



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE DETAILED CONTROL ROOM DESIGN REVIEW

SOUTH CAROLINA ELECTRIC & GAS COMPANY

SOUTH CAROLINA PUBLIC SERVICE AUTHORITY

V. C. SUMMER NUCLEAR STATION

DOCKET NO. 50-395

1.0 INTRODUCTION

NUREG-0737, Supplement 1, requires that a Program Plan be submitted within two months of the start of the Detailed Control Room Design Review (DCRDR). Consistent with the requirements of NUREG-0737, Supplement 1, the Program Plan should describe how the following elements of the DCRDR will be accomplished:

1. Establishment of a qualified multidisciplinary review team.
2. Function and task analyses to identify control room operator tasks and information and control requirements during emergency operations.
3. A comparison of display and control requirements with a control room inventory.
4. A control room survey to identify deviations from accepted human factors principles.
5. Assessment of human engineering discrepancies (HEDs) to determine which HEDs are significant and should be corrected.
6. Selection of design improvements.
7. Verification that selected design improvements will provide the necessary correction.
8. Verification that improvements will not introduce new HEDs.
9. Coordination of control room improvements with changes from other programs such as Safety Parameter Display System (SPDS), operator training, Regulatory Guide 1.97 instrumentation, and upgraded emergency operating procedures.

The South Carolina Electric & Gas Company (SCE&G) submitted a DCRDR Program Plan to the Nuclear Regulatory Commission (NRC) on November 1, 1983 (Reference 1) in order to satisfy the Program Plan requirements of NUREG-0737, Supplement 1 (Reference 2), for the V. C. Summer Nuclear Station.

The NRC staff reviewed the submittal with reference to the nine DCRDR requirements of NUREG-0737, Supplement 1, and the guidance provided in NUREG-0700 (Reference 3) and NUREG-0800 (Reference 4).

The staff's comments on the South Carolina Electric & Gas Company DCRDR Program Plan review were forwarded to South Carolina Electric & Gas Company by letter dated February 15, 1984 (Reference 5). Based on the Program Plan review, the staff concluded that South Carolina Electric & Gas Company addressed the nine requirements of a DCRDR specified in NUREG-0737, Supplement 1. NUREG-0737, Supplement 1, requires that a Summary Report be submitted at the end of the DCRDR. As a minimum, it was to:

1. Outline proposed control room changes.
2. Outline proposed schedules for implementation.
3. Provide summary justification for HEDs with safety significance to be left uncorrected or partially corrected.

On June 15, 1984, the Commission issued an order which confirmed SCE&G's commitment to submit a Summary Report by April 15, 1985.

The licensee submitted a Summary Report to the NRC on April 15, 1985 (Reference 6). Based on the review of the Summary Report, the staff requested additional information via a letter dated June 21, 1985 (Reference 7). On May 28, 1987, the licensee submitted a supplement to the Summary Report (Reference 8) in response to the NRC's request

2.0 EVALUATION

The purpose of the review was to determine whether the nine DCRDR requirements in NUREG-0737, Supplement 1, had been satisfied. The evaluation was performed by comparing the information provided by the licensee with the criteria in NUREG-0800, Section 18.1, Revision 0, Appendix A of the Standard Review Plan. The staff was aided in this review by its contractor, Science Applications International Corporation (SAIC). The staff's evaluation of the DCRDR, with respect to each of the nine elements to be contained in the Program Plan for the V. C. Summer Nuclear Station, is provided below.

2.1 Establishment of a Qualified Multidisciplinary Review Team

The DCRDR review team consisted of six members: the Program Manager, the Project Manager, the Site Manager, a reactor operator, a shift technical advisor, and an instrumentation and control engineer. The Project Manager

and Site Manager were employees of Essex Corporation, who also provided human factors engineering support. Overall administrative leadership was provided by the Program Manager, who was a utility employee. Additional human factors personnel from Essex Corporation, and nuclear engineering and risk analysis personnel were made available as needed.

Based on the above, the staff concludes that the licensee has met the NUREG-0737, Supplement 1, requirement for establishment of a qualified multidisciplinary review team.

2.2 System Function and Task Analysis

A generic task analysis was performed to identify operator tasks and information and control requirements using the following Westinghouse Owners Group Emergency Response Guidelines (ERGs), Revision 1: E-0, E-1, ES-1.1, E-3, ECA-0.0, ECA-0.2, FR-S.1, FR-C.1, FR-H.1, and FR-P.1. Information and control requirements were documented on Action-Information Requirements Detail forms.

Following the generic task analysis, Action-Information Requirements Detail forms were reviewed and modified to reflect plant-specific tasks and information and control requirements. An explanation was provided for all identified plant-specific differences.

Action-Information Requirements Summary forms were used to summarize behavioral element column entries for state/value, units/rate, precision, and trending required. This formed the basis for an instrumentation and control specification.

Finally, since the Westinghouse ERGs only covered approximately ninety percent (90%) of the instrumentation and controls required, a comparison was made between the plant-specific parameters to be observed and/or controlled, and the instrumentation and control requirements listed by Westinghouse in its system function and task analysis of the ERGs. The comparison identified ten additional instrument and three additional control requirements not previously included in the plant-specific V. C. Summer task analysis. These additional instrumentation and control requirements were documented on Action-Information Requirements Detail forms and on Action-Information Requirements Summary forms. Sample completed Action Information Requirements Detail forms and sample Action-Information Requirements Summary forms were provided in the Summary Report.

Based on the above, the staff concludes that the licensee has met the NUREG-0737, Supplement 1, requirement for a system function and task analysis to identify control room operator tasks and information and control requirements during emergency operations.

2.3 Comparison of Display and Control Requirements with a Control Room Inventory

The licensee developed a control room inventory using a half-scale photomosaic and detailed control board drawings. The availability and suitability of instrumentation and controls were verified by comparing the information and control requirements identified in the task analysis to the control room inventory sheets, the photomosaic, panel diagrams, and other applicable plant documentation. Any displays and controls which were found to be unavailable or unsuitable were documented as HEDs.

Validation of control room functions was also conducted in order to identify problems that may affect task performance. The validation process was conducted while exercising the Emergency Operating Procedures (EOPs) on the plant simulator. In addition, operator interviews were conducted to verify task performance issues.

Sixteen HEDs were written during the verification of the availability and suitability of displays and controls, and control room functions. Ten of these HEDs resulted from the simulator exercises and operator interviews. The remaining six HEDs were written during the verification of the availability and suitability of displays and controls.

Based on the above, the staff concludes that the licensee has met the NUREG-0737, Supplement 1, requirement for a comparison of display and control requirements with a control room inventory.

2.4 Control Room Survey

A comprehensive survey of the control room to identify deviations from accepted human factors engineering principles was conducted. The survey process was structured into thirteen task plans, each task plan involving a specific set of related control room design features. For example, task plans included a workspace survey, anthropometric survey, emergency equipment survey, control survey, and display survey. An example of a completed task plan for the anthropometric survey was provided in Attachment A of the Summary Report.

The following four methods were used in conducting each survey: measurements, observations, interview/questionnaires, and documentation reviews. The criteria used for each survey were from NUREG-0700, Section 6. Any deviations from the criteria were documented as HEDs. The licensee provided the objectives, scope, criteria, method, findings, and HED report summary for each of the thirteen surveys.

Based on the above, the staff concludes that the licensee has met the NUREG-0737, Supplement 1, requirement for a control room survey to identify deviations from accepted human factors engineering principles.

2.5 Assessment of Human Engineering Discrepancies to Determine Which Are Significant and Should Be Corrected

Based on the potential operator performance degradation and the severity of the consequence of error, each HED was placed into one of three categories. Category I HEDs are those which have been noted as documented errors, Category II HEDs are those associated with a high potential for degrading performance and Category III HEDs are those associated with a low potential for degrading performance. A priority number ranging from 1 (highest priority) to 9 (lowest priority) was also assigned. The significance level, assigned for scheduling of control room improvements, is discussed further in Section 2.6 of this report. Based on the review of individual HEDs, the staff concludes that the licensee has followed their assessment process.

Based on the above, the staff concludes that the licensee has met the NUREG-0737, Supplement 1, requirement for an assessment of HEDs to determine which are significant and should be corrected.

2.6 Selection of Design Improvements

Approximately 339 HEDs were identified during the DCRDR, of which approximately 50 (15%) HEDs were considered of high safety significance. Of these 50 HEDs, 37 (74%) will be fully corrected, 3 (6%) will be partially corrected, and 10 (20%) were determined to require no corrective action. The licensee provided detailed justification for each HED that will not be corrected or will be partially corrected in Section 7.5 of the Summary Report. These justifications were reasonable, and found to be acceptable to the staff.

HEDs were assigned a level indication, A, B, or C, to indicate the significance level for scheduling of design improvements. Level A and B indicated HEDs which encompass near term corrections. These changes will be made by start-up after the third refueling outage, given availability of materials, manpower, and engineering lead time. Level C represents long term changes which are outage independent. The licensee indicated that corrections to HEDs in level C are those which may be implemented at any time or should be made to minimize unscheduled down time or to enhance general control room design, or to maintain consistency. Corrections appear to be well-considered and reasonably scheduled according to safety priority.

Based on the above, the staff concludes that the licensee has met the NUREG-0737, Supplement 1, requirement for selection of design improvements.

2.7 Verification that Selected Improvements Will Provide the Necessary Correction

The licensee stated that the verification that selected improvements provide the necessary correction and do not introduce new HEDs included the reapplication of NUREG-0700 guidelines. Results of the evaluation

were documented on the "HED Backfit Assessment and Implementation Form." Improvements were designed with input from operations and engineering personnel, as well as human factors specialists.

Based on the above, the staff concludes that the licensee has met the NUREG-0737, Supplement 1, requirement for verification that selected improvements will provide the necessary correction.

2.8 Verification that Selected Design Improvements Will Not Introduce New HEDs

As discussed in section 2.7 above, the licensee reapplied NUREG-0700 guidelines in order to verify that selected design improvements will not introduce new HEDs.

Based on the above, the staff concludes that the licensee has met the NUREG-0737, Supplement 1, requirement for verification that the selected improvements will not introduce new HEDs.

2.9 Coordination of Control Room Improvements with Changes from Other Programs, such as the Safety Parameter Display System, Operator Training, Regulatory Guide 1.97 Instrumentation, and Upgraded Emergency Operating Procedure

Coordination with the SPDS included integrating the results of the DCRDR with the SPDS development. As part of the DCRDR, a comprehensive computer system survey was conducted for both the Technical Support Center and the plant process computer systems as well as the SPDS.

Coordination with operator training included providing improved licensee training as resolutions to HEDs.

Coordination with Regulatory Guide 1.97 instrumentation included modifications to the post-accident monitoring panel as resolutions to HEDs.

Coordination with upgraded EOPs included conversion of generic data based on the ERGs to plant-specific data by plant personnel during the task analysis activities. Resolutions to HEDs also included modifications to the EOPs.

Based on the above, the staff concludes that the licensee has met the NUREG-0737, Supplement 1, requirement for the coordination of the DCRDR with other Supplement 1 improvement programs such as the SPDS, operator training, Regulatory Guide 1.97 instrumentation, and upgraded EOPs.

3.0 CONCLUSIONS

The South Carolina Electric & Gas Company submitted a DCRDR Summary Report for the V. C. Summer Nuclear Station to the NRC on April 15, 1985 in compliance with the order issued June 15, 1984. The NRC staff reviewed the submittal with reference to the nine DCRDR requirements of NUREG-0737,

Supplement 1 and the guidance provided in NUREG-0700 and NUREG-0800. The staff's comments on South Carolina Electric & Gas Company DCRDR Summary Report review were forwarded to South Carolina Electric & Gas Company by letter dated June 21, 1985. Based on the Summary Report review, the staff concluded that additional information was necessary in order to determine whether or not the nine requirements of a DCRDR specified in NUREG-0737, Supplement 1 had been met.

The licensee submitted a supplement to the Summary Report for the V. C. Summer Nuclear Station to the NRC on May 28, 1987. The Supplemental Summary Report was reviewed with respect to the nine DCRDR requirements specified in NUREG-0737, Supplement 1. The staff's conclusions are provided below, organized by the nine NUREG-0737, Supplement 1 DCRDR requirements.

It is the staff's judgment that South Carolina Electric & Gas Company has met the following nine requirements for the DCRDR as detailed in NUREG-0737, Supplement 1:

- (1) Establishment of a qualified multidisciplinary review team.
- (2) Function and task analysis to identify control room operator tasks and information and control requirements during emergency operations.
- (3) Comparison of display and control requirements with the control room inventory.
- (4) Control room survey to identify deviations from accepted human factors principles.
- (5) Assessment of HEDs to determine which are significant and should be corrected.
- (6) Selection of design improvements.
- (7) Verification that selected improvements will produce the necessary correction.
- (8) Verification that the selected improvements do not introduce new HEDs.
- (9) Coordination of the DCRDR with other Supplement 1 improvement programs such as the SPDS, operator training, Regulatory Guide 1.97 instrumentation and upgraded EOPs.

Principal Contributor: G. Lapinsky, HFAB:DLPO

Dated: MAY 12 1988

4.0 REFERENCES

1. "Control Room Design Review Program Report for V. C. Summer Nuclear Station," attached to Letter from O. W. Dixon (SCE&G) to H. R. Denton (NRC), November 1, 1983.
2. NUREG-0737, Supplement 1, "Requirements for Emergency Response Capability" (Generic Letter No. 82-33), December 17, 1982.
3. NUREG-0700, "Guidelines for Control Room Design Reviews," September 1981.
4. NUREG-0800, "Standard Review Plan," Section 18.1, "Control Room," and Appendix A, "Evaluation Criteria for Detailed Control Room Design Reviews (DCRDR)," September 1984.
5. NRC comments on Review of DCRDR Program Plan, attached to Memorandum from W. T. Russell (NRC) to SCE&G, February 15, 1984.
6. Control Room Design Review Summary Report for V. C. Summer Nuclear Station, Unit 1, attached to letter from O. W. Dixon, Jr. (SCE&G) to H. R. Denton (NRC), April 15, 1985.
7. Review of the Detailed Control Room Design Review, letter from NRC to SCE&G, June 21, 1985.
8. Supplement to the Control Room Design Review Summary Report for V. C. Summer Nuclear Station, Unit 1, attached to Letter from D. A. Nauman (SCE&G) to T. E. Murley (NRC), May 28, 1987.