal to 3.2 seconds. This drop time is the time it takes for a fully withdrawn CEA to reach its 90% insertion position from when the electrical power is interrupted to the CEA drive mechanism. TS Surveillance Requirement 4.1.3.4 requires measurement of CEA drop time at least once every 18 months.

Prior to issuance of a TS amendment for Units 2 and 3 in August 1988, TS 3.1.3.4 required a maximum drop time of 3.0 seconds. An increase in allowable drop time was required because CEA drop time test results at Arkansas Nuclear One (ANO) Unit 2 using a new test method revealed a non-conservative factor associated with the "traditional" test method.

The "traditional" method of measuring CEA drop time involved testing each CEA individually by interrupting electrical power to Control Element Drive Mechanism (CEDM) from individual CEDM breakers. A chart recorder (visicorder) was connected to the subject CEA Reed Switch Position Transmitter (RSPT) to provide the position and to the upper gripper coil to show when current was interrupted to the CEA gripper. The CEA was then withdrawn from the core to its full out position; the visicorder was switched on to high speed; the CEA was dropped by opening its individual circuit breaker. Position of the CEA as a function of time was recorded on the visicorder chart in the form of the changing RSPT signal. From this chart the time from interruption of power to 90% CEA insertion was determined.

During the Unit 2 Cycle 4 drop time testing in December 1987, a new methodology was used to measure CEA drop times. This method uses special Combustion Engineering (CE) software loaded into one of the Control Element Assembly Calculators (CEAC) which utilizes the selected CEAC as a specialized high speed data acquisition system capable of initiating a reactor trip and monitoring all 91 CEA positions every 50 milliseconds through their individual RSPTs. The data may then be transferred for permanent storage or analysis. The special software (CEA Drop Time Test, or CDTT software) initiates the test by transmitting a large penalty factor to each of the Core Protection Calculator (CPC) channels, producing a reactor trip. It should be noted that the point at which power is interrupted to the CEA drive mechanism during an actual reactor trip is the reactor trip circuit breakers (RTCB), not the individual CEA breakers as in the traditional method.

Because the CDTT software begins sampling data as soon as it issues the penalty factor, the recorded drop times must be corrected for the delay time which is associated with the CPC processing time and actuation of the trip logic and trip breakers. This delay is part of the CPC instrumentation response time and is therefore already accounted for in other testing. This delay time is determined by monitoring a target CEA during its drop using a visicorder which is connected to the CEA in the same way as done for the traditional method. The visicorder trace drop time and the CDTT computed drop time are then compared to determine the delay time in the CDTT output to be subtracted from each CEA drop time.

During the Unit 2 Cycle 4 drop time testing, this new method produced results which indicated that several CEAs were close to the 3.0 seconds limit. Due to the nature of the rod drop test, it is not possible to simulate the test condition and completely verify the proper operation of the software until the actual test is performed. Since this was the first time in using the CDTT software, there was little confidence in its accuracy; drop time measurements were therefore reperformed for the 6 slowest CEAs using the previous established method with visicorder traces for individual rods. While it was found that the new software produced measurements about 560 milliseconds slower (minus an assumed nominal 200 millisecond processing time) than the visicorder method, this did not create much concern since results of the retest indicated that the drop times for all Unit 2 CEAs continued to satisfy the TS criteria of 3.0 seconds.

In May 1988, a similar rod drop test using the CDTT software was performed at ANO Unit 2. ANO discovered that the time it takes each CEA holding coil to release the CEA was increased by approximately 250 milliseconds when the CEAs were tripped using the RTCBs instead of the individual CEDM breaker (See LER 88-009, Docket No. 50-368). Since it was then realized that San Onofre Units 2 and 3 would experience a similar delay in actual rod drop times, SCE obtained a TS change in CEA drop time criteria from 3.0 to 3.2 seconds. On August 10, 1988, the NRC issued amendments to Units 2 and 3 TSs, which revised TS Section 3.1.3.4 to increase the allowable time for insertion of CEAs from 3.0 seconds to 3.2 seconds.

C. DESCRIPTION OF THE EVENT:

1. Event:

On August 13, 1988, Unit 3, Cycle 4 CEA Drop Test using the new method was conducted. CEA drop times were approximately 460 milliseconds greater than visicorder times seen in the previous cycle. The test was intended to actually measure the CPC processing time and the holding coil decay time. However, due to a problem with communication during the test, the visicorder was not started in time to determine these parameters. On the basis of assuming a processing time of 200 milliseconds, all CEAs met the 3.2 second TS requirement. The entire rod drop test was reperformed on August 15 to measure CPC processing time (based on the difference between the visicorder and the CCDT indicated times) and the increase in holding coil decay time. The processing time was determined to be about 60 milliseconds. Information from this testing indicated that the CEA holding coil decay time increases by about 400 milliseconds when the CEAs are tripped from the RTCBs instead of from the individual CEA circuit breakers. Using the results from the second full rod drop test, all CEAs in Unit 3 Cycle 4 met the new TS criteria of 3.2 seconds.

Assuming that a holding coil delay of 400 milliseconds measured for Unit 3 would be the same for Unit 2, then it would follow that the actual Unit 2 Cycle 4 CPC processing time is 160 milliseconds (e.g., processing time is that portion of the total observed increase of 560 milliseconds from Unit 2 Cycle 4 testing compared to previous cycles, minus a holding coil decay factor of 400 milliseconds). The actual processing time will vary from test to test, depending on the timing of the 4 CPC channels at the start of the test. Using this value instead of the 200 milliseconds assumed at the time, five of the 6 slowest Unit 2 CEAs met the 3.0 second drop time requirement. The drop time for the slowest Unit 2 CEA was 3.17 seconds without correction for CPC processing time. If 160 milliseconds is used instead of the assumed 200 milliseconds then the drop time for this CEA may have been 3.01 seconds. But there is uncertainty associated with the use of the Unit 3 holding coil delay increase to determine the Unit 2 CPC processing time. The holding coil delay is highly plant specific as it is dependent on the "as built" configuration of the wiring, and it may well be slightly different between Units 2 and 3.

Realizing that some Unit 2 CEAs could potentially exceed the 3.0 second requirement, SCE considered it prudent to implement the provisions of the approved CEA drop time increase on Unit 2, even though the TS amendment did not require completion of implementation before September 9, 1988. CE was contacted on August 15, after information about the first Unit 3 rod drop test and specific processing times from ANO became available, and CE provided SCE with CPC constant changes in order to ensure that Unit 2 continued to satisfy the 3.2 seconds drop time requirements. On August 15, at 1700, the new constants were installed in Unit 2, thereby fully implementing the TS amendment.

CEA 64 in Unit 3 has historically been the slowest (2.90 seconds, Cycle 1 visicorder measurement). This would equate to a worst case of 3.3 seconds by applying the 400 millisecond additional time delay. CEA 64 was replaced prior to Cycle 4 because of a history of slower drop times.

In conclusion, Unit 3 probably did exceed the 3.0 second rod drop time in Cycles 1, 2 and 3 after taking into account the additional coil decay time seen from the Cycle 4 CEAC Rod Drop Test. This was a condition prohibited by plant TSs. Since this condition was identified in August 1988, this LER is delinquent. (See Section G.4 for discussion on reportability evaluation.)

Without actually measuring the Unit 2 CPC processing time, the additional coil decay time for Unit 2 could not be determined. Thus, it could not be conclusively determined whether any Unit 2 CEAs ever exceeded the 3.0 second drop time requirement.

An opportunity to determine the Unit 2 CPC processing times arose after Unit 3 automatically tripped on January 6, 1989 (see LER 89-001, Docket No. 50-362), and after Unit 2 was manually tripped on January 12, 1989 (see LER 89-

001, Docket No. 50-361). By obtaining CPC trip times from the Plant Monitoring System (PMS) Sequence of Events recorder data and CEA position indications from the CPC trip buffer, and comparing this information with the previous Unit 3 Cycle 4 CDTT rod drop times, the CPC processing time for Unit 3 was calculated to be 56 $\pm$ 18 milliseconds. This CPC processing time agrees with the 60 millisecond value measured during the Cycle 4 drop testing. Therefore, this method of determining CPC processing time from trip data appears to be valid. Applying this method to the data obtained from the Unit 2 trip on January 12, 1989, it was determined that the CPC processing time for Unit 2 was 69 $\pm$ 20 milliseconds.

Based on the above approximations, it is calculated that the increase in coil decay times for Units 2 and 3 is about 482 and 443 milliseconds, respectively. From this, it is estimated that approximately 29 Unit 2 CEAs failed to meet the previous TS drop time requirement of 3.0 seconds. However, all Unit 2 CEAs satisfy the current 3.2 second TS drop time requirement.

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

None.

3. Sequence of Events:

DATE	ACTION
12/87	The first CEA drop time testing using CDTT software at Unit 2 during the Cycle 4 outage.
5/88	CEDM coil decay factor identified during ANO Unit 2 testing.
8/10/88	TS amendment issued, revising Units 2 and 3 CEA drop time criteria from 3.0 to 3.2 seconds.
8/13/88	The first CEA drop time testing using CDTT software at Unit 3 was performed. Processing time and coil decay time were not measured due to an error in visicorder trace initiation.
8/15/88	Unit 2 CPC constant changes installed to permit operation with CEA drop times of 3.2 seconds.
8/15/88	Unit 3 CEA drop time testing performed satisfactory using CCDT software. Increased coil decay time was found to be 400 milliseconds.

4. Method of Discovery:

This event was discovered when the additional coil decay time calculated from the Unit 3 test results were applied to previous test data for Units 2 and 3.

5. Personnel Actions and Analysis of Actions:

   Not applicable.

6. Safety System Responses:

   Not applicable.

D. CAUSE OF THE EVENT:

1. Immediate Cause:

   Unit 3 Cycle 4 testing utilizing the new test method revealed an additional time delay factor due to circuit time constraints associated with the electromagnetic decay of multiple CEDM coils tied together versus the decay time of an individual coil isolated from the other CEDM coils. The traditional method of response time testing provided coil discharge time of less than 0.3 seconds. The traditional method was the one used at all other CE sites. Although valid for earlier CE plants, this method is invalid for ANO and later plants due to a change in the Control Element Drive Mechanism Control System (CEDMCS) design by CE. One effect from the design change was that the energy stored in the holding coil was no longer dissipated through a resistor. The time for the energy to dissipate through the resistor established the response time. The new method of response time testing (power removal by opening trip circuit breakers) is representative of the actual conditions which would occur upon receipt of a manual or automatic reactor trip signal from the reactor protection system. The new method measures longer drop times than the traditional method as it takes longer to dissipate energy stored in all of the CEDM coils with the dissipating resistor effectively bypassed.

2. Root Cause:

   The CEDMCS design supplied by CE had introduced an additional time delay factor due to circuit time constants associated with the electromagnetic decay of multiple CEDM coils versus the decay time for an individual coil. This increased coil decay time was not identified by CE at the time it was implemented at ANO and subsequent plants (including SONGS Units 2 and 3). Consequently, when the CEDMCS design was implemented, the procedure specifying the method to be used to measure CEA drop times was based on the historical method which did not account for the additional time delay factor.

E. CORRECTIVE ACTIONS:

1. Corrective Actions Taken:

   a. Compliance with TS 3.1.3.4 has been restored for Units 2 and 3 by implementing the TS amendment.

   b. Appropriate surveillance procedures were revised to properly measure CEA drop times.

c. Since CE has been made aware of the incorrect test method through industry correspondence regarding this matter, corrective action to address the root cause is not required on SCE's part.

2. Planned Corrective Actions:

After analyzing the results of the Units 2 and 3 Cycle 4 drop time tests, it was determined that the current TS allowable time of 3.2 seconds does not provide sufficient margin for variations from test to test. This criteria is based on the analytical method which assumes that all CEAs drop at the same rate as the slowest CEA. A new analysis, based on the assumption that all CEAs drop at the same rate as the average CEA rather than the slowest CEA, has been performed with satisfactory results. Therefore, a TS amendment request to revise the drop time acceptance criteria to one that is based on an average CEA drop time will be submitted.

F. SAFETY SIGNIFICANCE OF THE EVENT:

An evaluation of the increase in CEA drop times for Units 2 and 3 for Cycles 1, 2 and 3 concluded that the longer drop time did not have any safety significance. The analyses model reactivity insertion assuming all CEAs are inserted at the TS limit, or slowest acceptable times. CE reviewed the effects of ANO's longer drop time on the accident analyses and concluded that it is appropriate to apply an average drop time instead of the maximum drop time. The total amount of negative reactivity added to the core at 3.0 seconds, following interruption of electrical power to the CEA's, would have always exceeded the amount assumed by the safety analyses.

More sophisticated 3-D analysis has shown that there was additional margin over what had previously been assumed. Furthermore, measured response times for other plant protection system components are significantly less than assumed in the safety analysis (e.g. measured Reactor Trip Breaker response times of 33 milliseconds versus 150 milliseconds assumed). Thus, because of the conservatisms discussed above, the overall plant response would have continued to satisfy the safety analysis assumptions regarding reactivity insertion.

G. ADDITIONAL INFORMATION:

1. Component Failure Information:

Not applicable.

2. Previous LERs on Similar Events:

None.

3. Results of NPRDS Search:

Not applicable.

4. Reportability Evaluation:

In August 1988, an incorrect judgment of non-reportability was made. Several factors contributed to SCE's judgment. These factors included the fact that there was minimal safety significance, that the NRC was aware of the holding coil decay issue through other correspondence and that this information had been disseminated to the industry by NRC Information Notice No. 88-47 dated July 14, 1988. SCE maintains that there was no error in reportability judgment with respect to Unit 2 since, until CPC processing time was calculated in January 1989, there was a lack of conclusive data that any CEAs had failed to satisfy the CEA drop time requirement. Regarding Unit 3, because it was judged that conditions need to be evaluated for reportability against the current docket criteria, SCE's review focused on the amended TS being properly implemented (i.e., CPC constant changes were properly installed) rather than on previous cycles governed under past criteria. Had SCE personnel recognized the need to review as-found conditions against previous less conservative criteria, additional effort would have been taken in evaluating this condition for reportability, and the need to submit a LER for a condition prohibited by TS would have been realized.

As corrective action, Compliance personnel responsible for reportability evaluations have been instructed on the need to consider reportability of conditions found to be less conservative than previous NRC docketed requirements. In addition, augmented reportability guidance used by Compliance personnel has been supplemented by this example.

5. CDTT Software Initial Implementation (Unit 2 Cycle 4):

One aspect of this event involved the improper assumption of a "nominal" 200 millisecond CPC processing time during the Unit 2 Cycle 4 CEA drop time testing while attempting to utilize the CDTT software for the first time. When this processing time was actually measured, as recommended by the vendor, it was determined to be about 60 milliseconds, resulting in rod drop calculation non-conservatism of about 140 milliseconds. Had actual processing time been measured during the Unit 2 Cycle 4 test, CEA drop time results would have indicated a greater offset from previous drop time data with several CEAs failing the TS criteria of 3.0 seconds, and the validity of using the CDTT software would have been further examined at that time.

The engineer tasked with implementing the new CDTT software questioned the use of the nominal 200 millisecond processing time and decided that it was valid since this value was about the same as the CPC processing times recorded on data sheets for various plant protection system (PPS) response time tests. The engineer did not realize that the processing times from PPS testing are also assumed values which are significantly larger than actual processing times (however, conservative with respect to determining total PPS response times).

Since all CEAs passed the 3.0 second TS criteria using either test method, the engineer elected at that time to not pursue the cause of the change in the CEA drop times from one method to the other. It should be noted that, with respect to plant safety, the parameter of interest is the sum of instrument response time and CEA drop time. By selecting the instrument response time reported for PPS testing, the engineer was assured that the sum of the two (3.2 seconds in this case) remained within the total time assumed in the accident analyses. This perspective contributed to the engineer's decision of not further examining the new test method at that time.

The Station Technical Manager (acting) has forwarded a memorandum to all Station Technical Division engineers discussing this event and stressing the importance of pursuing root cause to problems to the point of understanding their implications.