

COMMENTS ON THE
VOGTLE ELECTRIC GENERATING PLANT UNIT 1
DETAILED CONTROL ROOM DESIGN REVIEW

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DETAILED CONTROL ROOM DESIGN REVIEW PROGRAM PLAN

1.0 BACKGROUND

Georgia Power Company submitted their "Program Plan for Implementation of Control Room Design Review" for the Vogtle Electric Generating Plant to the Nuclear Regulatory Commission on September 14, 1984. The applicant's DCRDR program plan was submitted to the NRC in response to the requirements of NUREG-0737, Supplement 1.

Lawrence Livermore National Laboratory (LLNL) has evaluated the DCRDR program submittal. The disciplines of human factors engineering, nuclear engineering, electrical engineering, and systems engineering were represented on the LLNL evaluation team. All evaluation team members were familiar with nuclear power plant control rooms and experienced in the evaluation of DCRDRs.

The Vogtle program plan has been reviewed against the requirements of NUREG-0737, Supplement 1. Additional guidance was provided by NUREG-0700 and NUREG-0800, Standard Review Plan, Sections 18.0, 18.1, and 18.1 Appendix A. The following comments assess the Vogtle program plan submittal.

2.0 PROGRAM PLAN EVALUATION

2.1 DCRDR Review Team

Supplement 1 to NUREG-0737 requires the establishment of a qualified multidisciplinary review team to conduct a DCRDR. Guidelines for review team selection are found in NUREG-0700 and Appendix A to NUREG-0800, Section 18.1.

2.1.1 Summary of Review Team Composition and Structure

Georgia Power has established a multidisciplinary review team that includes:

- A Vogtle Operations Supervisor as Team Leader and Human Factors Specialist

- A Vogtle Shift Supervisor

- An Operations Support Supervisor supplied by Consultec Services as an Operations Technical Advisor

- Two I&C engineers

- A Plant Engineering Supervisor to provide design engineering input

All Vogtle review team members are identified by name and detailed resumes are provided.

Georgia Power plans that the entire DCRDR Team participate in the control room survey, human engineering deficiency assessment, selection of design improvements, and verification of improvements. The Team Leader will have the primary responsibility for coordination with other NUREG-0737 tasks and for the operating experience review. We could not determine specifically which DCRDR Team members will be involved in the function and task analysis, the comparison of display and control requirements with the control room inventory and the evaluation of the operator survey results.

The Review Team Leader will report to the Vogtle Unit Operations Manager and will have the authority to obtain necessary technical support directly from the appropriate department supervisors.

Review team members will be provided with orientation in Human Factors Methods, DCRDR Requirements and History, Emergency Response Guidelines, and Post Accident Monitoring Instrumentation.

2.1.2 Evaluation of Review Team Composition and Structure

While the background of review team members does not, in each case, envelope the criteria contained in Appendix A to NUREG-0800, Section 18.1, the team as a whole reflects training and experience well in excess of the recommended criteria. Of particular note is the Team Leader who has 8 years of experience in military reactor operation and training and 6 years experience in commercial power operations research, including human factors and human reliability. Adequate orientation of team members is planned and the relatively senior position of the team leader and certain other team members indicates that necessary facilities and technical support will be available.

It is noted that 3 of the 6 review team members, including the Team Leader/Human Factors Specialist, hold management positions at the Vogtle Plant. We are somewhat concerned that the normal duties of such senior people could severely limit their participation in the DCRDR process.

We conclude the team composition and structure clearly demonstrate understanding and intent to satisfy the requirements of Supplement 1 to NUREG-0737 regarding the formation of a multidisciplinary team. We suggest the utility be encouraged to insure that each team member's non-DCRDR workload allows for DCRDR participation to the fullest extent necessary and that the team as a whole participate in the evaluation of the operator survey results, comparison of control and display, requirements with the control room inventory, and development of the function and task analysis.

2.2. Function and Task Analysis

Supplement 1 to NUREG-0737 requires the applicant to perform systems function and task analyses to identify control room operator tasks and to identify control room operator information and control requirements during emergency operations. Supplement 1 to NUREG-0737 recommends the use of function and task analyses that have been used as the basis for developing emergency operating procedures technical guidelines and plant-specific emergency operating procedures to define these requirements.

2.2.1 Summary of Function and Task Analysis Plan

Georgia Power plans to base the Vogtle Function and Task Analysis upon generic Emergency Response and Functional Response Guidelines (ERGs and FRGs) developed for the Westinghouse Owners' Group. These guidelines will be reviewed to identify tasks required of operators under emergency conditions. Tasks required to operate systems in support of ERG implementation will be identified through review of existing Vogtle documentation. Instrumentation and controls required to complete each task will be identified by the plant specific component identification number.

Functional requirements for instruments and controls will not be identified at this stage. Rather, Georgia Power intends to evaluate the suitability of control room equipment as part of the comparison of control and display requirements with the control room inventory. Section 2.3 further discusses this evaluation.

2.2.2 Evaluation of Function and Task Analysis Plan

Use of the Westinghouse Owners' Group Emergency Response Guidelines as a functional and systems basis for conducting the task analysis is acceptable to the NRC as noted in Appendix A to Section 18.1 of NUREG-0800. However, the program plan does not indicate how modifications made to the generic ERGs, in order to develop plant specific emergency operating procedures will be factored into the task analysis. We recommend Georgia Power include evaluation of the plant specific features of their emergency procedures into the task analysis.

It is noted that the list of transients to be walked through during the validation phase does not include station blackout or remote shutdown. Georgia Power should include these transients, and any other emergency conditions that are not covered by the ERGs, in the scope of their function and task analysis. In cases where the ERG task analysis does not provide a basis for certain plant specific emergency procedures, or other plant specific procedures needed to support the performance of EOPs, a separate task analysis is required.

Although not clearly required by Supplement 1 to NUREG-0737, we suggest that the DCRDR process be applied to tasks and equipment required for remote shutdown. Special attention should be given to assuring that conventions and nomenclature used on remote shutdown equipment are consistent with those used in the control room.

While the "Task Analysis HED Principles" address functional requirements on control room equipment, the Task Analysis Work Sheets do not make provisions to document requirements such as range, accuracy, trending capability, and operability under accident conditions. We are concerned that failure to define specific requirements in these areas during the function and task analysis will not allow for a systematic and rigorous comparison of control room equipment capabilities versus control room operator information and control requirements during emergency conditions. Additionally, the planned approach will make it difficult to maintain the desired independence between the function and task analysis and the control room. We recommend that functional requirements be specifically identified and documented at this stage.

In light of the deficiencies and uncertainties noted above, we cannot conclude that the DCRDR program planned by Georgia Power will satisfy the function and task analysis requirements of NUREG-0737, Supplement 1.

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

Supplement 1 to NUREG-0737 requires the applicant to compare the display and control requirements determined from the task analyses with the control room inventory to determine missing controls and displays. Guidance in NUREG-0700 also calls for a review of the human factors suitability of instruments and controls used to satisfy information and control requirements.

2.3.1 Summary of Requirements/Inventory Comparison

Each ERG will be walked through by an operating crew to identify the instruments and controls in the primary control area that are used to carry out ERG tasks. Missing instruments or controls will be documented as human engineering deficiencies (HEDs).

The suitability of equipment identified in the walk through will be evaluated against a set of "Task Analysis HED Principles" developed by Georgia Power. These principles address accuracy, range, type of display, process variable selection, and availability of instrument or control capabilities under accident conditions.

2.3.2 Evaluation of Requirements/Inventory Comparison

The stated approach will establish the presence of controls and indication of parameters required to perform the ERGs and will, in principle, accomplish a comparison of operator display and control requirements needed to perform the ERGs with the control room inventory. However, the comparison required is between the plant specific EOPs and the control room. This comparison must include plant emergency procedures such as station blackout, that are not necessarily covered by the ERGs and other plant specific procedures required to support the performance of the EOPs. Therefore, Georgia Power's requirements/inventory comparison must be based upon the full set of plant specific EOPs and supporting procedures.

Additionally, many of the features to be considered in the comparison are difficult to evaluate by subjectively responding to the questions expressed in "Task Analysis HED Principles." This fact, together with the lack of a documented listing of specific functional requirements from the function and task analysis, causes us concern that a systematic comparison of requirements versus capabilities may not occur. Furthermore, it is not clear that what comparison does occur will be thoroughly documented.

We suggest that for each instrument or control related to emergency operations, Georgia Power document the device's specific capabilities and compare these with the specific requirements that should be documented as part of the function and task analysis. This comparison of documented requirements versus documented capabilities will ensure a rigorous and auditable evaluation of the suitability of displays and controls provided to the operators. The "Task Analysis HED Principles" contained in the Program Plan would form a good basis for identifying the important requirements to be identified by the task analysis and the important capabilities to be documented by the control room inventory.

Georgia Power must acceptably resolve the items above before we can conclude that the NUREG-0737, Supplement 1 requirements for a comparison of control and display requirements with the control room inventory will be adequately fulfilled.

2.4 Control Room Survey

Supplement 1 to NUREG-0737 requires that a control room survey be conducted to identify deviations from accepted human factors principles. NUREG-0700 provides guidelines and criteria for conducting a control room survey. The objective of the control room survey is to identify the characteristics of displays, controls, equipment, panel layout, annunciators and alarms, control room layout, and control room ambient conditions that do not conform to good human engineering practices.

2.4.1 Summary of Control Room Survey

Georgia Power intends to conduct the Vogtle control room survey in accordance with guidance of the Nuclear Utility Task Action Committee (NUTAC) "Control Room Design Review Survey Development Guideline," INPO 83-042. The survey will include completion of: questionnaires by engineering and operators to identify functions of and operating experience with control room equipment; check lists that compare specific control room design characteristics versus specific human engineering criteria; and surveys to gather and evaluate data regarding panel layout, control room environment, and design conventions.

2.4.2 Evaluation of Control Room Survey

The NUTAC Guidelines have been reviewed by the NRC staff and the staff's position is documented in Section III.4 of Appendix A to NUREG-0800, Section 18.1. The review concluded that INPO 83-042 represents a relaxation of some specific guidelines from Section 6 of NUREG-0700. Specific concerns with the guideline are:

Many objective, measurable criteria from NUREG-0700 have been replaced with subjective evaluations of human engineering suitability. For example, the question "Are any labels unclear about what is being displayed, what a control does, or the control's position," (OQ-16) replaces 19 NUREG-0700 criteria regarding label content, contrast, letter size and spacing, abbreviations, and control/indicator interrelation.

A number of Control Room survey items relating to issues such as indicator viewing angles, equipment accessibility, control room traffic patterns, functional and sequential grouping of indicators and controls are deferred to other portions of the DCRDR program.

Direct participation of the DCRDR team, particularly the human factors specialist, is assumed not to occur by the NUTAC Guidelines.

We are concerned that a control room survey based entirely upon the guidance of INPO 83-042 will not identify all human engineering deficiencies which may be assessed as significant.

Since the Vogtle program plan does not address how the NUTAC guidelines will be supplemented to correct these deficiencies, it appears that Georgia Power's efforts will not fulfill the NUREG-0737, Supplement 1 requirements in regard to Control Room Survey. We recommend that Georgia Power be prepared to support the suitability of the Control Room Survey Guidelines ultimately used on their DCRDR, and be able to identify where NUREG-0700 survey items, deferred by the NUTAC, have been completed for Vogtle.

2.5 Assessment of HEDs

Supplement 1 to NUREG-0737 requires that HEDs be assessed to determine which HEDs are significant and should be corrected. NUREG-0700 contains guidelines for the assessment process.

2.5.1 Summary of HED Assessment Process

Georgia Power plans to assign each HED to one of four categories:

- HEDs that can be easily corrected

- HEDs that are likely to impair emergency operations

- HEDs that are known to impair normal operations

- HEDs that do not fit the above categories

Specific criteria for categorizing HEDs have not yet been developed by the utility and no discussion of the assessment of cumulative and interactive effects was provided.

2.5.2 Evaluation of Assessment Process

The HED categories identified by the licensee will simply and effectively highlight the HEDs that should be corrected and aid in the prioritization of HED corrections. However, the lack of detail about the categorization process makes it impossible for us to determine if significant HEDs can be expected to be properly categorized.

Although HEDs that are likely, but not known to impair normal operation would fall into the "other" category, the utilities planned ongoing program to identify and evaluate control room design problems is a commendable effort to work out HEDs associated with normal operations.

While Georgia Power has developed an effective set of HED categories, the submittal did not contain enough detail to allow us to determine if the assessment process will satisfy the requirements of Supplement 1 to NUREG-0737.

2.6 Selection of Design Improvements

Supplement 1 to NUREG-0737 requires selection of control room design improvements that will correct significant HEDs. It also states that improvements that can be accomplished with an enhancement program should be done promptly.

2.6.1 Summary of Plan for Selecting Design Improvements

The Vogtle Program Plan indicates that selection criteria has not yet been developed.

2.6.2 Evaluation of Plan for Selecting Design Improvements

No conclusions can be reached at this time.

2.7 Verification of Control Room Design Improvements

Supplement 1 to NUREG-0737 requires verification that selected control room design improvements will provide the necessary corrections of HEDs, will not introduce new HEDs into the control room and will not result in increased risk, unreviewed safety questions, or temporary reduction in safety.

2.7.1 Summary of Improvement Verification Plan

Before control room changes are made, proposed HED corrections will be reviewed by Vogtle operations personnel. Changes involving movement, modification, addition, or deletion of instrumentation will be reviewed with respect to impact on the control room, operator performance, training and procedures. Additionally, large scale changes will be evaluated through modification of the plant simulator prior to implementation in the control room.

After implementation, each HED improvement will be reviewed by the DCRDR Team to verify the change has corrected the HED and has not created new HEDs. Furthermore, a process will be established to allow operators to document control room problems for evaluation by plant engineering, as they are identified via operating experience.

Verification that HED improvements will not increase risk, create unreviewed safety questions, or result in a temporary reduction in safety will be accomplished through use of the normal plant modification process which addresses these issues in accordance with 10CFR 50.59.

2.7.2 Evaluation of Improvement Verification Plan

The process described should adequately verify the suitability of HED corrections. However, we suggest the evaluation of the impact upon the control room, operator performance, training, and procedures be conducted for changes involving movement modification, addition or deletion of controls as well as instrumentation.

The additional evaluation provided by implementing large scale changes on the simulator in advance will provide valuable experience with the proposed modification, allowing unforeseen problems with improvements to be corrected prior to modification of the plant.

The degree to which the improvement verification process will be documented and the involvement of the DCRDR team in the improvement design process was not clear from the submittal. Georgia Power must ensure that the improvement reviews will generate documentation sufficient to allow NRC audit of this portion of the DCRDR. We also suggest that the DCRDR team be available to improvement designers and involved in the improvement design review process.

We expect the verification process described will satisfy the NUREG-0737, Supplement 1 requirements in this area provided adequate documentation of verification activities is developed and maintained.

2.8 Coordination of Control Room Improvements with Other Programs

Supplement 1 to NUREG-0737 requires that control room improvements be coordinated with changes from other programs; e.g., safety parameter display system (SPDS), operator training, Regulatory Guide 1.97 (R.G. 1.97), and emergency operating procedures (EOPs).

2.8.1 Summary of Coordination Plan

The revised Emergency Operating Procedures provide a common tie amongst the TMI related changes to the Vogtle control room, including DCRDR, Reg. Guide 1.97 and the SPDS.

Regulatory Guide 1.97 changes and the SPDS installation will be completed prior to the Control Room Survey.

2.8.2 Evaluation of Coordination Plan

Georgia Power's coordination plan reflects an understanding and intent to comply with this portion of NUREG-0737, Supplement 1.

We suggest, however, that the utility also consider coordination with other non-TMI related issues (e.g. fire protection, equipment qualification, and NUREG-1000).

2.9 Other DCRDR Activities

Georgia Power plans to conduct an operating experience review to identify potential HEDs. This review will include analysis of LERs from Westinghouse plants or that involve human error, and ongoing review of INPO Significant Event Reports and Significant Operating Experience Reports. They will also conduct a control room operating personnel survey by means of questionnaires and interviews with operating personnel. This survey will be updated after operational experience with the Vogtle Control Room is obtained. Use of an operating experience review conforms with guidance in NUREG-0700 and can be a valuable additional source of HEDs. Conduct of the operating experience review is essential to the Vogtle assessment process since the Category 2 HEDs are to be obtained from documented errors in plants similar to Vogtle and simulator operation.

An ongoing program to provide operations a mechanism to request engineering evaluation of possible HEDs identified by future operating experience will be established.

3.0 CONCLUSIONS

The information in the Vogtle DCRDR program plan reflects an understanding and intent to comply with the DCRDR requirements stated in Revision 1 to NUREG-0737. The senior level of personnel assigned to the DCRDR task and the provision made for a continued evaluation of the adequacy of Vogtle's control room human engineering design indicates a strong commitment to achieving a well designed control room. However, Georgia Power's approach to function and task analysis comparison of control and display requirements versus the control room inventory and the control room survey may not result in a DCRDR that completely meets the requirements of Supplement 1 to NUREG-0737. Specifically:

1. The program plan does not describe how modifications made to the generic ERGs in order to develop plant specific EOPs will be factored into the function and task analysis. Therefore, it could not be determined that the task analysis process will address plant specific features of the Vogtle design.
2. It is not clear that plant specific emergency operating procedures not covered by the ERGs are included in the function and task analysis. For example, station blackout appears to be omitted. In cases where the ERG task analysis does not provide a basis for these procedures or other plant specific procedures needed to support the performance of EOPs, a separate task analysis is required.
3. Specific functional requirements related to operator information and control needs will not be developed and documented during the function and task analysis. As a result they cannot be rigorously compared with documented capabilities of the Vogtle control room equipment during the comparison of control and display requirements with the control room inventory. The process planned by Georgia Power could result in undue influence of the control room design on the functional evaluation, the overlooking of certain requirements that are not readily apparent in a control room walk through, and the lack of an adequate audit trail.
4. The comparison of control and display requirements with the control room inventory is to be based upon walk through of generic Emergency Response Guidelines. This will not produce a plant specific evaluation that considers differences between the Vogtle Emergency Operating Procedures and the generic ERGs and it does not appear to address plant specific EOPs not covered by the ERGs or plant specific procedures required to support performance of the EOPs.

5. The use of INPO 83-042 as the sole basis for the control room survey is not expected to result in an effort that will identify all HEDs that may be assessed as significant.

Other concerns resulting from our review of the Vogtle Program Plan are:

1. The relatively senior positions of a number of team members presents a high potential that conflicting demands upon their time will dilute the DCRDR process. Georgia Power should insure DCRDR Team members' workload will allow full participation in the review process.
2. The DCRDR Team as a whole should participate in the evaluation of operator survey results, comparison of control and display requirements with the control room inventory and development of the system function and task analysis.
3. The impact that moving, modifying, adding or deleting controls will have on the control room, operator performance, training and procedures should be evaluated prior to implementing design changes.
4. It could not be determined that the improvement verification process will generate auditable documentation.
5. The program plan does not contain enough detail to allow complete evaluation of the HED assessment and design improvement selection methodology.

Georgia Power should address the deficiencies and concerns listed above during their performance and documentation of the Vogtle DCRDR to demonstrate that they will satisfy the requirements of Supplement 1 to NUREG-0737.

Finally, we offer the following suggestions for consideration by Georgia Power on matters not directly related to compliance with NUREG-0737, Supplement 1:

1. The DCRDR process should be extended to include remote shutdown capability and to assure that conventions and nomenclature used on remote shutdown equipment are consistent with those used in the control room.
2. The DCRDR Team should be available to the designers of control room improvements and should review proposed control room improvements before hardware changes are initiated in order to reduce the potential that unacceptable control room modifications will be made.
3. Consideration should be given to the coordination of the DCRDR with other non-TMI programs such as fire protection, equipment qualification, and NUREG-1000.

In summary, we are concerned that Georgia Power's approach to the function and task analysis, the comparison of information and control requirements with the

control room inventory, and the control room survey will result in an incomplete Detailed Control Room Design Review. Additionally, for certain DCRDR tasks, the Program Plan did not provide enough information to support a determination whether or not NUREG-0737, Supplement 1 requirements will be fulfilled by the Vogtle DCRDR. We recommend, therefore, that the NRC conduct an In-Progress Audit of the Vogtle DCRDR to observe the specific criteria and methods used by Georgia Power to perform the review and to further evaluate conformance with the requirements of Supplement 1 to NUREG-0737.