UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

OF THE SAFETY PARAMETER DISPLAY SYSTEM

FLORIDA POWER CORPORATION, ET AL.

CRYSTAL RIVER UNIT NO. 3 NUCLEAR GENERATING PLANT

DOCKET NO. 50-302

1.0 INTRODUCTION

All holders of operating licenses issued by the Nuclear Regulatory Commission (licensees) and applicants for an operating license (OL) must provide a Safety Parameter Display System (SPDS) in the control room of their plant. The Commission-approved requirements for the SPDS are defined in Supplement 1 to NUREG-0737.

The purpose of the SPDS is to provide a concise display of critical plant variables to control room operators to aid them in rapidly and reliably determining the safety status of the plant. NUREG-0737, Supplement 1, requires licensees and applicants to prepare a written safety analysis describing the basis on which the selected parameters are sufficient to assess the safety status of each identified function for a wide range of events, which include symptoms of severe accidents. Licensees and applicants shall also prepare an Implementation Plan for the SPDS which contains schedules for design, development, installation, and full operation of the SPDS as well as a design Verification and Validation (V&V) Plan. The Safety Analysis and the Implementation Plan are to be submitted to the NRC for staff review. The results from the staff's review are to be published in a Safety Evaluation (SE).

There are a number of requirements which the SPDS should satisfy. They are, with Supplement 1 to NUREG-0737 references in parentheses, as follows:

1. Concise display of critical plant variables to control room operators (4.1a)

2. Location convenient to control room operators (4.1b)

3. Continuous display of plant safety status information (4.1b)

4. High degree of reliability (4.1b)

5. Suitable isolation from electrical or electronic interference with safety systems (4.1c)

6. Designed incorporating accepted Human Factors Engineering Principles (4.1e)

7. Minimum information displayed shall be sufficient to determine plant safety status with respect to five safety functions (4.1f)

   i. Reactivity control
   ii. Reactor core cooling and heat removal from the primary system
   iii. Reactor coolant system integrity
   iv. Radioactivity control
   v. Containment conditions

8. Procedures and operator training addressing actions with and without the SPDS should be implemented (4.1c)

The NRC staff review was directed at: (a) confirming the adequacy of the parameters selected to be displayed to assess critical safety functions, (b) confirming that means are provided to assure th the data displayed are valid, and (c) confirming that the licensee has committed to a human factors program to ensure that the displayed information can be readily perceived and comprehended so as not to mislead the operator. If based on this review, the staff identifies a serious safety question or seriously inadequate analysis, the Director of NRR may request or direct the licensee to cease implementation.

The Florida Power Corporation submitted to the NRC a Safety Analysis Report (SAR) for the Crystal River 3 Safety Parameter Display System on August 30, 1984. The staff reviewed the analysis and, because of insufficient information, was unable to complete the review. A request for additional information regarding isolation devices, parameter selection and displays was forwarded to the licensee via letters dated December 17, 1985 and May 2, 1986 respectively. The licensee responded to these requests via letters dated June 30, 1986 and August 18, 1986.

Final confirmation of whether or not the Crystal River Unit 3 SPDS met the requirements of NUREG-0737, Supplement 1 could not be made based on the materials provided; thus, a postimplementation audit was conducted between October 21 and 23, 1987.

2.0 EVALUATION

The staff has evaluated the Crystal River Unit 3 SPDS based on all information available to date. The evaluation was consistent with Section 18.2, Rev. 0, of the Standard Review Plan (SRP -- NUREG-0800). A synopsis of that evaluation is provided below. The staff was assisted in its evaluation by Science Applications International Corporation (SAIC) personnel. A copy of the SAIC Technical Evaluation Report (TER), which contains a detailed evaluation of the available information, is attached. The staff concurs with the evaluations and conclusions in the TER.

2.1 Concise Display of Critical Plant Variables to Control Room Operators

Evaluation criteria related to this requirement address the selection of plant variables for display and the actual display of those variables. Particular attention is devoted to display factors which can impact rapid, reliable comprehension of plant safety status by operators.

It is the staff's judgment that the licensee has not met the NUREG-0737, Supplement 1 requirement to provide a concise display because the SPDS does not provide information sufficient to depict the five critical safety functions. Details are provided in the enclosed TER.

2.2 Located Convenient to Control Room Operators

Evaluation criteria related to this requirement address physical and visual factors which can impact operator access to SPDS displays and controls. The criteria also address SPDS interference with normal crew movement and visual access to other control room systems.

The staff concludes that the licensee has met the requirement for a SPDS location convenient to control room operators.

2.3 Continuous Display of Plant Safety Status Information

Evaluation criteria related to this requirement address SPDS users' timely and reliable awareness of plant safety status and of important changes in critical safety-related variables.

The staff concludes that the licensee has not met the requirement for a continuous display of plant safety status because overall status of the five critical safety functions is not displayed when the operator is displaying alpha-numeric screens and there is no provision to continuously display the post-trip screen information.

2.4 High Degree of Reliability

In order to determine the degree of reliability, the following areas were reviewed: Data Validity, System Verification and Validation, Maintenance and Configuration Control, System Security, Rapid Display of Information and Operational Availability.

The staff concludes that the licensee has not met the requirement for a high degree of reliability due to an invalid radiation alert that was continuously on presenting an incorrect status of radioactivity. The SPDS should not display invalid alerts over prolonged periods of time.

2.5 Suitably Isolated from Electrical and Electronic Interference with Safety Systems

Based on NRC staff approval of the Bailey 880 System Isolators, Sylvania Control Relay 5UK6-76, and Foxboro 2AO-VAI Isolators (as discussed in a NRC letter dated December 17, 1985), Florida Power Corporation has met the NUREG-0737, Supplement 1 requirement for electrical isolation.

2.6 Designed Incorporating Accepted Human Factors Engineering Principles

Evaluation criteria related to this requirement address display formats and the application of human factors engineering principles to those displays so that information is readily perceived and comprehended by users.

When the licensee contracted B&W to design the SPDS, a human factors review was included. In October 1986, the licensee hired General Physics to conduct an additional review using NUREG-0700 guidelines. A tabletop review of the SPDS location was done as part of the DCRDR efforts; however, the rest of the human factors review was conducted as a separate effort. The review was completed in July 1987 and was documented in a report by General Physics.

In summary, it is the review team's judgment that a human factors review of the SPDS has been conducted. The licensee should assess the Human Engineering Observations (HEOs) identified in that review and document design modifications proposed to resolve them. It is the staff's position that the licensee does not meet the NUREG-0737, Supplement 1 requirement for a design incorporating accepted human factors principles. The licensee should conduct followup human factors reviews as requirements 2.1 and 2.7 are met. Details are provided in the attached TER.

2.7 Minimum Information Displayed Should Be Sufficient to Determine the Plant Status With Respect to Five Functions

NUREG-0800 states that the minimum information to be provided shall be sufficient to provide information to plant control room operators about the following critical safety functions:

1. Reactivity control
2. Reactor core cooling and heat removal from the primary system
3. Reactor coolant system (RCS) integrity
4. Radioactivity control
5. Containment conditions

To monitor the plant process, the control room operator must be able to evaluate each of the above functions.

2.7.1 Critical Safety Functions

The SPDS design is based on the ATOG, which does not specifically use critical safety functions. Review of the SPDS with respect to the critical safety functions, however, concluded that only Reactivity Control and Radioactivity Control could be sufficiently monitored using the information provided by the system.

2.7.2 Parameter Selection

The parameters selected by the licensee do not provide sufficient information to the operator to determine plant status with respect to the following critical safety functions:

- Reactor Core Cooling and Heat Removal
- Reactor Coolant System Integrity
- Containment Conditions

The parameters missing from the SPDS and the reasons for needing them are listed below:

1. Reactor Coolant System (RCS) level is an indicator of primary system inventory, a necessary heat transfer medium for core cooling and heat removal. It is used to monitor for inadequate core cooling conditions.

2. Containment building sump level is a key indicator to identify a loss-of-coolant-accident breach of RCS integrity, particularly for smaller leaks during which RCS pressure may not be changing.

3. Containment isolation is used to provide a rapid assessment of containment conditions. The primary function of the containment is to prevent release of radioactive gases and particulate to the environment. By monitoring the status of all isolation valves, there is assurance that known process systems pathways penetrating containment have been secured.

4. Containment hydrogen concentration is a key parameter to monitor for containment combustible gas control. For some accident scenarios, hydrogen can be produced and released from the containment.

It is the staff's judgment that the licensee has not met the NUREG-0737, Supplement 1 requirement for the display of minimum information sufficient to determine plant status with respect to the five safety functions.

2.8 Procedures and Operator Training Addressing Actions With and Without SPDS

Evaluation criteria related to this requirement address procedures and training to assure that the normal control room operating crew can determine plant safety status both with and without the SPDS.

It is the staff's judgment that the licensee meets the NUREG-0737, Supplement 1 requirement for procedures and training with and without SPDS.

3.0 CONCLUSIONS

Based on its documentation review and on-site audit the staff concludes that the Crystal River Unit 3 SPDS does not meet the applicable requirements of NUREG-0737, Supplement 1. Florida Power should submit resolutions to the above staff findings along with a schedule for implementation of any necessary corrective actions.

In the interim we conclude that no serious safety questions are posed by the existing SPDS and that continued plant operation is justified pending final approval of the SPDS.

Date:

Principal Contributor:

C. Goodman