

NUCLEAR REGULATORY COMMISSION  
STAFF COMMENTS  
ON THE  
COOPER NUCLEAR STATION  
DETAILED CONTROL ROOM DESIGN REVIEW  
PROGRAM PLAN

BACKGROUND

Licenses and applicants for operating licenses shall conduct a Detailed Control Room Design Review (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). The need to conduct a DCRDR was confirmed in NUREG-0737 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 Nuclear Regulatory Commission (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-0801.

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 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 SPDS, operator training, Reg. Guide 1.97 instrumentation, and upgraded emergency operating procedures.

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. Pre-implementation audits may be conducted after submission of the Summary Report. 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-0801. Results of the NRC evaluation of a DCRDR will be documented in a Safety Evaluation Report (SER) or SER Supplement.

Significant HEDs should be corrected. Improvements which can be accomplished with an enhancement program should 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.

To the extent practicable, without delaying completion of the DCRDR, it should also 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, and the lessons learned from operating reactor events such as the Salem ATWS events. Generic

implications of the Salem ATWS events are discussed in NUREG-1000 and required actions are described in Section 1.2, "Post-Trip Review - Data and Information Capability, of the enclosure to Generic Letter 83-28.

#### DISCUSSION

The Boiling Water Reactor Owners' Group (BWROG) Control Room Survey Program was referenced in submittals related to the DCRDR for the Cooper Nuclear Station Plant. NRC staff review of the BWROG Control Room Survey Program found that the BWROG Program was not fully responsive to NUREG-0737 Task Action Plan Item I.D.1. The BWROG Program addresses only the planning and review phases of the DCRDR. Utilities referencing that Program are required by Generic Letter 83-18 to complete the following tasks:

1. Submit an individual Program Plan to the NRC referencing the BWROG Generic Program Plan. The plant-specific submittal should:
  - a. Document the qualifications of survey team members, and number and extent of plant personnel participation
  - b. Identify portions of the plant's DCRDR not performed in accordance with the methodology specified in the BWROG Program Plan
  - c. Discuss their program for prioritization of HEDs, reporting of DCRDR results, and implementation of control room enhancements.
2. Complete the BWROG Control Room Survey Checklist Supplement
3. Prioritize HEDs, determine corrective actions, develop an implementation schedule, and report the results of the DCRDR to the NRC
4. Repeat portions of the task analysis using updated plant specific emergency operating procedures to account for differences in the new procedures
5. Update operating experience review.

Nebraska Public Power District (NPPD) submitted a Program Plan for conducting a DCRDR at the Cooper Nuclear Station (CNS) control room by letter dated March 1, 1984. The Program Plan indicated that both the control room and equipment for remote shutdown would be evaluated during the DCRDR. The Program Plan also indicated that the DCRDR would include a "Maintenance Phase." That phase will involve continuing attention to human factors engineering in the control room with respect to procedures, modifications, and review of unusual events. Review of the equipment for remote shutdown and inclusion of the Maintenance Phase should increase the benefits of the DCRDR.

The DCRDR Program Plan for CNS was reviewed against the requirements of Supplement 1 to NUREG-0737. It was further reviewed against the requirements of Generic Letter 83-18. Consultants from Science Applications, Inc., assisted the staff in the review. Results of the review are provided below.

Establishment of a qualified multidisciplinary review team. The Program Plan indicated a basic understanding of the requirement for establishing a multidisciplinary team. Historically, two teams of individuals have been involved in the CNS DCRDR. The initial team performed the BWROG Control Room Survey of CNS in February 1981. That team included engineers, a licensed senior reactor operator, and human factors consultants. None of the initial team were employed by NPPD. The initial team's activities appear to have ended with the BWROG Control Room Survey Summary Report.

The CNS DCRDR is being continued by a new review team composed of NPPD and contractor personnel (General Electric and HPT, Inc.). The Program Plan indicated that the review team will perform all outstanding activities and integrate all action items.

The leader of the review team is the CNS Operations Manager. He reports monthly to the NPPD Manager, Nuclear Operations Division who has the ultimate responsibility for the CNS DCRDR. The Program Plan indicated that the review team leader was to assure:

1. Access to information (records, documents, plans, procedures, drawings, etc.)
2. Access to all required facilities
3. Access to any personnel with useful or necessary information
4. Access to support services
5. Freedom to document dissenting opinions.

The review team includes the following personnel in addition to the review team leader:

1. Human factors scientist
2. Senior reactor operator
3. Design engineer
4. Operations supervisor.

Support personnel include:

1. The General Electric Program Manager

2. Systems engineer - consultant
3. Instrumentation and controls engineer - consultant
4. Safety and licensing engineer - consultant.

Examination of the review team and support personnels' resumes indicated training and experience in:

1. Nuclear power plant (NPP) operations
2. NPP engineering
3. NPP operator training
4. NPP licensing
5. Instrument and control engineering
6. Mechanical engineering
7. Procedures development
8. Reliability evaluation
9. Human factors engineering
10. Task Analysis.

Several members of the review team were oriented through attendance at the BWROG Control Room Survey Workshop held October 18-20, 1983. A brief orientation to CNS is also planned.

The Program Plan did not indicate personnel assignments by technical task (i.e., control room survey, HED assessment, etc.). The staff recommends that NPPD assure that personnel from all pertinent disciplines participate in each technical task. In particular, personnel with human factors engineering training and experience should be given an important role in the later stages of the review (e.g., assessment of HEDs, selection of design improvements, integration, and verification). In the staff's judgment, such participation is important to satisfaction of the requirement in Supplement 1 to NUREG-0737.

Examination of review team resumes indicated that much of the human factors experience was in procedures development. NPPD may find it desirable to supplement that experience with specialized expertise (e.g., environmental measurement). It also appeared that most of the human factors experience was held by two senior level consultants. NPPD may find it desirable to supplement those consultants with a more readily available junior level

person. The recommended supplements to the review team would help to assure satisfactory results of the DCRDR.

Function and task analyses to identify control room operators tasks and information and control requirements during emergency operations; and a comparison of display and control requirements with a control room inventory. The Program Plan recognized the requirement to perform the function and task analyses and the requirement to compare function and task analyses results with a control room inventory. However, it was not clear that the requirements of Supplement 1 to NUREG-0737 would be met. In particular, the scant information provided did not lead to confidence that the function and task analysis requirement would be satisfied. An acceptable process for conducting the function and task analysis is:

1. Analyze the functions to be performed by systems in responding to transients and accidents to define, and describe, the tasks the operators are expected to perform.
2. From the tasks identified in Item 1 above, define the information necessary (e.g., parameter, value, status) for the operators to determine the need to perform the task, the control capabilities needed to perform the task and the information necessary to determine that the task has been performed successfully. (Note that no instrumentation has been identified yet; only operator needs derived from the task.)
3. Analyze the operator needs (from 2 above) to determine the characteristics of the information and control capability needed to perform the task. (Information characteristics include parameter type, dynamic range, setpoints, resolution/accuracy, speed of response, units, and the need for trending, alarming, etc. Control characteristics include type (discrete or continuous, rate, gain, response requirements, transfer function, locking functions, and information feedback associated with control use).

With respect to comparison of function and task analyses results with a control room inventory, the Program Plan indicated that task analysis results would be compared with the in-place inventory of controls and displays in the control room to assure that the control room supports the Emergency Operating Procedures (EOPs) and to identify missing controls and displays. That statement suggested that the control room itself will be used as the inventory. Such an approach differs from NUREG-0700 guidelines but is acceptable to the extent that the instruments and controls provide all the data needed for comparison with the results of the function and task analyses. Supplemental data sources should be used if necessary.

The key to satisfying the subject two requirements is comparison of the results of a prescriptive task analysis (i.e., one that identifies, in detail, what the operator needs to control systems which perform the

emergency functions called for in the EOPs) with the results of a descriptive control room inventory. The result of the comparison should be HEDs which are assessed and considered for correction just as all other HEDs (i.e., by enhancement, design improvement, procedure modification, training, etc.). NPPD should assure accomplishment of the above in order to satisfy the requirements of Supplement 1 to NUREG-0737.

A control room survey to identify deviations from acceptable human factors principles. The review phase of the CNS DCRDR is being conducted according to the BWROG Program addressed in Generic Letter 83-18. As part of that phase, the initial BWROG Control Room Survey was conducted at CNS in February 1981. The Program Plan indicated that the BWROG Control Room Survey Checklist Supplement will be completed as part of the DCRDR. In the staff's judgment, changes to the CNS control room since February 1981 should also be surveyed prior to completion of the DCRDR. Completion of the checklist supplement and survey of changes will satisfy the control room survey requirements of Generic Letter 83-18 and Supplement 1 to NUREG-0737.

Assessment of HEDs to determine which are significant and should be corrected. The Program Plan indicated an understanding of the requirement for assessing HEDs. A prioritization process, based on the likelihood of operator error and the resulting safety consequences, was described. Some HEDs will be selected for correction by enhancement without undergoing prioritization. All others will be prioritized by a process which sorts HEDs into those which are significant and those which may be corrected at NPPD's option. Significant HEDs are further sorted into groups according to whether they are recommended for prompt correction or not. HEDs identified for correction by enhancement will be corrected promptly. If conducted as described, the assessment process should satisfy the requirement in Supplement 1 to NUREG-0737.

Selection of design improvements. The Program Plan indicated understanding of the requirement for selection of design improvements. The possibility of resolving HEDs by enhancement, design modification, improved training and procedures, and other initiatives (e.g., the SPDS) was recognized. The review team will develop corrective actions using guidance in NUREG-0700 and EPRI NP-2411. The Program Plan indicated that the verification and validation processes will be used in conjunction with the selection of design improvements to assure that selected design improvements, both individually and collectively, correct HEDs and do not create other safety problems. Inadequate corrective actions will be reassessed and revised to meet verification process criteria (see discussion of verification below). Newly identified HEDs will be assessed and design improvements selected.

The specific mechanism and personnel involved in selection of design improvements are not described in the Program Plan. In the staff's judgment, active participation of persons with human factors training and experience is important to successful selection of design improvements. The mechanism for selection of design improvements should be systematic, iterative, and

integrative. Coordination of the selection of design improvements with verification and validation appears to meet the iterative and integrative aspects. If an appropriate mix of personnel conducts a systematic selection of design improvements, the requirement in Supplement 1 to NUREG-0737 should be satisfied. HEDs may be resolved by training, procedures, and the SPDS; but over reliance on these means should be avoided.

Verification that selection of design improvements will provide the necessary correction and will not introduce new HEDs. The Program Plan indicated an understanding of the requirements for verification that HEDs are corrected and that new HEDs are not created. Verification will include:

1. Comparison of the modified control room design with the control room human factors design conventions document.
2. Comparison of the modified control room design with the instrumentation and controls requirements identified during the control room survey and task analysis.
3. Comparison of the modified control room design with approved project design criteria (e.g., electrical separation criteria).

The Program Plan noted that verification would specifically address whether HEDs were corrected without creating other problems. NPPD also plans a validation of HED fixes (i.e., a dynamic performance evaluation of whether the control room operating crew can effectively perform their functions given the control room instrumentation and controls, procedures, and training.

Mock-ups, simulators, and the control room will be used as necessary during the validation. The personnel involved in the verifications and validation are not indicated. NPPD should assure active participation of persons with human factors training and experience during the verification processes. NPPD should also assure that conventions used in the verification process follow good human factors practice. If an appropriate mix of personnel conducts the verification and validation efforts as described, the requirements in Supplement 1 to NUREG-0737 should be satisfied.

Coordination of control room improvements with changes from other programs. The Program Plan indicated an understanding of the requirement for coordination/integration of the DCRDR with related efforts. The following efforts were listed:

1. Safety parameter display system (SPDS)
2. Emergency response facilities
3. Post-accident monitoring instrumentation (Regulatory Guide 1.97)
4. Bypassed and inoperable status indication

5. Updated EOPs

6. Changed requirements for training and staffing.

A chart showing the relationship among those efforts was provided in NPPD's April 15, 1983 response to Generic Letter 82-33. Commitment dates included in the confirmatory order for five of the above points were:

<u>TITLE</u>	<u>REQUIREMENT</u>	<u>COMPLETION SCHEDULE (OR STATUS)</u>
1. Safety Parameter Display System (SPDS)	Submit a safety analysis and an implementation plan to the NRC.	03/01/84
	SPDS fully operational and operators trained.	02/86
2. Detailed Control Room Design Review (DCRDR)	Submit a program plan to the NRC.	03/01/84
	Submit a summary report to the NRC including a proposed schedule for implementation.	08/84
3. Regulatory Guide 1.97 - Application to Emergency Response Facilities	Submit a report to the NRC describing how the requirements of Supplement 1 to NUREG-0737 have been or will be met.	03/01/84
	Implement (installation or upgrade) requirements	Completion dates provided on report table.
4. Upgrade Emergency Operating Procedures (EOPs)	Submit a Procedures Generation Package to the NRC.	06/30/84
	Implement the upgraded EOPs	09/30/85
5. Emergency Response Facilities	Technical Support Center fully functional.	04/86
	Operational Support Center fully functional.	Complete
	Emergency Operations Facility fully functional.	04/86

The Program Plan noted that the mechanism for coordination would be the review team leader's participation of the NPPD Station Operating Review Committee. That committee oversees all ongoing work on emergency response facilities and the control room. If conducted as described, coordination of the DCRDR with related efforts should satisfy the requirement in Supplement 1 to NUREG-0737.

Generic Letter 83-18. The requirements of Supplement 1 to NUREG-0737 and Generic Letter 83-18 overlap in the areas of:

1. Qualified multidisciplinary team
2. Function and task analysis
3. Control room survey
4. Assessment of HEDs
5. Selection of Design Improvements.

Comments in the previous paragraphs address those overlapping requirements. Utilities referencing the BWROG Control Room Survey Program must additionally identify portions of their DCRDR not performed in accordance with the BWROG Program and must update their operating experience review. NPPD indicated no deviations from the BWROG Program. An update of operating experience is planned. Thus, it appears that the peculiar requirements of Generic Letter 83-18 will be satisfied.

#### CONCLUSION

The CNS Program Plan addressed all of the DCRDR requirements stated in Supplement 1 to NUREG-0737. Information in the Program Plan indicated adequate understanding and intent to satisfy most of the requirements. However, several concerns were identified by the staff's Program Plan review.

The major concerns are:

1. The active participation of personnel from all pertinent disciplines, particularly human factors, in each technical task.
2. The ability of the function and task analyses to produce appropriate results for comparison with the control room inventory.
3. Update of the February, 1981 control room survey to cover changes to the control room since that survey.

The DCRDR Summary Report for CNS is expected in August 1984. Submissions on the SPDS, Regulatory Guide 1.97, and upgraded EOPs will be available by that

## REFERENCES

- NUREG-0660, "NRC Action Plan Developed as a Result of the TMI-2 Accident," May 1980; revision 1, August 1980.
- NUREG-0700, "Guidelines for Control Room Design Review," September 1981.
- NUREG-0737, "Clarification of TMI Action Plan Requirements," November 1980; Supplement 1, December 1982.
- NUREG-0801, "Evaluation Criteria for Detailed Control Room Design Reviews," October 1981, draft report.
- NUREG-1000, "Generic Implications of ATWS Events at the Salem Nuclear Power Plant," April 1983.
- Generic Letter 83-18, "NRC Staff Review of the BWR Owners' Group (BWROG) Control Room Survey Program," April 19, 1983.
- Generic Letter 83-28, "Required Actions Based on Generic Implications of Salem ATWS Events," July 8, 1983.
- Letter from J. M. Pilant (NPPD) to D. G. Eisenhut (NRC). Subject "Response to NUREG-0737 Supplement 1," April 15, 1983.
- Letter from J. M. Pilant to D. G. Eisenhut. Subject "NUREG-0737, Supplement 1 - Detailed Control Room Design Review," March 1, 1984.
- Letter from J. D. Weaver (NPPD) to B. Siegel (NRC). Subject "Revised Response to NUREG-0737, Supplement 1," March 1, 1984.
- EPRI NP-2411, "Human Engineering Guide for Enhancing Nuclear Control Rooms," May 1982.

time. A preimplementation audit addressing the results of the DCRDR and integration of the above activities with the DCRDR is planned following submission of the Summary Report.

Principal Contributor: D. I. Serig  
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