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SUBJECT: Forwards response to NRC 860909 request for addl info re SPDS. P&IDs transmitted by 861106 ltr. Info re data validation, human factor program & parameter selection provided.

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January 7, 1987

Director, Office of Nuclear Reactor Regulation
Attention: Mr. George W. Knighton, Director
PWR Project Directorate No. 7
Division of PWR Licensing - B
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

By letter dated September 9, 1986, the NRC requested that SCE provide additional information regarding the Safety Parameter Display System (SPDS) to facilitate completion of the NRC review of the SPDS. This NRC letter also requested several Piping and Instrumentation Diagrams (P&ID's) to expedite NRC review of SCE's Inservice Testing Program.

By letter dated November 6, 1986, SCE transmitted the requested P&ID's to the NRC.

The purpose of this letter is to provide the NRC with the remainder of the requested information which is contained in the attachment to this letter.

If you have any question, please contact me.

Very truly yours,

M O Medford

Enclosures

cc: Harry Rood, NRC Project Manager
F. R. Huey, USNRC Senior Resident Inspector

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RESPONSE TO NRC QUESTIONS

1.0 Isolation Devices
(Response provided by SCE to NRC letter dated May 8, 1986)

2.0 Data Validation

2.1 Valid and Invalid Data

The licensee's safety analysis contained information on out of range data, unvalidated data, and invalid data. However, it was unclear how these data were related to each other, if at all. Provide a description of the methods used to define valid data, invalid data, and unvalid data. Furthermore, describe how each type of data is coded for display, and how the data is used by operators.

SCE Response

The CFMS performs quality (validity) checking of its parameters in the logic leg algorithms and critical functions and provides this information to the Operator by informing him that because of failures, a critical function or logic leg can't complete its task.

In algorithms that have multi-inputs (cold leg temperatures, pressurizer pressure, steam generator level, boric acid makeup, HPSI cold leg flowrates, etc.), the computer decides when it does not have enough good information to be assured of a composite parameter's validity. CFMS will then color that logic leg or critical function yellow to alert the Operator and will also flag him by sector numbers to the problem parameters causing the algorithm failure. Any composite point generated by the algorithms are then given "Bad Data" status when of poor quality/validity.

When the Operator looks at the critical function, CFMS flags the various data quality possibilities for the function as follows:

1. No alarm, good quality - Blue (Valid)

2. No alarm, failed input - Yellow color (Invalid)

3. Alarm, failed input - Magenta/yellow color (Unvalid)

4. Alarm, good quality - Magenta (Valid)

In addition, the Operator can determine if a parameter failed before the alarm by the acknowledged/unacknowledged indicator for the various points, or by the alarm parameter list which provides alarm time indication.

3.0 Human Factors Program

3.1 Density of Displayed Data

The licensee's safety analysis states that the density of displayed data is not greater than 40%. For rapid and reliable communication of data, human factor guidelines call for a density of 25% or less. Define the number of display formats that have a data density greater than 25% and provide data to justify them.

SCE Response

The existing CFMS displays are of an adequate density for the following reasons:

1) The CFMS screens are graphics displays which use a mimic representation of plant systems with appropriate and corresponding process data adjacent to component symbols. Many of the symbol representations are hollow and occupy significant screen space without cluttering the screen. The 40% density estimate included the blank area inside hollow symbols.

2) The 40% value is within the 25% - 50% guideline provided in NUREG/CR-2247, "Human Engineering Guidelines for the Evaluation and Assessment of Visual Display Units." These types of guidelines are based on the consideration of search speed for reliable data retrieval. The use of mimics for data organization on the screen overcomes any decrement due to screen display density.

3) The density of individual screens could have been reduced while preserving the mimic representation concept by moving information to additional screens. However, this would have unduly complicated the three-tier hierarchal relationship by creating a fourth hierarchy level, a concept which research has shown reduces operator data search speed.

4) The screens do not appear cluttered on inspection.

Operator alarm overload is prevented in the CFMS design by the hierarchal accessing of information. The top level display of CFMS indicates the status of each of the critical functions. It also provides information on the specific parameter/component that is leading to a violation of the critical functions. If a critical function is identified (automatically by algorithm assessment) as being jeopardized, the CFMS automatically indicates which parameter/components are faulty. The operator can then sector down to displays at the system (second tier of the hierarchy) or subsystem (third tier) level to diagnose the problem. The number of alarms on each of the system and subsystem displays is commensurate with the task of diagnosing system problems. The alarms are naturally prioritized within the critical function scheme of the CFMS. In other words, the critical functions are prioritized by virtue of their importance to safety. This priority of importance is emphasized in operator training. If there is a problem with two critical functions simultaneously, this is indicated by the top level display (i.e., the critical function boxes turn yellow or red). The relative importance of the functions is known to the operator. The operator can then sector down to lower level displays for diagnosis of success path problems prioritizing his/her efforts by the relative importance of the critical functions.

3.2 Data Concentration

The (licensee's) safety analysis described seven critical functions and identified variables for each function. However, we were unable to determine if the variables needed to evaluate a critical function were all presented on one page or spread over several pages. For each critical function, define the location of each variable needed to evaluate the function.

SCE Response

The seven critical functions presented in the CFMS are all present on the bottom of each page in the critical function monitor. The main page (page 102) also contains the labeled critical function and its logic legs (algorithms). Because the number of input parameters necessary to define a critical function may exceed the size of a display page, only the logic legs (algorithms) for the seven critical functions can be shown on a single page. However, the logic legs provide a reference to any out of specification conditions in an algorithm so the Operator may transfer the display directly to the logic leg components.

3.3 Alarm Overload

The licensee's SPDS design utilize alarms to highlight an event and obtain the user's attention. However, our review was unable to determine if a method existed to prioritize alarms to prevent overloading the user with information. Describe the features of the design used to prevent information overload.

SCE Response

The critical functions monitoring system has three levels of alarms. The first level alarms are shown on almost every page. The only exceptions are Trending and Historical Data pages. These first level alarms are critical function alarms and ESF actuation signals (CPIS, CRIS, TGIS, EFAS, Reactor Trip, etc.).

The second level of alarms are on the critical function page and shows logic leg failures/alarms on the critical functions. This page also informs the Operator/User of individual components exceeding their specified parameter values for the critical functions logic.

Third level alarms for individual components are alarmed on their respective system/component page in one of the following four ways: Low-Low Alarm, Low Alarm, High Alarm and High-High Alarm. The high and low alarms indicate caution and are colored yellow, the low-low and high-high are colored magenta and signify danger requiring immediate operator attention.

Failed and alarmed components are also logged on appropriate lists with time markers, range values and alarm information for operator reference.

3.4 Oscillation of Process Variables and Displayed Date

Our review of the safety analysis noted that trend graphs of process variables are available from the SPDS. To complete our review, we need information on how the trend data is processed by the SPDS. Furthermore, the licensee should describe the features of the SPDS design that transmit and display oscillating process variables or limit cycling process variables, which may be symptoms of a severe accident.

<u>SCE Response</u>

The trending information provided by the CFMS is formatted by the Operator requesting a parameter and specifying a range for that parameter's values. The display is shown on a running time line with values that fall in the Operator's requested ranges. The Operator may also select a medium value for the parameter to color code around. In the case of a plant trip, the On-Duty Computer Technician (or the Operator himself) can set up this trending without difficulty. If the Operator needs past history of the parameter, he can do this through historical data in the same manner. Please note the historical data points are set up and logged to a printer for specific key parameters by procedure whenever a plant trip occurs. The purpose of this is to retrieve information for better reconstruction of a trip and ensuring plant transients that occur prior to a reactor trip are reviewed as part of the Post Trip Review process. The CFMS does not process trend data for the purpose of parameter trend predictions by CFMS.

4.0 Parameter Selection

4.1 Steam Generator Radiation

Our review of the licensee's variables was unable to identify the use of steam generator radiation as a displayed variable. Prior to isolation, steam generator radiation and plant vent stack radiation provide a rapid assessment of radiation status for the most likely radioactive release paths. The licensee's SPDS contains plant vent stack radiation, but does not contain steam generator radiation. Upon isolation of a steam generator, plant vent stack radiation is not a valid indicator of steam generator radiation. The licensee should indicate how radiation in the secondary system (steam generator and steamline) is monitored by the SPDS when the steam generator and/or their steamline are isolated, or provide justification for its exclusion.

SCE Response

As stated in NUREG-0696 Section 5.1, "The purpose of the SPDS is to assist control room personnel in evaluating the safety status of the plant." While the main steam line radiation is not monitored by SPDS there is adequate control room annunciation of main steam radiation to alert the operators to a high radiation condition in the steam generators. In the event the steam generators are isolated, the main steam line radiation monitor would provide monitoring of a release path through the steam generator safety valves or atmospheric steam dump valves since the main steam line radiation monitoring element is located upstream of the steam generator isolation valves.

4.2 Containment Hydrogen Concentration

Containment Sump Water Level is a key indicator of the viability of the ECCS recirculation mode of heat removal. The licensee's SPDS displays Quench Tank Water Level, which is a key indicator to identify leakage from the primary safety valves. However, Quench Tank Water Level is not useful in evaluating the viability of the ECCS recirculation mode of heat removal. We recommend the addition of Containment Sump Water Level to the SPDS, or provide justification for its exclusion.

SCE Response

The critical safety function of Reactor Core Cooling and Heat Removal from the Primary System is monitored by CFMS under two safety functions -- Core Heat Removal Control and RCS Heat Removal Control. The objective is to provide sufficient indication to determine if the reactor core is being adequately cooled and heat is being sufficiently removed from the system. To satisfy this objective, CFMS monitors several parameters -- core exit temperatures, hot and cold leg temperatures, saturation margin, steam generator level, steam generator pressure, reactor vessel level, shutdown cooling temperatures and flow, and the safety injection flow. These parameters are sufficient for the operator to assess RCS Heat Removal and Core Heat Removal for a wide range of conditions.

Both the Containment Sump Area water level and the Containment Emergency Sump water level were added into the Safety Parameter Display in 1984 and 1985. However, they are not used in the RCS inventory critical function, as the flow path for RCS loss from relief valves or primary valve leakage is through the Quench Tank and Reactor Drain Tank. San Onofre performs RCS leak rate calculations in the Safety Parameter Display System using the containment sump instruments as an input to determine compliance with the maximum RCS leakrate limits of the Technical Specifications, however these inputs are not used to trigger the critical function algorithms.

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