SAIC-88/1821

TECHNICAL EVALUATION REPORT OF THE DETAILED CONTROL ROOM DESIGN REVIEW FOR TENNESSEE VALLEY AUTHORITY'S WATTS BAR NUCLEAR PLANT, UNIT 1

TAC NO. M63655

January 17, 1989

Prepared for:

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Contract NRC-03-87-029

Task Order No. OSP-5

TABLE OF CONTENTS

TECHNICAL EVALUATION REPORT
OF THE
DETAILED CONTROL ROOM DESIGN REVIEW
FOR
TENNESSEE VALLEY AUTHORITY'S
WATTS BAR NUCLEAR PLANT, UNIT 1

1.0 INTRODUCTION

The Tennessee Valley Authority (TVA) submitted a generic Detailed Control Room Design Review (DCRDR) Program Plan to the Nuclear Regulatory Commission (NRC) on June 9, 1983 (Reference 1) in order to satisfy the Program Plan requirements of NUREG-0737, Supplement 1 (Reference 2) for the Sequoyah, Watts Bar, Bellefonte and Browns Ferry Nuclear Plants. The Program Plan was resubmitted September 13, 1983 (Reference 3) to correct duplicating errors in the original plan. 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 4) and draft NUREG-0801 (Reference 5).

NUREG-0737, Supplement 1 requires that a Program Plan be submitted within two months of the start of the 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, operator training, Regulatory Guide 1.97 instrumentation, and upgraded Emergency Operating Procedures (EOPs).

The staff comments resulting from the NRC review of the TVA DCRDR Program Plan were forwarded to TVA by letter dated November 17, 1983 (Reference 6). Based on the Program Plan review, the staff concluded that TVA addressed most of the nine requirements of a DCRDR specified in NUREG-0737, Supplement 1. However, the staff determined that certain elements, notably the task analysis, needed strengthening to provide reasonable assurance that the DCRDRs based on the plan would produce results that satisfy NRC requirements.

A meeting between NRC and TVA was held on June 14, 1984, in order to provide further detailed information and address the staff's Program Plan review concerns. As a result of this meeting, NRC indicated to TVA that an opportunity to more completely assess TVA's methodology for performing the system function and task analysis activity may involve an in-progress audit at Watts Bar. However, no in-progress audit was conducted at Watts Bar during the DCRDR.

At the end of the DCRDR, licensees/applicants are required by NUREG-0737, Supplement 1 to submit a Summary Report to NRC, which must, as a minimum:

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.

Tennessee Valley Authority (TVA) submitted a Summary Report for the Watts Bar Nuclear Plant Units 1 and 2 to the NRC on October 2, 1987 (Reference 7). The Summary Report was reviewed by Science Applications International Corporation (SAIC) personnel and a pre-implementation audit was conducted from November 14 through November 18, 1988. The audit team consisted of an NRC staff member, an SAIC representative, and a representative from Comex Corporation. Together, the team represented the disciplines of nuclear systems engineering, reactor operations, and human factors engineering.

This Technical Evaluation Report reflects the consolidated observations, findings, and conclusions of the audit team members. A list of audit meeting attendees is provided in Attachment 1 and the audit agenda is provided in Attachment 2.

2.0 EVALUATION

The purpose of the evaluation was to determine whether the nine DCRDR requirements of NUREG-0737, Supplement 1 had been satisfied. The evaluation was performed by comparing the information provided by TVA with the criteria in NUREG-0800, Section 18.1, Rev. 0, Appendix A of the Standard Review Plan (Reference 8). The reviewers' evaluation of the DCRDR for the Watts Bar Nuclear Plant, and a summary of the criteria from the Standard Review Plan are provided below.

2.1 Establishment of a Qualified Multidisciplinary Review Team

The organization for conduct of a successful DCRDR can vary widely but is expected to conform to some general criteria. Overall administrative leadership should be provided by a utility employee, who should be given sufficient authority to ensure that the DCRDR team is able to carry out its

mission. A core group of specialists in the fields of human factors engineering and nuclear engineering are expected to participate with assistance as required from personnel in other disciplines. Human factors expertise should be included in the staffing for most, if not all, technical tasks. Finally, the DCRDR team should receive an orientation briefing on DCRDR purpose and objectives which contributes to the success of the DCRDR. NUREG-0800, Section 18-1, Appendix A describes criteria for the multidisciplinary review team in more detail.

The overall administrative leadership of the DCRDR team was provided by a TVA employee. His successor as the DCRDR administrator will continue to manage the project through the modification implementation phase. The Watts Bar DCRDR study team consisted of a core group of specialists in the fields of nuclear engineering, instrumentation and control engineering, reactor operations, and human factors engineering. Essex Corporation was contracted to provide human factors support. Each TVA DCRDR team member was given a two-day course in human factors engineering and control room design, including the purpose and objectives of a DCRDR.

The audit team evaluated the staffing for each technical task and determined that the appropriate expertise was included in the DCRDR team. It is the audit team's judgment that TVA has met the NUREG-0737, Supplement 1 requirement for a qualified multidisciplinary review team.

2.2 System Function and Task Analysis

The purpose of the system function and task analysis is to identify the control room operators' tasks during emergency operations and to determine the information and control capabilities the operators need in the control room to perform those tasks. An acceptable process for conducting the function and task analysis is as follows:

1. Analyze the functions performed by systems in responding to transients and accidents in order to identify and describe those tasks operators are expected to perform.

2. For each task identified in Item 1 above, determine the information (e.g., parameter, value, status) which signals the

need to perform the task, the control capabilities needed to perform the task, and the feedback information needed to monitor task performance.

3. Analyze the information and control capability needs identified in Item 2 above to determine appropriate characteristics for displays and controls to satisfy those needs.

The Watts Bar DCRDR task analysis methodology was presented in Section 4.0 of the Summary Report.

The function and task analysis efforts covered all of the site-specific emergency response guidelines, developed from the generic Westinghouse Owners' Group (WOG) Emergency Response Guidelines (ERGs), High Pressure version, Rev. 1, September 1983. Differences between the generic and plant-specific ERGs were considered. A list of emergency operating procedures that were analyzed during task analysis is provided in Attachment 3.

The audit team selected action steps from both the generic and supplemental ERGs and traced the methodology under which each of the task analysis methods were performed to determine the adequacy of the methods used and availability of documentation. It was noted that the sample set of tasks reviewed by the audit team were thoroughly analyzed, including the alternate Response Not Obtained Column Tasks, Cautions, Warnings and Notes. In addition, documentation was adequate and was readily available and auditable.

The system function and task analysis was based on the December, 1985 version of plant specific emergency operating procedures. Based on an evaluation of the licensee's results, the audit team identified the following concerns:

a. The DCRDR team did not perform a task analysis of the six ERG based critical safety function trees.

b. The DCRDR team did not perform a task analysis of six ERG based Emergency Contingency Actions (ECAs) including:

ECA 1.1 Loss of Emergency Cooling Circulation
ECA 1.2 Loss of Coolant Accident Outside Containment
ECA 2.1 Uncontrolled Depressurization of all Steam Generators
ECA 3.1 Steam Generator Tube Rupture Loss of Coolant Accident with Subcooled Recovery
ECA 3.2 Tube Rupture Plus Loss of Coolant Accident with Saturated Recovery
ECA 3.3 Steam Generator Tube Rupture With Loss of Pressurizer Pressure Control

c. The DCRDR team did not perform an analysis of the Symptoms sections of the emergency procedures.

Because the DCRDR team did not perform the necessary system function and task analysis for the areas described above, it is the audit team's judgment that the licensee did not meet the NUREG-0737, Supplement 1 requirement for a function and task analysis. In order to meet the requirement, TVA should conduct an additional task analysis effort that addresses the concerns listed above.

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

The purpose of comparing display and control requirements to a control room inventory is to determine the availability and suitability of displays and controls required to perform the ERGs. The success of this element depends on the quality of the function and task analysis and the control room inventory. The control room inventory should be a complete representation of displays and controls currently in the control room. The inventory should include appropriate characteristics of current displays and controls to allow meaningful comparison to the results of the function and task analysis. Unavailable or unsuitable displays and controls should be documented as human engineering discrepancies (HEDs).

The verification of instrument and control availability and suitability was accomplished by comparing the operator's requirements during emergency operations derived from the task analysis activities to the equipment in the Watts Bar control room. A "walk- and talk-through" by DCRDR team members and

qualified operators was performed for each of the steps analyzed on the task analysis worksheets. "Human Factors Guidelines" checksheets were used to evaluate the adequacy of the instrument/control demonstrated by the operator, and the information/control equipment for fulfilling the task analysis requirement. Real-time simulations were also performed using time-dependent emergency procedures to evaluate perceptual-cognitive loading, communications, and spatial relationships. Potential HEDs were documented as human engineering concerns (HECs) during the review phase, and then converted to HEDs during the assessment activity.

The audit team found that the Watts Bar DCRDR team conducted a successful comparison of display and control requirements versus the control room inventory for those areas for which system function and task analyses had been performed. However, because there still exist some areas to be subjected to system function and task analysis, as discussed in paragraph 2.2, it is the audit team's assessment that the licensee does not meet the NUREG-0737, Supplement 1 requirement for a comparison of display and control requirements with the control room inventory. In order to meet this requirement the licensee should conduct a supplemental comparison of display and control requirements to the control room inventory for the additional task analysis of critical safety function trees, ECAs, and Symptoms.

2.4 Control Room Survey

The key to a successful control room survey is a systematic comparison of the control room to accepted human engineering guidelines and human factors principles. One accepted set of human engineering guidelines is provided in Section 6 of NUREG-0700 (Reference 4); however, other accepted human factors standards may be chosen. Discrepancies should be documented as HEDs.

NUREG-0737, Supplement 1 does not require the performance of operator interviews as a formal part of the DCRDR. However, NUREG-0700 states that such surveys are needed to make sure that problems encountered in plant operation or in preparations for operation are addressed.

The licensee performed a comprehensive survey of operator concerns through the use of a detailed control room operations questionnaire followed

up by interviews of the individual operators. Twenty operators were involved in the survey.

The audit team selected eight of the operator concerns from the raw data collected by the licensee and traced each of these through all phases of the DCRDR process. The concerns selected were those which were mentioned by a significant percentage of the interviewees as human engineering problems. The audit team was able to trace every concern through each step of the assessment process, and in all cases the concern was satisfied in an appropriate manner.

The human engineering guidelines used for the control room surveys were a modified version of Section 6 of NUREG-0700. Modifications to the checklists were primarily alterations of general guidelines to make them plant specific. Clarifications of the guidelines were made as appropriate. In addition, operator interview questions were referenced in the guidelines so that the person performing the survey was able to coordinate the operator interview questions and survey guidelines. It is the audit team's judgment that the survey guidelines and process for conducting the survey are comprehensive and thorough.

It was the audit team's judgment that TVA met the NUREG-0737, Supplement 1 requirement for a control room survey.

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

Based on the guidance of NUREG-0700 and the requirements of NUREG-0737, Supplement 1, all HEDs should be assessed for significance. The potential for operator error and the consequence of that error in terms of plant safety should be systematically considered in the assessment. Both the individual and aggregate effects of HEDs should be considered. The result of the assessment process is a determination of which HEDs should be corrected because of their potential impact on plant safety. Decisions on whether HEDs are safety-significant should not be compromised by consideration of such issues as the means and potential costs of correcting HEDs.

The assessment process at Watts Bar was conducted according to the Program Plan but cannot be judged complete until the licensee performs additional task analysis work and completes the comparison of the operator and display and control requirements to the control room inventory to any additional human engineering discrepancies.

The review team also identified concerns regarding the assessment and disposition of two safety significant HEDs.

082 Accidental changing of controller setpoints. - The concern is that the subject controllers will be relocated under a relocation HED. Therefore the concerns that caused the origination of 082 should be reassessed at the controller's relocation on the new panel (M-27-B).

199 Certain valves could be opened with Phase A isolation not reset. - This was the result of a North Anna 2 licensee event report 82-010. It was found that the valves could be reopened from the control room by holding the control switch open when the Phase A isolation signal was present. TVA's justification for not correcting this HED, if it is in fact a HED, was that it would require a deliberate action on the part of the operator. No investigation was made by TVA to determine if the control circuit was functioning correctly. Additional engineering justification is required.

It was the review team's judgment that the licensee did not meet the requirement of NUREG-0737, Supplement 1 for an assessment of human engineering discrepancies. In order to meet this requirement, TVA should assess the significance of any new HEDs arising from the additional system function and task analysis to be conducted, and address the issues associated with HEDs 082 and 199.

2.6 Selection of Design Improvements

The purpose of selecting design improvements is to determine corrections to HEDs identified from the review phase of the DCRDR. Selection of design improvements should include a systematic process for the

development and comparison of alternative means of resolving HEDs. Furthermore, according to NUREG-0737, Supplement 1, the licensee should document all of the proposed control room changes.

The DCRDR study team developed design modifications on a panel-by-panel basis. Full scale prints of the modified panels were generated by computer graphics. The prints included the revised panel layouts, labels, demarcations and mimics. In order to verify that they were making the appropriate changes, the DCRDR team used eleven Watts Bar reactor operators and other Watts Bar personnel to evaluate the adequacy of the proposed modifications.

In order to determine the adequacy of the proposed modifications and schedules for implementation, the audit team evaluated all Category 1 and 2 HEDs (Attachment 4) against the NRC guidance provided in Appendix A of NUREG-0800 Standard Review Plan Section 18.1.

Based on the audit team evaluation of all Category 1 and 2 proposed modifications, along with review of a sample of Category 3 modifications and schedules for implementation, it is the audit team's judgment that TVA has met the NUREG-0737, Supplement 1 requirement for selection of design improvements.

2.7 Verification that Selected Design Improvements Will Provide the Necessary Correction

A key criterion of DCRDR success is a consistent, coherent, and effective interface between the operator and the control room. This criterion may be met by effectively executing the processes of selection of design improvements, verification that selected improvements will provide the necessary correction, and verification that the improvements will not introduce new HEDs. According to NUREG-0800, techniques for the verification process might include resurveys of panels, applied experiments, engineering analyses, environmental surveys, and operator interviews. The consistency, coherence, and effectiveness of the entire operator-control room interface are important to operator performance. Thus, evaluation of both the changed and unchanged portions of the control room is necessary during the verification process.

Based upon expertise of the individuals, DCRDR Team members were assigned responsibility for proposing corrective actions for each of the HEDs. The proposals for corrective action were presented to the whole of the DCRDR Team for evaluation against two primary criteria:

- o The corrective action should resolve the original concern
- o The correction should not result in new concerns

A formal review and approval process equivalent to the assessment and categorization methodology was employed. Corrective actions resulting in panel arrangements were mocked up in an iterative process. Full-size computer generated modified panel layouts were then evaluated by operators and human factors specialists.

Upon completion of the iterative proposal process described above, HEDs enter the formal plant engineering change procedures of preparation, review, and implementation, which includes an additional human engineering review (Human Factors Engineering - Design Review). However, there is no formal procedure for verifying that each modification, as implemented, corrects its associated HED without creating any new HEDs.

It was the audit team's judgment that the licensee did not meet the NUREG-0737, Supplement 1 requirements for verification that selected improvements will produce the necessary correction.

2.8 Verification that Selected Design Improvements Will Not Introduce New HEDs.

As discussed in Section 2.7 above, the implementation of HED corrective actions at Watts Bar go through a formal plant engineering change procedure for preparation, review, and implementation, which includes a human engineering review (Human Factors Engineering - Design Review). However, there is no formal process for verifying that the implemented modifications do not introduce new discrepancies. It was the audit team's judgment that TVA did not have a process which meets the requirement of NUREG-0737, Supplement 1, for verifying that selected design improvements do 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 Procedures

Improvement of emergency response capability requires coordination of the DCRDR with other activities. Satisfaction of Regulatory Guide 1.97 requirements and the addition of the Safety Parameter Display System (SPDS) necessitate modifications and additions to the control room. The modifications and additions should be specifically addressed by the DCRDR. Exactly how the modifications are addressed depends on a number of factors including the relative timing of the various emergency response capability upgrades. Regardless of the means of coordination, the result should be integration of Regulatory Guide 1.97 instrumentation and SPDS equipment into a consistent, coherent, and effective control room interface with the operators.

a. The licensee made the decision to construct a new post accident monitoring system that includes SPDS. The new SPDS will receive a DCRDR type survey and additional man in the loop testing. It was the review team's judgment that the licensee coordinated SPDS with DCRDR.

b. Regulatory Guide 1.97 instrumentation requirements were coordinated with DCRDR as evidenced by the modified panel layouts being implemented as a result of the DCRDR. It was the review team's judgment that the licensee coordinated Regulatory Guide 1.97 instrumentation with DCRDR.

c. The DCRDR team identified approximately 100 procedures-related concerns that were combined into HED-006 and sent to the Emergency Operating Procedures writer staff for assessment and correction. In addition, the DCRDR task analysis was based on the draft December 1985 version of the plant specific emergency operating procedures that were derived from the Revision 1 Westinghouse Emergency Response Guidelines. It was the review team's judgment that TVA coordinated DCRDR with upgraded EOPs.

The audit team has concluded that the Watts Bar Nuclear Plant met the NUREG-0737, Supplement 1 requirement for coordination of the DCRDR with other NUREG-0737, Supplement 1 improvement programs.

3.0 CONCLUSIONS

TVA submitted the Detailed Control Room Design Review (DCRDR) Summary Report for Watts Bar Nuclear Plant, Units 1 and 2, to NRC on October 2, 1987. A preliminary evaluation of the Summary Report was conducted by SAIC which resulted in the identification of a number of concerns. In order to resolve the concerns and evaluate the Watts Bar DCRDR, a pre-implementation audit was conducted from November 14 to November 18, 1988. During the audit, the NRC staff, accompanied by SAIC and Comex representatives, performed a detailed evaluation of TVA's DCRDR. The evaluation included examination of TVA's DCRDR documentation, discussions with the DCRDR study team, inspection of the existing control room, and inspection of mockups and proposed corrective action modifications. This report reflects the consolidated findings and conclusions of the NRC audit team. The conclusions are provided below, organized by the nine NUREG-0737, Supplement 1 DCRDR requirements.

1. The establishment of the multidisciplinary review team used for the DCRDR has met the requirement of NUREG-0737, Supplement 1.

2. The system function and task analysis, which was based on Revision 1 of the Westinghouse Emergency Response Guidelines and supplements, does not meet the requirements of NUREG-0737, Supplement 1. While the audit team found that the task analysis was appropriately conducted at Watts Bar, three concerns were identified:

    1. The critical safety function trees were not analyzed.
    2. Six ECA procedures were not analyzed.
    3. The Symptoms sections of the emergency instructions were not analyzed.

    The operator information and control requirements embedded in these procedures should be analyzed using the DCRDR task analysis methodology.

3. The control room inventory does not meet the requirements of NUREG-0737, Supplement 1. While the audit team found that an adequate comparison of operator information and control requirements to the control room inventory was made for the tasks identified by the DCRDR team, it will be necessary for TVA to conduct an additional control room inventory for any new display and control requirements identified by the additional system function and task analyses performed pursuant to criterion 2.

4. The control room survey methodology and results meet the requirement of NUREG-0737, Supplement 1.

5. The licensee did not meet the requirement of NUREG-0737, Supplement 1 for an assessment of human engineering discrepancies. In order to meet this requirement, TVA should assess the significance of any new HEDs arising from the additional system function and task analysis to be conducted, and address the issues associated with HEDs 082 and 199.

6. The licensee met the NUREG-0737, Supplement 1 requirement for selection of design improvements.

7. The methodology for verifying that control room improvements correct HEDs did not meet the requirements of NUREG-0737, Supplement 1. The audit team found that a formal process had not been implemented at Watts Bar to verify that the DCRDR modifications correct the human engineering discrepancies and do not introduce new discrepancies.

8. The methodology for verifying that the control room modifications do not introduce new HEDs did not meet the requirements of NUREG-0737, Supplement 1. The audit team found that a formal process had not been implemented at Watts Bar to verify that the DCRDR modifications correct the human engineering discrepancies and do not introduce new discrepancies.

9. The coordination of the DCRDR with other programs, including upgraded EOPs, SPDS, Regulatory Guide 1.97, and training, met the requirements of NUREG-0737, Supplement 1.

4.0 REFERENCES

1. Letter from D.S. Kammer to E. Adensam, forwarding "Program Plan for Control Room Design Reviews for All TVA Nuclear Plants," June 9, 1983.

2. NUREG-0737, Supplement 1, "Requirements for Emergency Response Capability" (Generic Letter No. 82-33), December 17, 1982.

3. Letter from L.M. Mills to E. Adensam, forwarding TVA Program Plan, September 13, 1983.

4. NUREG-0700, "Guidelines for Control Room Design Reviews," September 1981.

5. NUREG-0801, "Evaluation Criteria for Detailed Control Room Design Reviews," Draft for Comment, October 1981.

6. Memorandum for: T. Novak, NRC, From: W. Russell, NRC, Subject: Review of Tennessee Valley Authority Program Plan for Control Room Design Reviews, NRC, November 17, 1983.

7. Detailed Control Room Design Review Summary Report for the Watts Bar Nuclear Plant Units 1 and 2, Tennessee Valley Authority, October 2, 1987.

8. NUREG-0800, "Standard Review Plan," Section 18.1, "Control Room," and Appendix A, "Evaluation Criteria for Detailed Control Room Design Reviews (DCRDR)," September 1984.

ATTACHMENT 1

LIST OF MEETING ATTENDEES

MEETING ATTENDEES

NAME	ORGANIZATION
D.G. Bennett	TVA/OPS
M.C. Brickey	WBN/NE/EEB
P.I. Castleman	NRC/OSP
C.R. Cook	TVA/OPS
G.R. Davis	TVA
J. DeBor	SAIC
G.A. Elliff	SCI Services Inc.
J.J. Erpenbach	WBN
J.E. Gibbs	WB Engineering Project
R.J. Griffin	WBN-Project Management
W. Hansen	Comex Corporation
M.K. Jones	WBN Technical Support
A.E. Little	NE/Engineering Assurance
J.A. Martin	WBN-NE
G.W. Mauldin	WBN/EA
D.E. McCloud	WBN Site Licensing
J.A. McDonald	TVA-WBN
R.G. Orendi	Westinghouse
B. Paramore	Essex Corporation
B. Pedde	TVA-WBN
H.E. Price	Essex Corporation
M.E. Reeves	WBN-Project Management
M.J. Sallitto	WBN/NE/EEB
M. Von Schimmelmann	NE/EA
B.S. Willis	WBN/OPS
J. Young	WBN Site Licensing
M.L. Young	WBN/NE/EEB

ATTACHMENT 2

MEETING AGENDA

AGENDA

WATTS BAR
DETAILED CONTROL ROOM DESIGN REVIEW
PREIMPLEMENTATION AUDIT

November 14-18, 1988

Monday, November 14

8:30 NRC Entrance Briefing

9:00 Licensee Overview Discussion of Watts Bar DCRDR

10:00 Tour of Control Room

11:00 Evaluation of DCRDR Review Team

1) Management and Structure
2) Composition and Qualifications
3) Team Support and Interactions
4) Orientation

12:00 Lunch

1:00 Evaluation of DCRDR System Function and Task Analysis

The team will review the system function and task analysis documentation for:

1) E-0 Reactor Trip or Safety Injection
2) E-1 Loss of Reactor or Secondary Coolant
3) E-2 Faulted Steam Generator Isolation

3:00 Comparison of Display and Control Requirements with Control Room Inventory

The team will review the control room inventory documentation for the three procedures (E-0, E-1, E-2) evaluated for task analysis. The documentation needed will include:

1) Action-Information Requirements Detail (AIRD) forms
2) Action-Information Requirements Summary (AIRS) forms
3) DCRDR Validation Forms
4) Human Engineering Discrepancy forms for resulting from validation activities.

NOTE: Part of the task analysis and inventory evaluation will be conducted in the control room.

5:00 NRC Caucus

1) Summarize Findings
2) Request personnel, documentation and access needs for Day 2

5:30 End - Day 1

Tuesday, November 15

8:30 Evaluation of DCRDR Control Room Survey

1) Review team will conduct a sample survey in the control room. The purpose of the survey is to identify ten typical Human Engineering Discrepancies that should have been identified during the DCRDR survey.

2) Licensee will locate the NRC sample survey Human Engineering Discrepancies in their documentation. The purpose of this exercise is to evaluate the comprehensiveness and categorization of discrepancies.

11:00 Evaluation of DCRDR Human Engineering Discrepancy Assessment

Review team will evaluate the adequacy of the assessment activity including:

1) Identification of relative degree of degradation on operator performance.

2) Assessment of effect on plant safety.

3) Consideration of human engineering discrepancy interactions (aggregate effect).

4) Prioritization of corrective actions.

5) Justifications for leaving safety significant discrepancies uncorrected or partially corrected.

12:00 Lunch

1:00 Evaluation of DCRDR Design Improvements

The review team will evaluate the proposed and implemented design improvements. This will include a review of:

1) Hardware modifications

2) Procedure modifications

3) Training modifications

4) Schedules for modification implementations

NOTE: The review team will conduct this activity in the control room to the extent possible.

5:00 NRC Caucus

5:30 End - Day 2

Wednesday, November 16

8:30 Continue Evaluation of DCRDR Modifications

12:00 Lunch

1:00 Evaluation of Procedures:

1) Procedure to ensure that the proposed modifications correct the human engineering discrepancy.

2) Procedure to ensure that the proposed DCRDR modifications do not introduce new human engineering discrepancies.

2:00 Evaluation of the coordination of the DCRDR activity with other control room upgrade programs.

The review team will evaluate the coordination of the DCRDR program with 4 specific control room upgrade programs:

1) Safety Parameter Display System

- o Coordination with DCRDR instrument range and setpoint modifications.
- o DCRDR type human engineering review of displays.

2) Operator Training

- o Operator training as a method to correct HEDs.
- o Operator training on DCRDR modifications.

3) Regulatory Guide 1.97 Instrumentation

- o DCRDR evaluation of availability of Regulatory Guide 1.97 instrumentation during EOP validation activities.
- o DCRDR evaluation of suitability of Regulatory Guide 1.97 instrumentation during EOP validation.

4) Upgraded Emergency Operating Procedures

- o Westinghouse Owners Group, Emergency Response Guidelines Revision 1, use as the basis for identification of operator information and control needs during DCRDR task analysis.
- o DCRDR modifications made to upgraded EOPs to correct human engineering discrepancies.

5:00 NRC Caucus

5:30 End - Day 3

Thursday, November 17

8:30 Three Sample Simulator Exercises if possible:

The purpose of the simulator exercises is to demonstrate the human engineering adequacy of the control room, with the control room team staffing at Watts Bar. The exercises should include:

1) Reactor trip or safety injection.

2) Loss of reactor or secondary coolant.

3) Faulted steam generator isolation.

10:30 Review of DCRDR-related Concerns or Allegations

12:00 Lunch

1:00 NRC Caucus Continues

2:30 Detailed Technical Exit Briefing

The purpose of the detailed exit briefing is to ensure that the NRC team findings are technically accurate. This meeting should be attended by all appropriate licensee technical staff. This meeting will include a detailed NRC evaluation of where the licensee stands with regard to:

1) Nine Supplement 1 to NUREG-0737 DCRDR requirements.

2) DCRDR-related concerns or allegations.

5:00 End - Day 4

Friday, November 18

8:30 NRC Exit Briefing

The NRC exit will include a management level summary of where TVA stands with regard to the Watts Bar DCRDR. This will include:

1) Nine Supplement 1 to NUREG-0737 DCRDR requirements.

2) DCRDR-related concerns and allegations.

3) Tentative schedule for NRC Safety Evaluation Report on Watts Bar DCRDR.

ATTACHMENT 3

EMERGENCY OPERATING PROCEDURES SUBJECTED TO TASK ANALYSIS

TABLE 3
EMERGENCY INSTRUCTIONS USED
FOR VALIDATION

NUMBER	TITLE
E-0	Reactor Trip or Safety Injection
ES-0.1	Reactor Trip Response
ES-0.2	SI Termination
ES-0.3	Natural Circulation Cooldown
E-1	Loss of Reactor or Secondary Coolant
ES-1.1	Post LOCA Cooldown
ES-1.2	Transfer to Containment Sump
ES-1.3	Transfer to Hot Leg Recirculation
E-2	Evaulted Steam Generator Isolation
E-3	Steam Generator Tube Rupture (SGTR)
ES-3.1	SI Termination Following SGTR
ES-3.2	Post-SGTR Cooldown Using Backfill
ES-3.3	Post-SGTR Cooldown by Ruptured S/G Depressurization
E-FOP	Foldout Page
FR-S.1	Response to Nuclear Power Generation/ATWS
FR-S.2	Response to Loss of Core Shutdown
FR-C.1	Response to Inadequate Core Cooling
FR-C.2	Response to Saturated Core Cooling
FR-H.1	Response to Loss of Secondary Heat Sink
FR-H.2	Response to Steam Generator Overpressure
FR-H.3	Response to Steam Generator High Level
FR-H.4	Response to Loss of Normal Steam Release Capabilities
FR-H.5	Response to Steam Generator Low Level
FR-P.1	Response to Pressurized Thermal Shock
FR-P.2	Response to Cold Overpressure Condition
FR-Z.1	Response to Phase B Containment Pressure
FR-Z.2	Response to Containment Flooding
FR-Z.3	Response to High Containment Radiation
FR-I.1	Response to High Pressurizer Level
FR-I.2	Response to Low Pressurizer Level
FR-I.3	Response to Voids in Reactor Vessel
ECA-0.0	Loss of All AC Power
ECA-0.1	Loss of All AC Power Recovery Without SI Required
ECA-0.2	Loss of All AC Power Recovery With SI Required

ATTACHMENT 4

SAFETY SIGNIFICANT HEDs

WATTS BAR NUCLEAR PLANT
CONTROL ROOM DESIGN REVIEW

HED	SHORT TITLE	SAFETY
CATEGORY 1		
099	Lack of Narrow Range Containment Pressure Indication In The Horseshoe.	Yes
151	Eberline System Usability.	Yes
153	Lack of Adequate Pyrotronics Alarm Power Supply For The Control Room Panels.	Yes
159	Lack Of Feedwater Isolation Reset And Status.	Yes
200	Lack of Phase B Isolation Status Lights.	Yes
202	Functional Description Not Included In Change Package.	Yes
CATEGORY 2		
008	Industrial Safety/Personnel Electrical Shock Hazard.	Yes
015	Noise Problems.	Yes
157	Panel Layout Problems On M-3/M-4.	Yes
163	M-6 Panel Layout, Emergency Core Cooling System Layout.	Yes
167	M-9 Panel Layout.	Yes
176	Pressure Indicator For Annulus Vacuum Not Located On M-27 With EGTS. Alarm Setpoint Is Such That LCO Exists Before Alarm Comes In.	Yes
CATEGORY 3		
019	Spare Parts And Supplies For The Main Control Room and Auxiliary Control Room.	Yes
043	Multiple Input Annunciators.	Yes
056	Need For Seal Water Flow Alarm/Unalarmed Seal Flow Could Exceed 40 GPM Tech Spec.	Yes
062	Shared Alarms Not Duplicated In The Unit 2 Control Room.	Yes
091	Scales/Math Conversions Required Between Controls and Indicators.	Yes

WATTS BAR NUCLEAR PLANT
CONTROL ROOM DESIGN REVIEW

HED	SHORT TITLE	SAFETY
CATEGORY 3 (continued)		
092	Lack of Main Control Room Controls And Indicators For Control and Service Air Compressors.	Yes
093	Multipoint Records RR-90-1.	Yes
107	Square Root Scale Used On Bit Flow Indicator.	Yes
119	Multipoint Records Are Hard To Read.	Yes
132	Failure Mode For Delta Flux Differential Indication Not Apparent.	Yes
160	M-4/M-5 Panel Layout Problems.	Yes
162	Lack of Status Light For Cold Overpressurization Mitigation System Arm/Block.	Yes
181	L-10 Layout Problems.	Yes
192	Auxiliary Feedwater Level Controllers Can Be Changed In Auxiliary Control Room.	Yes
193	Rod Bottom Lights Not Adequate.	Yes
CATEGORY 4		
076	CCP Burnout After Blackout After Switchover To Containment Sump After Location.	Yes
082	Accidental Changing Of Controller Setpoints.	Yes
087	Inadvertent Operation of Rad Monitor Test Switches.	Yes
103	Controllers Include Moving Scale Fixed Pinter Meters.	Yes
110	Improper Scale On Incore Thermocouple Indicator Readout.	Yes
199	Certain Valves Could Be Opened With Phase A Isolation Not Reset.	Yes