

EVALUATION
OF THE
DETAILED CONTROL ROOM DESIGN REVIEW
PROGRAM PLAN
FOR
ROCHESTER GAS AND ELECTRIC CORPORATION'S
R.E. GINNA NUCLEAR POWER PLANT

INTRODUCTION

The Nuclear Regulatory Commission (NRC) Division of Human Factors Safety and their consultants, Science Applications International Corporation (SAIC) have, as a team, evaluated the Program Plan (Reference 1) submitted by Rochester Gas and Electric (RG&E) for conduct of a Detailed Control Room Design Review (DCRDR) at the R.E. Ginna Nuclear Power Plant. The disciplines of human factors engineering, instrumentation and control engineering, nuclear engineering, and reactor operations were represented during this evaluation. All evaluation team members were familiar with nuclear power plant control rooms and experienced in evaluating DCRDRs. The purpose of the evaluation was:

1. To determine whether the planned program would result in a successful DCRDR
2. To determine whether an in-progress audit was necessary
3. To provide an audit agenda where appropriate
4. To provide constructive feedback to RG&E

Evaluation was conducted relative to the requirements of Supplement 1 to NUREG-0737 (Reference 2). Additional guidance was provided by NUREG-0700 (Reference 3) and Section 18.1, revision 0, of NUREG-0800 (Reference 4). This report provides the results of the evaluation. Comments of the Nuclear Regulatory Commission (NRC) staff member responsible for evaluation of the RG&E DCRDR have been integrated into the report in order to represent the consolidated observations, conclusions, and recommendations of the NRC staff and its consultants (SAIC).

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BACKGROUND INFORMATION

Licenses and applicants for operating licenses shall conduct a DCRDR. The objective is to "improve the ability of nuclear power plant control room operators to prevent accidents or cope with accidents if they occur by improving the information provided to them," NUREG-0660, Item I.D (Reference 5). The need to conduct a DCRDR was confirmed in NUREG-0737 (Reference 6) and Supplement 1 to NUREG-0737. DCRDR requirements in Supplement 1 to NUREG-0737 replaced those in earlier documents. Supplement 1 to NUREG-0737 requires each applicant or licensee to conduct a DCRDR on a schedule negotiated with the NRC.

NUREG-0700 describes four phases of the DCRDR and provides applicants and licensees with guidelines for its conduct. The phases are:

1. Planning
2. Review
3. Assessment and implementation
4. Reporting

Criteria for evaluating each phase are contained in NUREG-0800.

A Program Plan is to be submitted within two months of the start of the DCRDR. Consistent with the requirements of Supplement 1 to NUREG-0737, the Program Plan shall 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 the design improvements provide the necessary correction and do not introduce new HEDs.
8. Coordination of control room improvements with changes from other programs such as SPDS, operator training, Reg. Guide 1.97 instrumentation, and upgraded emergency operating procedures

Licensees and applicants are expected to schedule Element 1 for accomplishment during the planning phase, Elements 2 through 4 for accomplishment during the review phase, and Elements 5 through 7 for accomplishment during the assessment and implementation phase. Scheduling of Element 8 is expected to cut across the planning, review, and assessment and implementation phases.

Program Plans are not approved by the NRC, but staff comments will be provided per the requirements of Supplement 1 to NUREG-0737. Those comments will, among other things, provide the staff's judgment as to whether the Program Plan will lead to a successful DCRDR. Staff comments on the Program Plan do not require response and may be used as the licensee or applicant chooses.

A Summary Report is to be submitted at the end of the DCRDR. As a minimum it shall:

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

The NRC will evaluate the organization, process, and results of the DCRDR. Evaluation will include review of required documentation (Program Plan and Summary Report) and may also include reviews of additional documentation, briefings, discussions, and on-site audits. In-progress

audits may be conducted after submission of the Program Plan but prior to submission of the Summary Report. The staff will prepare a report following an in-progress audit. That report will be transmitted to applicants and licensees for their use. Pre-implementation audits may be conducted after submission of the Summary Report. Results of a pre-implementation audit will be included in the NRC evaluation of the DCRDR which follows receipt of the Summary Report. NRC evaluation will be in accordance with the requirements of Supplement 1 to NUREG-0737. Additional guidance for the evaluation is provided by NUREG-0700 and NUREG-0800.

Supplement 1 to NUREG-0737 requires that significant HEDs be corrected. Improvements which can be accomplished with an enhancement program may be done promptly. Other control room upgrades may begin following publication of the SER (or SER Supplement), resolution of any open issues, and approval of a schedule for upgrade.

A human factors evaluation of the design of the remote shutdown capability provided to meet 10 CFR Part 50, Appendix A, GDC-19 and 10 CFR Part 50, Appendix R is not specifically identified as a requirement in Supplement 1 to NUREG-0737. NRC staff review of this issue is not completed. In the interim, the NRC staff recommends that the scope of the DCRDR include a human factors evaluation of the design of the remote shutdown capability. To the extent practicable, without delaying completion of the DCRDR, the NRC staff also recommends that the DCRDR address any control room modifications and additions (such as controls and displays for inadequate core cooling and reactor system vents) made or planned as a result of other post-TMI actions, as well as the lessons learned from operating reactor events such as the Salem ATWS events. Implications of the Salem ATWS events are discussed in NUREG-1000 (Reference 7) and required actions are described in Section 1.2, Post Trip Review - Data and Information Capability, of the enclosure to Generic Letter 83-28 (Reference 8).

EVALUATION OF PROGRAM PLAN

1. Establishment of a Qualified Multidisciplinary Review Team

The Rochester Gas and Electric (RG&E) Program Plan contains a description of the review team organizational structure, qualifications and

responsibilities of the team members. The RG&E core review team consists of:

1. Engineering-discipline manager
2. Responsible engineer
3. Electrical engineer
4. Mechanical engineer
5. Liaison engineer
6. Lead human factors specialist (consultant)
7. Human factors specialist (consultant)

The list of core review team members does not include a reactor operator, nuclear systems engineer, and instrumentation and control engineer. These disciplines are recommended in guidance provided in Subsection 2.1 of NUREG-0800 and Subsection 2.3 of NUREG-0700.

Other specialists will be used to support the core review team on an as required basis. Those specialists will include personnel selected from the following groups:

1. Instrumentation and Control Group
2. Operations Group
3. Simulator Project Group
4. Training Group

Our review of the responsibilities and qualifications of the team members indicated that qualified human factor specialists will be involved in the DCRDR program. Brief descriptions of qualifications for each participating human factors consultants were provided in the Program Plan. In contrast, no background detail was given with regard to the other RG&E team members. This lack of information prevents a definitive conclusion on the qualifications of the overall RG&E review team members.

Another concern related to the review team involves staffing and task assignment. According to Section 18.1, revision 0 of the Standard Review Plan, the licensee should to provide information on the team member assignments and levels of effort at the time the Program Plan report is submitted. However, this information was not included in the R.E. Ginna Program Plan.

In summary, RG&E has demonstrated partial understanding and the intent to satisfy the Supplement 1 to NUREG-0737 requirement to establish a qualified multidisciplinary review team. However, the Program Plan description of the review team has produced three concerns. First, the disciplines of reactor operator, nuclear systems engineer and instrumentation and control engineer are not represented on the DCRDR team. Second, the licensee does not provide enough information on the qualifications of most of the review team members, except for the human factors engineering disciplines. Third, the Program Plan does not contain information on proposed task assignments and estimated levels of effort for each team member. For these reasons a definitive evaluation of RG&E's response to this requirement was not possible.

2. Use of Function and Task Analysis

RG&E plans to use the Westinghouse Owner's Group (WOG) task analysis background documentation to provide the generic basis for the analysis of system functions. The licensee also recognizes that the WOG data cannot fulfill all the requirements of the requisite plant-specific evaluations. In order to document the plant-specific differences, RG&E states that a top-down approach, utilizing the WOG emergency response guidelines (ERGs) system function review and task analysis (SFRTA) and Ginna plant-specific emergency operating procedures, will be used as the basis for identifying plant functions and operator tasks. However, RG&E does not state whether the Basic version of the ERGs and background documentation or the Rev. 1 version will be used. NRC letter (Reference 9) dated April 5, 1984, recommends the Rev. 1 documents because it is easier to extract the needed information from the Rev. 1 background documents.

RG&E states that all steps and contingencies represented in the WOG ERGs will be analyzed during this review resulting in a list of plant-specific tasks in the accomplishment of all branches of the WOG ERGs. This conforms to the Supplement 1 to NUREG-0737 requirement that all tasks performed by the operators during emergency operations be included in the task analysis.

From the tasks identified in the analysis of the ERGs and plant specific EOPs, RG&E plans to define the operator task needs. For each task,

the display information necessary for an operator decision to activate a control or monitor a system state will be determined. Next the operator control functions will be analyzed to document needed control characteristics. The information to be collected to determine the operator control needs for each task will include: parameter, equipment, position, status, type, mode, type of feedback and feedback state that is desired or needed. The information needs for the operator tasks will be described in terms of the following characteristics: parameter, state, type, units needed, range and divisions required. This approach follows the guidance for the determination of instrumentation and control characteristics provided in NUREG-0800.

The Control Room Review Task Development form and Task Analysis forms (Pages A-6, and A-7 of the Program Plan) provide an appropriate format for producing an auditable record of how the needed characteristics of the instruments and controls were determined. This conforms to the guidance provided in comment 4 of the NRC letter dated April 5, 1984 (Reference 9).

According to the Program Plan, the task analysis team members will consist of RG&E DCRDR team members along with the human factors consultants. However, the specific multidisciplinary task analysis team members were not identified in the Program Plan.

While the procedures RG&E proposes for data collection are appropriate, the licensee does not explicitly state that the information collected to determine the operator information and control needs will be collected independent of the existing control room. The concern here, is that the data collectors will collect existing control room instrument data, rather than performing an analysis which is independent of the control room. One reason for this concern is that the "ID" column on the Task Analysis Instrumentation Requirement form has two columns for control room specific "ID" numbers. We cannot determine if these numbers entered before or after the instrumentation requirements are compared to the inventory data.

In conclusion, the system function and task analysis procedures if carried out as stated in the plan, should result in one that meets the requirement of Supplement 1 to NUREG-0737. However, our review of the RG&E methodology has identified several concerns. The methodology does not

specify whether Basic or Revision 1 WOG ERGs is going to be used for the analyses. RG&E does not specifically state that the task analysis will not depend on the existing control room for instrument and control characteristics. Finally, the multidisciplinary review team who will conduct the SFRTA was not described in the Program Plan.

3. Comparison of Display and Control Requirements With Control Room Inventory

The program plan states that the inventory will be conducted in the control room by the human factors specialists. The instrument data collected in the inventory will be compared to the requirements identified in the task analysis. Discrepancies will be recorded as human engineering discrepancies. This should produce inventory results which conform to the requirement in Supplement 1 to NUREG-0737, by identifying missing displays and controls.

In addition, RG&E plans to evaluate the adequacy of the existing controls and displays to meet the needs identified in the Task Analysis. This will be done in the verification and validation processes as outlined in the Program Plan.

The verification will be conducted to determine the availability and suitability of the instruments and controls. Personnel knowledgeable in plant systems, instrumentation and controls engineering, human factors engineering and operations will participate in the verification process. Also system designers will be available for consultation. It is our judgment that the verification team structure and process outlined by RG&E does follow the verification guidance provided in Subsection 3.7 of NUREG-0700.

The validation will be conducted to determine if the functions allocated to the control room operating crew can be accomplished within the structure of the established emergency operating procedures and the design of the control room as it exists. In order to accomplish the validation, RG&E has outlined three methods which may be used, depending on the availability of the control room and the simulator. It is our determination that the validation processes outlined by RG&E follows to the validation guidance provided in Subsection 3.8 of NUREG-0700.

In conclusion, the RG&E control room inventory activity will be used to identify missing and unsuitable controls and displays. The methodologies described for the inventory, verification and validation activities follow the guidance provided in NUREG-0700 and NUREG-0800 and therefore should successfully satisfy the inventory requirement in Supplement 1 to NUREG-0737.

4. Control Room Survey

The program plan states that the "human factors engineering survey will follow the guidelines illustrated in Section 6 of NUREG-0700." In addition, the plan states that "the Human Factors Engineering Guidelines will be addressed for the nine topic areas" in Section 6 of NUREG-0700. If carried out following this guidance, RG&E's survey will satisfy the survey requirement of Supplement 1 to NUREG-0737.

In terms of staffing, RG&E proposes to have human factors specialists, experienced utility personnel who are familiar with the control room instruments and equipment, and operations personnel as core-members of the control room survey team. To supplement this core survey team, additional specialists such as lighting, HVAC and communication systems experts will be brought in where they are needed. The disciplines proposed for the control room survey team follow the guidance outlined in Subsection 3.6.5 of NUREG-0700.

In summary, the licensee has shown the necessary understanding and commitment to perform a successful control room survey, and if the guidelines described in Section 6.0 of NUREG-0700 are followed as stated, the results from the survey will satisfy the survey requirement in Supplement 1 to NUREG-0737.

5. Assessment of HEDs

The licensee describes the methodologies for the assessment and categorization of human engineering discrepancies (HEDs) in Section 5.1 of the Program Plan. The assessment procedure includes the evaluation of HEDs, categorization of HEDs, and recommendations for HEDs to be corrected.

As stated by RG&E the evaluation process begins by having the human factors specialist separate HEDs into the nine major categories suggested by NUREG-0700. Then each HED will be evaluated independently by each assessment team member. Each reviewer will then assess the impact of the HED and rate it accordingly. The criteria for the HED evaluation and rating process includes impact of HEDs on plant safety, impact on operator performance, and potential impact on operating crew error. During this evaluation process, the interactive or cumulative effects of HEDs will also be assessed. These criteria follow the objectives outlined in NUREG-0800.

The plan goes on to say that upon completing the evaluation phase, the HEDs will be recategorized based on their significance. They will be classified in one of the following categories: (1) highest significance - those that could substantially impact a safety system or operator response during an emergency condition; (2) significant - those that could affect a non-safety system or operator response during a non-emergency situation; and (3) least significant - those that could affect operator response in a non-substantial way. In our judgment, this is a feasible categorization scheme.

After the HEDs have been reviewed and categorized by each team member independently, the assessment team will gather and discuss their individual ratings of each HED to reach a consensus on the HED rating. After the consensus is reached, the lead human factors specialist will document this rating.

In summary, the HED assessment process proposed by RG&E is consistent with guidance provided in NUREG-0800 Section 18.1, and should lead to satisfactory compliance with the requirement in Supplement 1 to NUREG-0737.

6. Selection of Design Improvements

After the HEDs have been assessed and categorized, they will be given to representatives of the appropriate organizations within the plant, such as the Operations Department or the Engineering Department. The design improvement recommendations will be developed by the cognizant plant personnel and forwarded to the DCRDR team for evaluation. The DCRDR team will evaluate each recommendation on a number of factors. Among the factors will be viability, soundness, feasibility, and human factors engineering.

However, there is a concern that the human factors specialist will not be included in all phases of the design improvement process. The Program Plan indicates that the human factors specialist will only act as a verifier of the design solutions, rather than an integral part of the interdisciplinary team which develops the improvements.

A schedule for corrective actions will be established based on importance, the availability of equipment, outage time availability, engineering design lead time and integration with other activities.

The selection of design improvement methodology conforms to the intent of the guidance provided in NUREG-0700 and NUREG-0800. If RG&E follows its stated selection process and scheduling approach for the implementation of design improvements, the selection of improvement requirement in Supplement 1 to NUREG-0737 should be satisfied. However, there is a concern that the human factors specialist will not be included in the entire process.

7. Verification that Design Improvements Provide the Necessary Correction and Do Not Introduce New HEDs.

RG&E does not describe a methodology for verifying that the recommended solutions do correct the HED and that the solutions do not introduce new HEDs into the control room. Without this verification process, the RG&E methodology does not follow the guidance provided in Subsection 4.3 of NUREG-0700 and Section 2.7 of NUREG-0800 and will not satisfy this requirement in NUREG-0737, Supplement 1.

8. Coordination of Control Room Improvements With Other Programs.

Our review indicates that the licensee is performing a DCRDR along with other control room upgrade programs such as SPDS, EOPs, and training through descriptions of these programs in Sections 1.2.2, 1.2.3, 1.2.4 and 1.2.5 of the plan.

However, the program descriptions do not discuss a coordination effort between DCRDR and other programs, but rather describe what is being done for each individual program. We recommend that the licensee provide within the Summary Report, additional information and procedures with regard to this

required coordination of control room activities with other emergency response capabilities and will not satisfy the requirement of NUREG-0737, Supplement 1. The additional information should include a description of the mechanism whereby the results of each program are integrated into the other programs in an iterative manner.

9. Other

The licensee plans to review plant operating experience by (1) examining both in-house and industry-wide historical documents, and (2) conducting a survey of the control room operating personnel. Although the licensee is not required to perform this task, we evaluated this section because it was submitted for review.

The licensee proposes to review both in-house and industry-wide documents containing information on human factors errors at the plant and in similarly designed Westinghouse plants. The documents reviewed will be in the form of LERs. The LER review results will be screened by a human factors specialist and a subject matter expert to determine whether the finding is relevant to the DCRDR. If it is, then it will be prioritized and an analysis will then be performed. Subsequent assessment of LER HEDs will be applied to any other relevant HEDs identified in later tasks of the DCRDR.

This technique to review operating experience to identify HEDs follows the guidance provided in Subsection 3.3 of NUREG-0700 and should provide valuable input to the DCRDR process.

SUMMARY OF CONCLUSIONS

In summary, the RG&E program plan addressed most of the DCRDR requirements stated in Supplement 1 to NUREG-0737. Information in the program plan indicated an understanding of and an intent to satisfy most of the requirements. Our review of the program plan did, however, identify several concerns. These concerns are:

1. The disciplines of reactor operator, nuclear systems engineer and instrumentation and control engineer are not represented on the DCRDR core team.
2. RG&E did not provide enough information about the qualifications of the RG&E DCRDR team members to judge their adequacy.
3. The program plan does not contain information on proposed task assignments and estimated level of effort for each DCRDR team member.
4. The licensee did not state whether they intended to use the Basic or Revision 1 WOG ERGs for the task analysis and validation activities.
5. The licensee did not specifically state that they plan to perform a function and task analysis which identifies the necessary instrumentation and control characteristics independent of the control room.
6. The licensee does not specifically state that the human factors specialist will be included in all phases of the design improvement process. The Program Plan indicates that the human factors specialist will act as verifier of the finished solution, rather than participating in the improvement development.
7. The licensee did not provide a procedure for verifying that the design improvements provide the necessary correction and do not introduce new HEDs.
8. The licensee did not provide a method by which all control room upgrade activities will be coordinated.

Since resolution of the above concerns would increase the benefits of the DCRDR, it is recommended that a clarification meeting be held between the NRC and the licensee in the near future.

REFERENCES

1. Detailed Control Room Design Review Program Plan, R.E. Ginna Nuclear Power Plant, Rochester Gas and Electric Corporation, October 1984.
2. Supplement 1 to NUREG-0737 - Requirements for Emergency Response Capability (Generic Letter No. 82-33), U.S. Nuclear Regulatory Commission, December 17, 1982.
3. NUREG-0700, Guidelines for Control Room Design Reviews, U.S. Nuclear Regulatory Commission, September 1981.
4. NUREG-0800 (Standard Review Plan), Revision 0, Section 18.1 and Appendix A to Section 18.1, September 1984.
5. NUREG-0660, Vol. 1, "NRC Action Plan Developed as a Result of the TMI-2 Accident," U.S. Nuclear Regulatory Commission, May 1980; Revision 1, August 1980.
6. NUREG-0737, "Clarification of TMI Action Plan Requirements," U.S. Nuclear Regulatory Commission, November 1980.
7. NUREG-1000, Generic Implications of ATWS Events at the Salem Nuclear Power Plant, April 1983.
8. Generic Letter 83-28, Required Actions Based on Generic Implications of Salem ATWS Events, July 8, 1983.
9. Letter from H. Brent Clayton to Dennis L. Ziemann, Subject: Meeting Summary - Task Analysis Requirements of Supplement 1 to NUREG-0737, March 29, 1984 Meeting with Westinghouse Owners Group (WOG) Procedures Subcommittee and Other Interested Persons, U.S. Nuclear Regulatory Commission, April 5, 1984.

R.E. Ginna Nuclear Power Plant
TAC No. 51163
SAIC/1-263-07-351-25
Contract NRC-03-82-096