Enclosure 1

SAFETY EVALUATION

I. 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 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 Report (SER).

Prompt implementation of the SPDS in operating reactors is a design goal of prime importance. The staff's review of SPDS documentation for operating reactors called for in NUREG-0737, Supplement 1 is designed to avoid delays resulting from the time required for NRC staff review. The NRC staff will not review operating reactor SPDS designs for compliance with the requirements of Supplement 1 of NUREG-0737 prior to implementation unless a pre-implementation review has been specifically requested by licensees. The licensee's Safety Analysis and SPDS Implementation Plan will be reviewed by the NRC staff only to determine if a serious safety question is posed or if the analysis is seriously inadequate. The NRC staff review to accomplish this will be directed at (a) confirming the adequacy of the parameters selected to be displayed to detect critical safety functions, (b) confirming that means are provided to assure that the data displayed are valid, (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, and (d) confirming that the SPDS will be suitably isolated from electrical and electronic interference with equipment and sensors that are used in safety systems. If, based on this review, the staff identifies a serious safety question or seriously inadequate analysis, the Director of IE or the Director of NRR may require or direct the licensee to cease implementation.

II. SUMMARY

The staff has reviewed the licensee's submittals (Reference 1 through 3) regarding the Safety Parameter Display System (SPDS) and concludes that it is acceptable for the licensee to continue implementation of its SPDS program.

The staff has not identified any serious safety questions or inadequacies of analysis thusfar in its review, and finds no reason to direct the licensee to cease implementation. Continued implementation of the SPDS is conditional to a confirmatory staff review of the adequacy of the parameters selected for display on the SPDS. The information needed by the staff to conduct the confirmatory review is defined herein.

III. EVALUATION

Florida Power and Light Company (FP&L), submitted several documents in which the Turkey Point SPDS design and implementation plans are described. The staff has reviewed these documents, and the results of that review are presented below.

A. SPDS DESCRIPTION

The Turkey Point SPDS is based on a generic design known as the Safety Assessment System (SAS) developed by the Ad Hoc Group of the Westinghouse Owners Group Subcommittee on Instrumentation. The SPDS provides three top level displays. These displays are for the following modes of operation:

1. Normal Operation Display - Selected during plant conditions at or above normal operating pressure and temperature

2. Heatup/Cooldown Display - Selected when RCS is intentionally cooled below normal operating values or is being heated up prior to startup

3. Cold Shutdown Display - Selected to monitor Cold Shutdown plant conditions.

The displays are selected from a dedicated function key pad located near the control board, and displayed on a medium resolution, multi-color, 19" cathode-ray tube (CRT) located on the control board. The specific display formats for the three modes of operation consist of bar graphs, trending graphs, message areas, and digital values for the various parameters monitored.

The staff has been briefed on the generic design (Reference 4) and has witnessed a demonstration of a SAS prototype (Reference 5). To date, the staff has not performed a complete and comprehensive review of the generic design program.

B. PARAMETER SELECTION

Section 4.1f of Supplement 1 to NUREG-0737 states that:

"The minimum information to be provided shall be sufficient to provide information to plant operators about:

(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."

For review purposes, these five items have been designated as Critical Safety Functions.

1. Variable Selection

In the evaluation of the SPDS variables and in its recommendations, the staff has considered the Westinghouse Owners' Group's "Westinghouse Emergency Response Guidelines (ERGs) Program," which was reviewed and approved by the staff (Reference 7), as a principal technical source of variables important to safety. The SPDS variables selected by the licensee and their coordination with the Critical Safety Functions are summarized in Table 1 (grouping made by licensee). While we find that the variables selected comprise a generally comprehensive list, we note that the status of the following variables may not be available on the SPDS proposed for Turkey Point:

1. Containment Isolation
2. Containment Hydrogen Concentration
3. Steam Generator (or Steamline) Radiation
4. Hot Leg Temperature
5. Stack Radiation Monitor
6. Sump Level
7. Containment Pressure

Containment isolation is an important parameter for use in making a rapid assessment of "Containment Conditions." In particular, a determination that known process pathways through containment have been secured provides significant additional assurance of containment integrity. Containment hydrogen concentration is a key parameter used in the emergency guidelines to monitor combustible gas control and to indicate a compromise of the "Containment Conditions" safety function. Steamline (or steam generator) radiation, in conjunction with containment radiation and reactor stack radiation, gives a rapid assessment of radiation status for the most likely radioactive release paths to accomplish the "Radioactivity Control" safety function. For a rapid assessment of Radioactivity Control, the licensee has not demonstrated how radiation in the secondary system (steam generators and steamlines) is monitored by SPDS when the steam generators and/or their steamlines are isolated. The analysis should be expanded to include this discussion.

Hot leg temperature is a key indicator used in the ERGs (Revision 1, "ES-0.1, Attachment A," "Generic Instrumentation," page 3) to determine the viability of natural circulation as a mode of heat removal. Reference 1 indicates "RCS average temperature" as a proposed variable, but does not specify hot leg temperature.

As discussed above, reactor stack radiation, in conjunction with other radiation monitors, provide a rapid assessment of radiation status to accomplish the "Radioactivity Control" CSF. Reference 1 discusses a "Secondary Radiation" target light derived steam generator blowdown and steam jet air ejector radiation, but does not indicate if or how specific values for these variables for stack radiation and steam generator radiation are available from the SPDS console.

Containment sump level a key indicator to identify a LOCA, particularly for smaller leaks in which RCS pressure may not be changing. It also is an indicator of the viability of the ECCS recirculation mode of heat removal.

Containment Pressure is a direct indication that containment integrity may be threatened by overpressurization. Also, as the Containment Pressure increases, it provides the driving force that can cause the containment environment to escape to the atmosphere through leaks in the containment structure.

Reference 2 discusses a "Containment Environment" target light derived from containment temperature, level, and pressure, but does not indicate if and how specific values for Containment Pressure and Sump Level are available at the SPDS console.

The above variables do, for given scenarios, provide unique inputs to determinations of status for their respective critical safety functions, which have not been discussed by the licensee as being satisfied by other variables in the proposed Turkey Point SPDS list. The licensee should address these concerns by: 1) adding the recommended variables to the Turkey Point SPDS, 2) providing alternate added variables along with justifications that these alternates accomplish the same safety functions for all scenarios, 3) provide justification that variables currently on the Turkey Point SPDS do in fact accomplish the same safety functions for all scenarios, or 4) identifying that these variables are in fact available from the SPDS console.

Based on this review of the licensee's supporting analyses, and our observations that the selected variables appear to be consistent with the Westinghouse Owners Group ERGs, we find that proposed list of key variables to be generally acceptable, with the exceptions noted above.

Finally, design flexibility should be provided for possible future expansion of the SPDS. For example, with consideration of the Westinghouse Owners Group ERGs and with possible amendments to the ERGs, other key variables may be identified to assess the safety status of the CSFs.

2. Variable Validation

The licensee submittals do not address validation of the SPDS variables relative to the Critical Safety Functions or the useability of the SPDS display during transients and accidents for a rapid assessment of plant safety status. The licensee should provide a description of a variable validation program discussing the following items:

1) Relationship to the Critical Safety Functions by additional consideration given to control room walkthroughs of transients and accidents utilizing the SPDS.

2) Useability, demonstrating that the following criteria are met:

   a) The selected transient and accident test cases should exercise the SPDS parameters to the fullest extent possible, including their representativeness beyond design basis scenarios.

b) The proposed transient and accident test cases should cover the instrument set points for systems actuation and operator actions identified in the EOPs.

C. DISPLAY DATA VALIDATION

The staff reviewed the licensee's October 4, 1984 submittal to determine that means are provided in the design to assure that the data displayed are valid. The Turkey Point design provides several checks on data validity depending on the number of sensors available for input. All analog data undergo a range check. If more than one sensor is available for input, the data points are averaged (assuming they pass the range check). In addition, these data are analyzed to determine whether their variance from the average and from each other is reasonable, i.e., for sample size of two, less than 10 percent variance; for sample size greater than two, variance having a probability of less than 1/(2N). Based on this use of physical redundancy as well as analytical validation regimes, the staff confirms that means are provided in the SPDS design to assure that the data displayed are valid.

D. HUMAN FACTORS PROGRAM

The staff is aware of the human factors program that provided input to the generic design and confirms that an appropriate commitment has been made to incorporate human factors into the SAS design. The staff

recommends that FP&L continue to incorporate human factors into the plant-specific application of the generic design. Such a commitment is important because it addresses a common problem of generic designs, that is, inconsistency with plant-specific conventions including color-codes, abbreviations, acronyms, and symbols. Based on the above, the staff confirms that FP&L has committed to a human factors program in the design and implementation of its SPDS.

E. ELECTRICAL AND ELECTRONIC ISOLATION

In order to satisfy the NRC requirements concerning the SPDS, Florida Power and Light Company, the licensee for Turkey Point, submitted a Parameter Selection Evaluation and Implementation Plan dated May 1, 1984. The plan addressed the requirements that the SPDS must be suitably isolated from equipment and sensors that are used in safety systems. It did not address the testing of this equipment or the maximum credible fault that was applied to the isolators. On November 13, 1984, ICSB received FPL letter (L-84-276) with additional information on the licensee's SPDS. The information obtained did not address the 120 VAC 20A maximum credible fault testing of TEC module 156, 980 and 981 isolators. On January 14, 1985, FPL provided the necessary information (L-85-19) required for ICSB to complete its review. The following evaluation addresses the qualification and documentation of the isolators as acceptable interface devices between the Class 1E safety related system and the SPDS.

1. Discussion and Evaluation

The SPDS provides a centralized computer-based data and display system to assist control room personnel in evaluating the safety status of the plant. Data is transmitted from the safety-related instrument loop to the SPDS via Technology for Energy Corporation (TEC) module 156, 980 and 981 isolators which are fully qualified and installed to IEEE-323-1974 and IEEE-344-1975 standards.

The TEC Model 980 Analog Signal Isolator is a four channel unit with various input ranges, which plugs into the TEC Model 1480-1 Isolation Module Bin. The bin furnishes all connections to the module for input, output, power and testing. The four signal channels are parallel paths from the instrument loops being monitored by the SPDS. Isolation is achieved by the use of a magnetic field carrying information across an electrically isolated barrier. The input signal is superimposed on an internally generated ac carrier through a modulator circuit. The output of the modulator drives the isolating transformer. The transformer output is then demodulated and filtered to remove the ac carrier and amplified to provide an analog of the input signal. The application of a low-pass filter in the output circuitry ensures that the capacitive coupling between the transformer windings is not a significant part of the isolation impedance of the complete module.

The TEST function on the front panel allows the operator to periodically test the dielectric strength of the isolator by switching the unit out

of service and applying 1000 VDC between the input and output. Leakage current can then be measured to check isolation integrity.

The TEC Model 156 Analog Signal Isolator is a single channel current or voltage sensing device, which can be configured to accept a variety of input ranges. Input and output connections are located on barrier strips to provide physical separation. Isolated output is achieved through the magnetic coupling method described above for the TEC Model 980 Isolator.

The TEC Model 981 Digital Isolator is a four channel multi-input range instrument connected to the TEC 2200 Isolation System via a TEC Model 1480-1 Isolation Module Bin. The bin furnishes all connections to the module for input, output, power and testing.

The four channels in each module are parallel paths for signals from the IE circuits being monitored to the SPDS monitoring equipment. The function of the isolator is to sense voltages or contact closures while preventing any credible failure at its output from having an adverse effect on the IE input circuits. The 981 input interface consists of range selection resistors, and a Hewlett Packard (HP) HCPL-3700 AC/DC Logic Interface Optocoupler. The HCPL-3700 is a voltage/current threshold detection optocoupler. This optocoupler uses an internal Light Emitting Diode (LED) and a high gain photon detector. Hysteresis is provided in an input buffer for extra noise immunity and switching

stability. The buffer circuit is designed with internal clamping diodes to protect the circuitry from overvoltage and overcurrent transients. The model 981 features four independent digital output stages. The output stages feature an optically isolated power MOSFET switch, which is configured to provide a single ended TTL logic output.

The licensee has identified the maximum credible fault as 120 VAC 20A. Both the analog and digital isolators have undergone testing to ensure that isolation integrity is maintained while a maximum credible fault is applied to the non-1E side. This credible fault was applied to each device in the transverse mode for a minimum of 20 seconds to ensure adequate time for any failure to completely propagate, and to allow sufficient time to observe the steady state condition on the 1E inputs. None of the components on the 1E side of the isolators were damaged or stressed by this test and the isolation boundary was maintained.

The applicant performed an additional fault test by applying 2000 VDC @ 10 milli Amperes in the transverse mode to the output of the Model 156, 980, and 981 isolators. The test results indicated that no perturbations from the fault were reflected back into the class 1E side of the isolators.

The seismic qualification testing is in accordance with the seismic criteria that was the basis for plant licensing. Environmental testing was not included because the amplifiers are located in the mild environment of the control room.

2. Conclusion

Based on an audit of the above documentation on isolation devices (Optical and Transformer) that are used within the Turkey Point design, the staff concludes that these devices are qualified isolators and are acceptable for interfacing the SPDS with safety systems, and that this equipment meets the Commission's requirements in NUREG-0737, Supplement No. 1.

IV. GENERAL CONCLUSIONS

The NRC staff reviewed the Florida Power and Light Company submittals to confirm the adequacy of the parameters selected to be displayed to monitor critical safety functions, to confirm that means are provided to assure that the data displayed are valid, to confirm 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, and to confirm that the SPDS is suitably isolated.

Based on its review, the staff confirms that:

- An appropriate commitment to a Human Factors Program was made in the design of the SPDS.

- Means are provided in the SPDS design to assure that the data displayed are valid.

- the SPDS will be suitably isolated from electrical and electronic interference with equipment and sensors that are used in safety systems.

However, the staff could not confirm that:

- Parameters selected for display are adequate to detect critical safety functions for a wide range of events. The staff recommends the addition of the hot leg temperature, stack radiation steam generator or steamline radioactivity, containment isolation, and sump level, containment pressure and containment hydrogen concentration, or additional justification that they may be excluded. Also additional discussion should be provided to relate the bases for variable selections to the EPGs and to describe the program to validate the list of SPDS variables.

The staff has not identified any serious safety questions or inadequacies in the licensee's analysis and, therefore, finds no reason to direct the licensee to cease implementation. However, the continued implementation of the SPDS by the licensee is conditional to a satisfactory confirmatory review by the staff on the above design information requested from the licensee.

The conclusion that SPDS implementation may continue does not imply staff confirmation that the SPDS meets the requirements of Supplement 1 to

NUREG-0737. Such confirmation can be made after a post-implementation audit or when the staff has otherwise obtained sufficient information.

Principal Reviewers:

G. Lapinsky
J. Joyce

V. REFERENCES

1. Letter, J.W. Williams, Jr. (FPL) to D.G. Eisenhut (NRC), dated February 14 1984 (L-84-33).

2. Letter, J.W. Williams, Jr. (FPL) to D.G. Eisenhut (NRC), dated May 1, 1984 (L-84-114) (with attachment).

3. Letter, J.W. Williams, Jr. (FPL) to D.G. Eisenhut (NRC), dated October 4, 1984 (L-84-276) (with attachment).

4. Memorandum for Voss A. Moore (NRC) from Leo Beltracchi (NRC), Subject: Minutes of Safety Assessment System Group/Staff Meeting, December 2, 1981

5. Memorandum for Voss A. Moore (NRC) from Leo Beltracchi (NRC) and George Lapinsky (NRC), Subject: SAS Demonstration, May 19, 1982.

6. Supplement 1 to NUREG-0737, Requirements for Emergency Response Capability (Generic Letter 82-33), dated December 17, 1982.

7. Safety Evaluation of "Emergency Response Guidelines," Generic Letter 83-22, June 8, 1983.

8. Letter, J. W. Williams, Jr. (FPL) to D. G. Eisenhut (NRC), dated January 14, 1985 (L-85-19) (with attachment)

TABLE 1

SAFETY FUNCTION VARIABLES

TURKEY POINT PLANT, UNITS 3 AND 4

Critical Safety Function	Variable
Reactivity Control	Source Range Power Level Intermediate Range Power Level Power Range Power Level Startup Rate Reactor Trip Signal
Reactor Core Cooling and Heat Removal from the Primary System	Cold Leg Temperature Core Exit Temperature Feedwater Isolation Signal Main Steam Isolation Signal RCS Average Temperature Reactor Vessel Level RHR Flow RHR Heat Exchanger A&B (Hx) Inlet Temperature RHR Hx Outlet Temperature Safety Injection Actuation Signal S/G Level S/G Pressure A&B Subcooling
RCS Integrity	Charging Flow Containment Environment Containment Radiation Core Exit Temperature Letdown Flow Pressurizer Level Pressurizer Pressure RCS Pressure Reactor Vessel Level Secondary Radiation S/G Level S/G Pressure
Radioactivity Control	Containment Radiation Secondary Radiation
Containment Integrity	Containment Environment

* A derived parameter using containment pressure, temperature, and sump level.

** Derived from S/G Blowdown & Air Ejector Radiation.