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SUBJECT: Forwards reised response to NRC Question 222.44 updated for applicability to both units per 830401 commitment satisfying info requirements of License Conditions 2.C(12) & 2.C(10).Next FSAR amend will reflect revised response.

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April 20, 1983

Director, Office of Nuclear Reactor Regulation
Attention: Mr. George W. Knighton, Branch Chief
Licensing Branch No. 3
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Gentlemen:

Subject: Docket Nos. 50-361 and 50-362
San Onofre Nuclear Generating Station
Units 2 and 3

License Conditions 2.C(12) and 2.C(10) of the San Onofre Nuclear Generating Station Units 2 and 3 Operating Licenses respectively required that Southern California Edison Company (SCE) provide, by April 1, 1983, an evaluation of control system failures caused by (1) high energy line break, and (2) failure of any power sources, sensors, or sensor impulse lines which provide power or signals to two or more control systems.

SCE's letter of April 1, 1983 provided a response satisfying the first portion of the license conditions relative to high energy line break (response to NRC Question 222.43). The letter also indicated that the response relating to the second portion of the license conditions which was previously submitted as part of Amendment No. 29 to the San Onofre Units 2 and 3 FSAR (response to NRC Question 222.44), was based on Unit 2 and was being updated for applicability to both San Onofre Units 2 and 3 and that the revised response would be submitted by May 1, 1983.

Consistent with this commitment, enclosed please find seven (7) copies of the revised response to NRC Question 222.44 which is applicable to both San Onofre Units 2 and 3. SCE considers that the enclosed response to the NRC Question 222.44 in conjunction with the response to NRC Question 222.43 which was submitted on April 1, 1983 satisfy the information requirements of License Conditions 2.C(12) and 2.C(10) for San Onofre Units 2 and 3 respectively.

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The San Onofre Units 2 and 3 FSAR will be amended to reflect the revised response in the next FSAR amendment.

If you have any questions or comments, please let me know.

Very truly yours,

RW Krieger for KPBaskin

Enclosure

cc: J. B. Martin, Region V
H. Rood(To be opened by addressee only)

Question 222.44 Control System Failures

The analyses reported in Chapter 15 of the FSAR are intended to demonstrate the adequacy of safety systems in mitigating anticipated operational occurrences and accidents. Both Congress and ACRS have raised an issue on this area. Commissioner Ahearne has responded to Congress regarding this issue (Refer to attachment to this enclosure) and part of his response referred to control system reviews to be performed in connections with OL licensing.

Based on the conservative assumptions made in defining these Chapter 15 design-basis events and the detailed review of the analyses by the staff, it is likely that they adequately bound the consequences of single control system failures.

To provide assurance that the design basis event analyses adequately bound other more fundamental credible failures you are requested to provide the following information:

(1) Identify those control systems whose failure or malfunction could seriously impact plant safety.

(2) Indicate which, if any, of the control systems identified in (1) receive power from common power sources. The power sources considered should include all power sources whose failure or malfunction could lead to failure or malfunction of more than one control system and should extend to the effects of cascading power losses due to the failure of higher level distribution panels and load centers.

(3) Indicate which, if any, of the control systems identified in (1) receive input signals from common sensors. The sensors considered should include, but should not necessarily be limited to, common hydraulic headers or impulse lines feeding pressure, temperature, level or other signals to two or more control systems.

(4) Provide justification that any simultaneous malfunctions of the control systems identified in (2) and (3) resulting from failures or malfunctions of the applicable common power source or sensor are bounded by the analyses in Chapter 15 and would not require action or response beyond the capability of operators or safety systems.

Response

Note: Unless otherwise noted by prefix 2 or 3, all tag numbers in the following response apply to Units 2 and 3.

(1) The failures or malfunctions of the following control systems may impact plant safety. 32

- Feedwater control system (FWCS)
- Turbine generator control system (TGCS)
- Steam bypass control system (SBCS)
- Reactor regulating system (RRS)
- Control element drive mechanism control system (CEDMCS)
- Pressurizer pressure control system (PPCS)
- Pressurizer level control system (PLCS)

(2) The following common power sources have been identified as supplying power to the control systems listed in Item (1):

a. 208/120 V-ac (Volts Alternate Current) distribution panel Q0612:
Supplies power to CEDMCS, TGCS, RRS, PPCS, and PLCS

b. 208/120 V-ac distribution panel Q065:
Supplies power to CEDMCS, FWCS, SBCS, TGCS, RRS, PPCS, and PLCS

c. 480 V MCC (Motor Control Center) BO (Unit 2 only), 3BN:
Supplies power to 208/120 V-ac distribution panel Q0612 32

d. 480 V MCC BX:
Supplies power to 208/120 V-ac distribution panel Q065

e. 480 V Bus B10:
Supplies power to 480 V MCC BO (Unit 2 only)

f. 480 V Bus 3B09:
Supplies power to 480 V MCC 3BN

g. 480 V Bus B16:
Supplies power to 480 V MCC BX

h. 4.16 KV Switchgear Bus 2A08:
Supplies power to 480 V Bus 2B16 and B10 (Breaker for B10 normally closed)

i. 4.16 KV Switchgear Bus 3A08:
Supplies power to 480 V Bus 3B16 and B10 (Breaker for B10 normally open)

j. 4.16 KV Switchgear Bus 3A09:
Supplies power to 480 V Bus 3B09

k. 125 V-dc (Volts Direct Current) Distribution Panel D5P4:
Supplies control power to TGCS and SBCS

The Unit 3 motor control centers 3BN and 3BX are independently powered up to the Unit 3 auxiliary transformer.

(3) The common sensors and common instrument taps/lines which have been identified for the control systems listed in item (1) are provided in Table 222.44-1.

(4) 1. Impact of Loss of Common Power Sources

The control systems identified in (1) that receive power from common power sources are identified in (2). The effect of losing the power sources and an evaluation of plant response are provided below. The results of this evaluation provide justification that any simultaneous malfunctions of control systems identified herein resulting from common power supply malfunctions are bounded by the analyses of Chapter 15.

a. Loss of 120 V-ac from Distribution Panel Q0612

This power loss will impact the control element drive mechanism control system (CEDMCS), the turbine-generator control system (TGCS), the reactor regulating system (RRS), the pressurizer pressure control system (PPCS), and the pressurizer level control system (PLCS). The loss of power to the CEDMCS will not cause the CEAs to drop, since the CEDMCS is also powered by distribution panel Q065. The TGCS is also redundantly powered by panel Q065, and therefore, the turbine control valves will not be impacted by the loss of power from panel Q0612. The RRS, PPCS and PLCS will lose control power if their instrument channel selector switches are on the channels powered by this distribution panel. Otherwise, they will be unaffected as their instrument channel selector switches will be on the channels powered by distribution panel Q065. For the case of a power loss to the RRS, the regulating group CEAs will remain in their position prior to the power loss and the pressurizer programmed level to the PLCS will be lost. If power is lost to the PPCS, the back-up heater control and pressurizer high pressure heater cutoff capability will be lost. However, motive power to the heaters will be available for manual control. The loss of power to the PLCS will result in the loss of automatic control of the standby charging pumps, but motive power to the charging pumps will be available for manual control.

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Evaluation of Plant Response:

The loss of the CEDMCS, TGCS, RRS, PPCS, and PLCS due to the loss of 120 V-ac from power panel Q0612 will not impact plant safety. The loss of power to the RRS may result in the inability to follow turbine load

Table 222.44-1

COMMON SENSORS AND INSTRUMENT LINES/TAPS
FOR CONTROL SYSTEMS

Tap Location	Instrument	System Input
Pressurizer	PT-0100-X (Pressure) LT-0110-1 (Level-upper tap)	RRS, PPCS, SBCS PLCS
Pressurizer	PT-0100-Y (Pressure) LT-0110-2 (Level-upper tap)	RRS, PPCS, SBCS PLCS
Main Steam Line	FT-1011 (Flow)	FWCS, SBCS
Main Steam Line	FT-1021 (Flow)	FWCS, SBCS

transients. The loss of back-up heater control (due to loss of power to the PPCS) and control power to the standby charging pumps (due to loss of power to the PLCS) will not significantly impact the plant response. Should the turbine load decrease, there will be a mismatch between primary system heat generation and secondary system heat removal, which will eventually result in a reactor trip (on high pressurizer pressure). The consequences of this scenario is bounded by the loss of condenser vacuum event described in FSAR paragraph 15.2.1.3. For this event scenario, the reactor trips on a high pressurizer pressure trip signal. The radiological releases and RCS pressure increase are maximized for this event. Therefore, the consequences of a loss of power to the RRS, CEDMCS, TGCS, PPCS, and PLCS are less limiting than those for the LOCV event.

b. <u>Loss of 120 V-ac from Distribution Panel Q065</u>

This power loss will impact the control element drive mechanism control system (CEDMCS), the feedwater control system (FWCS), the steam bypass control system (SBCS), the turbine generator control system (TGCS), the reactor regulating system (RRS), the pressurizer pressure control system (PPCS), and the pressurizer level control system (PLCS).

As indicated earlier, redundant power is supplied to the CEDMCS and TGCS from panel Q0612. The loss of power to the FWCS will result in the reduction of feedwater flow to the steam generators (SGs). Additionally, the SBCS will be lost. The RRS, PPCS and PLCS will lose control power if their instrument channel selector switches are on the channels powered by this distribution panel. Otherwise control power will be unaffected, as the instrument channel selector switches will be on the channels powered by distribution panel Q0612. Additionally, power to control the main pressurizer spray valves of the PPCS and the letdown control valves of the PLCS will be lost. The loss of control power to the RRS will result in the inability of the RRS to follow small turbine load transients.

Evaluation of Plant Response:

The consequence of the RRS inability to follow turbine load transients was previously discussed. The closure of the spray valves and the letdown control valves will not significantly impact the plant response. The loss of power to the FWCS will result in a mismatch between primary system heat generation and secondary system heat removal causing an increase in pressurizer pressure and a decrease in SG level. This will cause a reactor trip either on high pressurizer pressure or low steam generator level. Due to the unavailability of the SBCS, subsequent to the turbine trip on reactor trip the main steam safety valves will open and auxiliary feedwater flow will be initiated to remove the decay heat.

The analysis of the loss of condenser vacuum (LOCV) event provided in the FSAR paragraph 15.2.1.3 assumes a loss of feedwater flow and unavailability of the SBCS on turbine trip. The primary and secondary system pressures increase rapidly for this event until the auxiliary feedwater is actuated on low SG level and the main steam safety valves are opened on high steam generator pressure. Subsequently, the atmospheric dump valves are opened when the operator takes manual actions to control RCS heat removal. Radiological releases and RCS pressure increase are maximized for this event. The consequences of a power loss to the RRS, FWCS, SBCS, CEDMCS, PPCS, and PLCS would be no more limiting than those for the LOCV event. Therefore, the FSAR analysis for this event bounds the consequences of a power loss to these control systems.

c. Loss of 480 V MCC BO (Unit 2 only), 3BN

The impact of losing this motor control center (MCC) is similar to the loss of 120 V-ac from panel Q0612, since power panel Q0612 receives power from this MCC.

Evaluation of Plant Response:

The plant response for loss of power panel Q0612 applies.

d. Loss of 480 V MCC BX

The impact of losing this MCC is similar to the loss of 120 V-ac from power panel Q065, since panel Q065 receives its power from this MCC. 32

Evaluation of Plant Response:

The plant response for loss of power panel Q065 applies.

e. Loss of 480 V Bus B10

The impact of losing this bus is similar to the loss of 120 V-ac from power panel Q0612, since this panel receives power from MCC BO which is powered from Bus B10.

Evaluation of Plant Response:

The plant response for the loss of power panel Q0612 applies.

f. Loss of 480 V Bus 3B09

The impact of losing this bus is similar to the loss of 120 V-ac from power panel Q0612, since panel 3Q0612 receives power from MCC 3BN which is powered from Bus 3B09.

Evaluation of Plant Response:

The plant response for the loss of power panel Q0612 applies.

g. Loss of 480 V Bus B16

The impact of losing this bus is similar to the loss of 120 V-ac from power panel Q065, since this panel receives power from MCC BX which is powered from Bus B16.

Evaluation of Plant Response:

The plant response for the loss of power panel Q065 applies.

h. Loss of 4.16 KV Switchgear Bus 2A08

The impact of losing this Unit 2 switchgear bus is the loss of 120 V-ac from power panels 2Q065 and 2Q0612 when the 480 V bus B10 is powered from this switchgear bus. Otherwise, a loss of 120 V-ac from power panel 2Q065 only will result. The loss of 120 V-ac from power panels 2Q065 and 2Q0612 will cause the loss of power to the CEDMCS, TGCS, RRS, FWCS, SBCS, PPCS, and PLCS. Should this happen, then the CEDMCS and the TGCS will not be redundantly powered since both power panels 2Q065 and 2Q0612 are impacted. 32

Evaluation of Plant Response:

The plant response to a loss of power to power panel 2Q065 only is described in item (4) 1.b above.

The loss of power to the CEDMCS and TGCS due to a loss of 120 V-ac from power panels 2Q065 and 2Q0612 will result in a reactor trip and turbine trip almost immediately with the reactor coolant pumps (RCPs) powered and operating. Additionally, the loss of power to the FWCS will reduce the feedwater flow to the steam generators (SGs). The reduction in feedwater flow coupled with the unavailability of the SBCS and closure of the turbine control valves will result in a heat removal imbalance between the primary and secondary systems. Consequently, the primary and secondary system pressures will increase, and the SG levels will decrease. The main steam safety valves will open and the auxiliary feedwater flow will be initiated to remove the decay heat.

The consequences of the above scenario is bounded by the loss of normal ac power event analysis provided in FSAR paragraph 15.2.1.4. For the FSAR analysis, forced reactor coolant flow is assumed to be lost due to the loss of power to the RCPs. Therefore, radiological releases and RCS pressure increase are maximized for the loss of normal ac power event. The consequences of a power loss to the CEDMCS, TGCS, RRS, FWCS, SBCS, PPCS, and PLCS would be no more limiting than those for the loss of normal ac power event.

i. Loss of 4.16 KV Switchgear Bus 3A08

The impact of losing this Unit 3 switchgear bus is a loss of 120 V-ac from power panel 3Q065 when the 480 V bus B10 is powered from switchgear bus 2A08. If, however, bus B10 is powered from switchgear bus 3A08, then a loss of 120 V-ac from power panels 3Q065 and 2Q0612 will result, impacting Units 2 and 3 individually.

Evaluation of Plant Response:

The plant response to a loss of power to panel 3Q065 is described in item (4) 1.b, and to panel 2Q0612 is provided in item (4) 1.a above.

j. Loss of 4.16 KV Switchgear Bus 3A09

The impact of losing this bus is similar to the loss of 120 V-ac from power panel Q0612, since panel 3Q0612 receives power from bus 3B09 which is powered by this switchgear bus.

Evaluation of Plant Response:

The plant response for the loss of power panel Q0612 applies.

k. Loss of 125 V-dc Distribution Panel D5P4 32

The impact of losing this distribution panel is a loss of control power to the TGCS and SBCS. The power loss to the TGCS will result in a turbine trip. Additionally, the SBCS will not be available.

Evaluation of Plant Response:

The loss of power to the TGCS and SBCS will result in a turbine trip with the SBCS unavailable. The turbine trip will produce a reduction in steam flow from the SGs to the turbine due to closure of the turbine stop valves. The turbine trip will result in a reactor trip signal from the turbine stop valves through unitized actuator pressure monitors. In the absence of a reactor trip on turbine trip, the reactor will trip on high pressurizer pressure due to the heat removal imbalance between the primary and secondary systems. The unavailability of the SBCS will result in the opening of the main steam safety valves in order to remove the decay heat. This scenario is bounded by the turbine trip event described in the FSAR paragraph 15.2.1.2.

(4) 2. Impact of Failure in Common Sensors

Description of the effect of malfunctions of the common sensors identified in Table 222.44-1 on the control systems are provided below. Additionally, an evaluation of plant response is provided. Knowledge of system design and

transient analysis was used to develop these descriptions. The results of this evaluation provide justification that any simultaneous malfunctions of control systems identified herein, resulting from common sensor malfunctions, are bounded by the analyses of FSAR Chapter 15.

a. Malfunction of Pressurizer Pressure Signal to RRS, SBCS, and PPCS

a.1 Pressurizer Pressure Signal Fails Low to RRS, SBCS, and PPCS

If a malfunction causes a low pressurizer pressure signal to be transmitted, the PPCS effect would be that the pressurizer heaters will be turned on, and the pressurizer spray valves will be shut. The pressurizer pressure is only a compensating input to the RRS, which employs the turbine load index signal to effect a CEA motion. Therefore, the regulating group CEAs will not be withdrawn or dropped due to a low pressurizer pressure signal. The SBCS will not be impacted since the pressurizer pressure input is employed only as a "bias" signal for this system.

Evaluation of Plant Response:

The effect of turning on the pressurizer heaters would be an increase in the RCS pressure. The reactor would eventually trip on high pressurizer pressure, if the operator did not take any mitigating actions. This scenario is bounded by the loss of condenser vacuum (LOCV) event analysis provided in the FSAR paragraph 15.2.1.3. This analysis assumes a loss of feedwater flow and unavailability of the SBCS. The above scenario would cause a primary to secondary heat removal imbalance and a RCS pressure rise no more limiting than the LOCV. Radiological consequences and RCS pressure increase are maximized for the LOCV event and remain well within the acceptance criteria. 32

a.2 Pressurizer Pressure Signal Fails High to RRS, SBCS, and PPCS

If a malfunction causes a high pressurizer pressure signal to be transmitted, the PPCS effect would be that the pressurizer sprays would come on and the pressurizer heaters would be de-energized. The RRS will not adjust the regulating group CEAs in response to the high pressurizer pressure signal since this is only a compensating input to this system. Additionally, the SBCS will not modulate the turbine bypass valves, since the pressurizer pressure signal is employed as a "bias" signal for determining the extent of the valve modulation required.

Evaluation of Plant Response:

The reactor would trip on a low pressurizer pressure setpoint and a SIAS may result. This scenario is bounded by the analysis presented in FSAR paragraph 15.6.3.4 for the inadvertent opening of a pressurizer safety valve. RCS depressurization is more rapid for this event. The reactor trips on a low pressurizer pressure trip setpoint, and no fuel pins experience a DNBR less than 1.19 (CE-1 CHF correlation), thus preventing any violation of the fuel thermal limits. Additionally, there are no event related offsite doses since the integrity of the primary and secondary system is maintained.

b. Malfunction of Main Steam Flow Signal to FWCS and SBCS

b.1 Main Steam Flow Signal Fails Low to FWCS and SBCS

If a malfunction causes a low steam flow signal to be transmitted, the FWCS will reduce the feedwater flow. The SBCS will not open the turbine bypass valves, since the steam flow rate is perceived by this control system as being smaller than what can be accommodated by the turbine.

Evaluation of Plant Response:

The mismatch between feedwater flow and turbine demand may produce a reactor trip on either a high pressurizer pressure or low steam generator level. The auxiliary feedwater system and manual control of the SBCS (and/or atmospheric dump valves) is available to achieve a stabilized plant condition. The loss of condenser vacuum (LOCV) event described in the FSAR paragraph 15.2.1.3 bounds this scenario as it results in a more severe secondary side transient prior to reactor trip on high pressurizer pressurizer. 32

b.2 Main Steam Flow Signal Fails High to FWCS and SBCS

If a malfunction causes a high steam flow signal to be transmitted, the FWCS will increase the feedwater flow and the SBCS may open the turbine bypass valves due to its perception of a high steam flow through the turbine.

Evaluation of Plant Response:

The mismatch between feedwater flow and turbine demand may result in an increase in the steam generator level and pressure. A high steam generator level signal would close the feedwater regulating valves and trip the turbine. A reactor trip on turbine trip or high steam generator level would follow with actuation of auxiliary feedwater on steam generator low level signal. Auxiliary feedwater and manual operation of the SBCS (and/or atmospheric dump valves) provide a mechanism for RCS heat removal to stabilize the plant.

The increase in feedwater flow (with a loss of offsite power) event analyzed in the FSAR paragraph 15.1.2.2 bounds the above scenario. This analysis assumes maximum increase in feedwater flow due to a failure in the FWCS. This maximizes the increased heat removal aspects of the transient and, therefore, results in a more adverse fuel performance transient. A turbine trip signal is generated on a high steam generator level and no credit is taken for the SBCS so that steam is released through the main steam safety valves and the ADVs.

(4) 3. Impact of Failure in Common Instrument Lines/Taps

Table 222.44-1 identifies the common instrument lines/taps that feed the sensors for the control systems identified in (1) above. The malfunctions of these sensors due to this failure may affect the performance of the RRS, SBCS, PPCS, and PLCS.

a. Evaluation of Pressure and Level Signals Failing Low Due to Instrument Tap Damage on Plant Response

This event can only be caused by the occurrence of a broken process sensing line coincident with rupture of the level transmitter diaphram. The following analysis of this event is provided.

If the failure causes a low pressure and level signals to be transmitted, the pressurizer heaters would turn on and the pressurizer spray valves would decrease flow. The PLCS would decrease letdown flow and increase charging flow. The RRS will not adjust the CEAs in response to a low pressurizer pressure signal due to reasons indicated earlier. 32

The low pressurizer pressure input to the SBCS would not cause the turbine bypass valves to open, since a low primary pressure would indicate overcooling of the primary. Due to increased charging flow and actuation of the pressurizer heaters, the reactor may trip on high pressurizer pressure. The CVCS malfunction (PLCS malfunction) event described in FSAR paragraph 15.5.2.1 bounds this scenario.

b. Evaluation of Pressure and Level Signals Failing High Due to Instrument Tap Damage on Plant Response

Failure high of the pressurizer level signal due to instrument tap damage is a credible event. Failure high of the pressurizer pressure signal is considered unlikely since a process sensing line break causes pressure to fail low and a perfect line crimp would not in itself result in a high pressure. Nevertheless, the following analysis is provided:

If the failure causes a high pressure and level signals to be transmitted then the pressurizer heaters would de-energize and the spray valves would increase flow. The RRS will not adjust the CEAs since the pressurizer pressure is a compensating input to this system. The SBCS will not open the turbine bypass valves since the pressurizer pressure is employed as a "bias" signal. The PLCS would increase letdown flow and decrease charging flow. As a result of these control system actions, a low pressurizer pressure situation may result, leading to a possible reactor trip and SIAS on low pressurizer pressure.

The reactor trip on low pressure would prevent any fuel rods from experiencing a DNBR less than 1.19 (CE-1 CHF correlation) and there is no over-pressurization. Since there is no fuel failure and release of primary fluid to the atmosphere, the letdown line break event of paragraph 15.6.3.1 clearly bounds the radiological consequences.

c. Evaluation of Pressure Signal Failing High and Level Signal Failing Low Due to Instrument Tap Damage on Plant Response:

This event is considered unlikely since it requires the process sensing line to be perfectly crimped coincident with a high pressure transient. Neverthe- 32
less, the following analysis is provided:

The plant response is similar for the PPCS, RRS, and SBCS as discussed above for the pressure signal failing high. The PLCS, however, would increase charging and decrease letdown. The increases in charging and pressurizer spray flows with no pressurizer heaters will lead initially to a low pressure condition, and subsequently to a steadily increasing pressurizer level. During the initial time period when a low pressure condition exists, the conclusions stated for the pressure and the level signals failing high also apply to this scenario.

d. Evaluation of Pressurizer Pressure Signal Failing Low and Level Signal Failing High Due to Instrument Tap Damage on Plant Response:

As discussed in the evaluation of both signals failing low, the PPCS, RRS, and SBCS response will be similar. The PLCS, however, would increase letdown flow and decrease charging flow. A reactor trip may occur as a result of low pressure, brought about by the increased letdown flow. The conclusions stated for the pressure and level signals failing high also apply to this scenario.

References

FSAR chapter 15. No FSAR change was made.