



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

ENCLOSURE 2

SAFETY EVALUATION
RELATED TO THE SAFETY PARAMETER DISPLAY SYSTEM
CAROLINA POWER AND LIGHT COMPANY
BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2

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 reviewed the SPDS Safety Analysis Report for Brunswick, Units 1 and 2 and concludes that there is no serious safety issues posed by the SPDS and it is acceptable for the licensee to continue implementing its SPDS Program. The staff finds the parameter selection for the Brunswick SPDS to be generally acceptable, but could not confirm the adequacy of the parameters chosen to represent the Radioactivity Control Safety Function. The staff also had concerns regarding the information density of two of the displays. The information needed by the staff to conduct a confirmatory review of these issues is defined herein.

III. EVALUATION

Carolina Power and Light Company (CP&L) submitted for staff review a Safety Analysis Report and Implementation Plan on the Safety Parameter Display System (SPDS) for the Brunswick Steam Electric Nuclear Generating Plant, Units 1 and 2 (Ref. 1). This submittal describes the display system, provides the design bases for the system, discusses parameter selection and display formats, describes the human factors considerations used in the design, and contains a Verification and Validation Plan for the design. The staff's review of the licensee's Safety Analysis Report is presented in the text which follows.

A. SPDS DESCRIPTION

The Brunswick Safety Parameter Display System is a subsystem of a computer system known as the Emergency Response Facility Information System (ERFIS). The SPDS was developed and supplied by General Electric Company (G.E.). The Brunswick SPDS is identical in most respects to the generic G.E. Safety Parameter Display System that was audited by the staff as part of the GESSAR II Final Design Approval effort (Ref. 2 and 3). Areas of agreement between the Brunswick SPDS and the GESSAR II were confirmed by the licensee (Reference 4).

The Brunswick SPDS consists of three primary displays that are designed to support the information needs of the Emergency Procedure Guidelines (EPGs). These displays, RPV Control Display, Containment Control Display, and Critical Plant Variables Display, are elaborated in three special function displays. The special function displays provide:

- 1) two-dimensional plots of the limiting conditions defined in the Emergency Operating Procedures (EOPs), e.g., Suppression Pool Load Limit Curve, 2) trend plots of all control parameters, showing data from the most recent 30 minutes; and 3) the validation status of SPDS input data.

The Brunswick displays appear to differ slightly from the generic G.E. displays, but in ways that are likely to improve the useability of the displays. For instance, extraneous titles have been deleted from the Brunswick version of the Critical Plant Variables Display, and a

radiation status box has been added. Because of the overall similarity of the Brunswick design and the G.E. generic design (Ref. 1 and 4), the staff has based some of the conclusions stated in this Safety Evaluation Report on its audit of the G.E. generic prototype.

B. PARAMETER SELECTION

Section 4.1f of Supplement 1 to NUREG 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.

The selection of the SPDS process variables for display was made by G.E. based on the BWR generic Emergency Procedure Guidelines (EPGs). The staff confirmed that the variables selected are consistent with the

presently approved BWR EPGs (Revision 3) with one possible exception. Revision 3 contains a Radioactivity Release Control Guideline which contains an Entry Condition based on off-site radioactivity release rate. The Brunswick SPDS display contains a status box that indicates "RAD NORMAL". Since the staff was not provided with a list of inputs to this status box, the staff could not confirm that the input variables are consistent with the Radioactivity Release Control Guideline. The licensee should provide a list of the variables that provide input to the radiation status box.

Contingent upon confirmation of the adequacy of selected Radioactivity Control parameters, the staff finds the SPDS variable selection acceptable. In addition, the staff noted that the design includes sufficient capability for expanding the system so that additional variables (such as hydrogen concentration) may be added as a result of future revisions to the generic EPGs.

C. DISPLAY DATA VALIDATION

The staff reviewed the CP&L submittal to determine that means are provided in the design to assure that the data displayed are valid. The staff confirmed (Ref. 4) that the validation methodology and the scope of its application in the Brunswick SPDS does not differ from that used in the generic design audited by the staff (Ref. 3). Therefore,

the staff utilized the results of its audit of the GESSAR II generic SPDS (Ref. 3) in its evaluation of the Brunswick data validation methodology.

Because G.E. considers its data validation methodology to be proprietary (Ref. 2), a detailed description will not be presented here. Generally, the data validation includes range and consistency checks as well as data conditioning algorithms.

Based on the staff's audit of the GESSAR II SPDS and the similarity of the GESSAR II and the Brunswick design, the staff confirms that means are provided in the Brunswick SPDS design to assure that the data displayed are validated.

D. HUMAN FACTORS PROGRAM

The staff also evaluated the CP&L submittal for a commitment to a Human Factors Program in the development of the SPDS. As evidence of the licensee's commitment to a human factors program, the staff noted several aspects of the design process. First, CP&L has based the Brunswick SPDS design on the generic G.E. design which was developed by a multi-disciplinary team and included a comprehensive human factors review (Ref. 2). Secondly, the results of the Brunswick System Function and Task Analysis are being compared to the SPDS with regard to display content, information accessibility, and data useability. Finally, although not specifically called out in the licensee's submittal, the

staff recognized that the generic displays have been modified to take into account some plant-specific factors, e.g., Suppression Pool Level is indicated in inches in the Brunswick version, in feet and inches in the generic version. If not already done, the licensee should also assure that the SPDS developed for Brunswick by G.E. has taken into account other plant-specific aspects such as color-coding conventions, abbreviations, acronyms, equipment terminology, and symbology.

The staff's review of the display formats did identify a few areas of concern. For instance, on the Critical Plant Variables Display the last line of text includes the title "Brunswick." The staff feels that operators do not need this information, but may need the information "Unit 1" or "Unit 2." Likewise, personnel at the Technical Support Center and Emergency Off-site Facility would certainly want to confirm that they are receiving data from the correct unit.

Also, the staff shares the CP&L concern that some of the displays seem overcrowded (Ref. 1, Enclosure 2, item II.D.1). The RPV Control Display and the Containment Control Display are of particular concern. CP&L is considering a modification or deletion of the "system status" blocks to resolve the problem. The staff urges the licensee to consider other options very carefully before deleting the system status information. The present design, although overcrowded, structures the information in an easily assimilated way, i.e., in normal reading order, left to right, and in flow path order from affective resource to affected function.

The staff finds this format to be extremely useful and cautions the licensee not to destroy a good concept while attempting to improve its readability. On the other hand, a good concept is useless if the needed information cannot be easily localized, recognized, and read. Therefore, consideration should be given to other methods of simplifying the display, such as grouping, highlighting, hierarchical labelling, demarcation, color-coding, and masking or display-on-demand-only.

With the exception of the two issues discussed above, the displays appear to be well designed and are generally consistent with accepted human factors principles. On the basis of the staff's knowledge about the G.E. design process (Ref. 2 and 3) and the information provided in the CP&L submittal, the staff concludes that an appropriate commitment was made to incorporate human factors considerations into the design of the Brunswick SPDS.

E. ELECTRICAL AND ELECTRONIC ISOLATION

NUREG-0737, Supplement 1, requires that the SPDS be suitably isolated from electrical or electronic interference with equipment and sensors that are in use for safety systems. The staff audited the General Electric generic design for adequacy of the isolators (fiber optics cables) and concluded that they are qualified isolation devices and are acceptable for interfacing the SPDS with safety systems (Ref. 2 and 3). Since the Brunswick design also uses fiber optic cables for isolation, the conclusions of the staff regarding the GESSAR II SPDS apply.

Based on the above, the staff confirms that the Brunswick SPDS will be suitably isolated from interference with equipment and sensors that are in use for safety systems.

IV. Summary of findings.

1. The variables selected for display are generally adequate to assess critical safety function. The staff could not confirm that the input variables for the Radioactivity Control Safety Function are adequate.
2. The licensee has stated that the SPDS will be suitably isolated from plant safety systems through the use of fiber optics cables.
3. The licensee's design provides means to assure that displayed data are validated.
4. The design and implementation of the licensee's design includes appropriate commitment to a human factors engineering program that should allow reasonable assurance that the information provided will be readily perceived and comprehended by its users.

V. CONCLUSIONS

A conclusion that SPDS implementation may continue does not imply staff confirmation that the SPDS meets all of the SPDS requirements of Supplement 1 to NUREG-0737. Such confirmation can only be made after a post-implementation review or when the staff has otherwise obtained sufficient information.

The continued implementation of the SPDS by the licensee is conditional to a satisfactory confirmatory review by the staff on the design information requested from the licensee in Section III.B. of this Safety Evaluation Report and summarized in the related request for additional information.

The NRC staff reviewed the Brunswick 1 and 2 Safety Analysis 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 validated, 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 concludes that no serious safety questions are posed by the proposed SPDS and, therefore, implementation may continue subject to the licensee response to the request for additional information.

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Dated:

VI. REFERENCES

1. Letter from E.E. Utley (CP&L) to D.B. Vassallo (NRC) with enclosures, dated December 27, 1984.
2. Memorandum for D. Crutchfield (NRC) from W. Russell (NRC), with enclosure, "Draft Input Safety Evaluation Report for the General Electric Company's GESSAR II Safety Parameter Display System." Note: This SER input will be included in Supplement 4 of NUREG-0979 (in press).
3. Memorandum for C. Thomas (NRC) from S. Weiss (NRC), Subject: Design Verification Audit Report for the General Electric Safety Parameter Display System; dated November 2, 1984.
4. Letter from A. D. Cutter (CP&L) to D. Vassallo (NRC), dated April 19, 1985; subject: "Summary of March 21, 1985 Teleconference Regarding Brunswick SPDS."