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PROGRAM PLAN FOR IMPLEMENTATION

OF

DETAILED CONTROL ROOM DESIGN REVIEW

IOWA ELECTRIC LIGHT & POWER COMPANY
DUANE ARNOLD ENERGY CENTER

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1. INTRODUCTION

The Detailed Control Room Design Review (DCRDR) is part of a broad effort within the industry and the Nuclear Regulatory Commission (NRC) to upgrade control rooms, emergency response facilities, and procedures.

Guidance for the DCRDR and related activities has been provided by the NRC in the form of various NUREGs and Regulatory Guides, by the Nuclear Utility Task Action Committees (NUTAC) of the Institute of Nuclear Power Operations (INPO), and by several Boiling Water Reactors Owners Group (BWROG) committees. This guidance forms the basis for the Iowa Electric Light and Power Company (IEL&P) DCRDR. While there are differences among utility, industry and NRC positions on some of the specific criteria in these documents, the basic objectives are common. However, a DCRDR program plan that is oriented only toward meeting the detailed NRC critera does not guarantee an adequate or coordinated approach to improving control room operability and plant safety.

The primary purpose of this program plan is to describe the manner in which IEL&P has conducted and intends to complete the human factors review of the Duane Arnold Energy Center (DAEC) control room, in response to the requirements of Generic Letter 83-18 and Section 5 of NUREG 0737, Supplement 1; and to demonstrate that the IEL&P DCRDR will improve the ability of the control room operators to prevent accidents, or cope with accidents if they occur, by improving the man-machine interface. Previous DCRDR efforts by IEL&P are

included in this plan. IEL&P does not intend to wait for NRC approval of this program plan before commencing the review; however, IEL&P expects that any comments to the plan noted by the NRC staff will be brought to IEL&P's attention in a timely manner.

The second purpose of this plan is to ensure that an adequate DCRDR will be conducted. It is intended that any audit of IEL&P's DCRDR by the NRC or others will use this program plan as its reference document, and that the criteria for completeness and adequacy will be taken from this document and supporting IEL&P procedures.

A final report identifying methods of work, aspects of the control room that support operator performance, and deficiencies found, along with proposed solutions, will be submitted to the NRC upon completion and evaluation of the DCRDR. An overall schedule for the DCRDR, SPDS installation, and new emergency procedures is included in our latest semiannual report for the "Plan for the Integrated Scheduling of Plant Modifications for the DAEC."

2. OVERVIEW

2.1 Purpose

The primary purpose of the IEL&P DCRDR is to ensure that the DAEC control room will support operator tasks during emergency conditions. The tasks required during emergencies will be based on the human factored, function oriented plant-specific Emergency Operating Procedures (EOPs).

2.2 Objectives

The following specific objectives are defined to ensure that the DCRDR fulfills its stated purpose:

- Establish a qualified multidisciplinary review team and review program incorporating accepted human factors engineering principles.

- Review the original BWROG control room survey.

- Perform a supplemental control room survey to augment the original BWROG survey using the BWROG control room survey checklist supplement.

- Update the DAEC operating history by review of Licensee Event Reports (LERs) and scram reports.

- Identify the input/output requirements of control room operations tasks contained in the revised EOPs.

- Compare the input/output requirements of the control room tasks with a control room inventory to identify any missing displays or controls.

- Identify Human Engineering Discrepancies (HEDs).

- Determine the extent and priority of all identified HEDs.

- Formulate and recommend resolutions of all identified HEDs.

- Validate the proposed resolutions to ensure that they eliminate or mitigate the HEDs for which they are formulated, and that these resolutions do not result in new HEDs.

- Prepare a summary report of the DCRDR, including implementation schedules, for submittal to the NRC.

2.3 Definition of Terms

Detailed Control Room Design Review (DCRDR) - A post-TMI task listed in NUREG-0660, "Task Action Plan Developed as a Result of the TMI-2 Accident," and NUREG-0737, the staff supplement to NUREG-0660, as Task I.D.1. The IEL&P DCRDR will consist of the original BWROG control room survey and the supplemental survey.

Original BWROG Control Room Survey - A survey of the DAEC control room performed by the BWR owners group in 1980. This survey was done in response to Item 1.D.1 of NUREG 0660 and NUREG 0737 before the NRC guidance (NUREG 0700 and NUREG 0801) for the DCRDR was

issued; and included some, but not all of the requirements subsequently defined in Supplement 1 to NUREG 0737, and NRC generic letter 83-18.

Supplemental Survey - The control room survey that will be performed as part of the IEL&P DCRDR to complement the original BWROG control room survey. It will consist of:

1. A survey of those aspects of the control room that have not changed since the original BWROG survey was performed, using the BWROG control room survey checklist supplement. (See Appendix A.)

2. A survey of those parts of the control room that have been changed since the original BWROG survey was performed, using both the BWROG control room survey checklist supplement and the checklist used for the original BWROG survey. (See Appendix B.)

Control Room Survey - One of the activities that constitute a DCRDR. The control room survey is a static analysis of the control room performed by comparing the existing control room to requirements set by human engineering criteria defined in checklists and other documents.

Emergency Operating Procedures (EOPs) - Function oriented, plant-specific procedures directing the operator actions necessary to mitigate the consequences of transients and accidents that cause plant parameters to exceed reactor protection set points, engineered safety feature set points, or other appropriate technical specification limits.

Emergency Procedures Guidelines (EPGs) - Generic guidelines, developed from system analysis of transients and accidents, that provide sound technical basis for function oriented plant-specific EOPs.

Human Engineering - Human Factors Engineering (HFE) - The experimental and theoretical discipline concerned with designing the physical environment to accommodate human needs and constraints.

Human Engineering Discrepancy (HED) - A characteristic of the control room that does not comply with established human engineering criteria.

Nuclear Utility Task Action Committee (NUTAC) for DCRDR - A committee of representatives from various nuclear utilities and the Institute of Nuclear Power Operations (INPO), organized to define areas of DCRDR implementation for which an overall industry effort can provide assistance to individual utilities in completing Task I.D.1 of NUREG-0737.

Operating Experience Review - One activity of a DCRDR. The operating experience review screens plant operating documents and operator experience to discover human engineering shortcomings that have caused or had the potential to cause actual operating problems in the past.

Review Team - A multi-disciplinary group of individuals responsible for conducting the DCRDR.

Safety Parameter Display System (SPDS) - An aid to the control room operating crew used to monitor the status of critical safety functions (CSFs) that constitute the basis for function oriented plant-specific, EOPs.

Talk-Through - A process in which an experienced operator steps through a procedure, stopping at each step to describe his actions to review team members, and to answer questions about information and control requirements.

Task Analysis - The systematic process of examining and analyzing operator tasks to identify objectives, criteria and conditions for each function and task step, along with the controls, skills and knowledge associated with the performance of the tasks. In the DCRDR context, task analysis is used to provide the basis to assess how well the existing control room supports emergency

operations. Task analysis is concluded with the verification and validation steps. As required by Supplement 1 to NUREG 0737, the DCRDR task analysis utilizes as a basis the function and task analysis work performed in developing EOP technical guidelines and plant specific EOPs.

Validation - The process of determining whether the control room operating crew can perform their functions effectively, given the proper control room instrumentation, procedures, and training. Validation techniques include a dynamic performance evaluation. (See Talk-through and Walk-through.)

Verification - The process of determining whether instrumentation, controls, and other equipment exist in the control room to meet the specific requirements of the emergency operation tasks performed by operators.

Walk-Through - A process in which an experienced operator acts out a procedure in real time, without interruptions, in order for observers to study the information and control requirements in a dynamic manner.

2.4 General Description of DCRDR Activities

The DCRDR has been divided into five phases: planning, execution, assessment, correction, and documentation.

The original BWROG control room survey, as conducted at DAEC, included the planning, execution, assessment and correction phases. Documentation of the BWROG survey will be included in IEL&Ps final summary report.

The IEL&P DCRDR program is being performed in accordance with the methodology specified in the BWROG program plan.

The activities in each phase of the supplemental survey are described in detail in the following sections of this plan.

3. PLANNING PHASE

3.1 DCRDR Review Team

The ultimate responsibility for the DAEC DCRDR resides with the IEL&P Director of Nuclear Generation. The day-to-day conduct of the review, however, will be the responsibility of a review team established specifically for this DCRDR. The review team will also be responsible for planning, scheduling, and coordinating the total, integrated effort.

Review team activities will include developing the methodologies for the review and assessment of discrepancies, establishing the overall plan and schedule for the DCRDR, acting as a resource for the line organizations, and integrating all action items. The

review team will develop, or have developed, all reports relating to the DCRDR and ensure that appropriate reports are submitted to IEL&P management for review and approval.

3.2 Review Team Structure

The review team will consist of individuals with the wide range of skills necessary to perform the DCRDR. It will include the following personnel as the core team:

- Review Team Leader
- Human Factors Specialist(s)
- Senior Reactor Operator (SRO) (or Shift Technical Advisor with operating experience)
- Reactor Operator (RO)
- Instrumentation and Controls Engineer
- Design Engineer

Resumes of core team members are included in Appendix C. The core team will be supplemented, as required, by other disciplines such as mechanical and electrical engineering; training; computer

operations; procedures; licensing; health physics and emergency preparedness. During the course of the review, any additional specialists (e.g., lighting, acoustics) required for specific tasks will be made available to the review team as needed.

3.2.1 Review Team Leader

The review team leader will provide the administrative and technical direction for the review. He will coordinate access to information, facilities, and individuals providing input to the team. He will provide a cohesive force for the various IEL&P department personnel and vendor organizations involved in the review. Plant operations personnel will provide input to the review team through the review team leader.

It will be the responsibility of the review team leader to resolve differences of opinions on methodology, technique and review findings, among team members.

3.2.2 Human Factors Specialist (HFS)

The human factors specialist will participate in each phase of the DCRDR and provide the human factors technical leadership for the review. The human factors specialist will coordinate all activities of other

required human factors personnel and verify that task performance quality is maintained at a level necessary for a valid and comprehensive review.

3.2.3 Instrumentation and Controls (I&C) Engineer

The I&C engineer will assist in the identification of plant system design features and will serve as the review team's expert on the capabilities and limitations of controls and instrumentation. The I&C engineer also will provide input during the assessment phase of the review, especially when the review team considers recommendations for correcting or mitigating HEDs.

3.2.4 Reactor Operator (RO), Senior Reactor Operator (SRO)

At least one RO and one SRO (or shift technical advisor) from DAEC will serve as members of the core review team. They will assist in identifying operator tasks and will serve as the review team experts on the operational constraints for operation of plant systems. They will ensure appropriate operator input to review team decisions.

3.2.5 Design Engineer

The design engineer will assist in the identification of plant system design goals and functions and will serve as the review team expert on the factors affecting design decisions at the plant. The design engineer will provide input during the analysis of functions and tasks for plant systems and during the assessment and correction phases of the DCRDR.

3.3 Review Team Orientation

Each member of the review team will contribute in-depth knowledge of specific topics to the team. It is important, however, that the review team be able to conduct the DCRDR from a common basis of understanding. Therefore, the review team will undergo an orientation program designed to provide each team member with a certain base level of knowledge, particularly of human factors. A secondary purpose of the orientation is to acquaint each team member with the other disciplines represented on the team. However, the intent is not to make each team member an expert in all specialties.

The orientation program will cover the following subjects:

- Human Factors - The orientation will familiarize the team with principles of human factors engineering and their application to DCRDR. Included in this area will be a brief synopsis of the history of the DCRDR requirement and its ultimate goals. This orientation will be slanted toward those review team members with little or no background in human factors.

- A brief orientation covering the functions of the other review team members will also be provided.

- Miscellaneous - During the course of the review, other subjects requiring orientation will be identified and appropriate instruction will be provided.

4. EXECUTION PHASE

4.1 Objective

The overall objective of the IEL&P DCRDR is to determine the extent to which the DAEC control room provides the operators with sufficient information to complete their required function and task responsibilities efficiently and reliably under emergency conditions. This section of the implementation plan describes the process that will be used to accomplish this overall objective.

4.2 Operating Experience Review

The purpose of the operating experience review is to identify potential problem areas in the control room by studying plant-specific documentation and by interviewing operators.

4.2.1 Historical Documentation Review

The following documentation will be reviewed:

- Licensee Event Report (LER)
- SCRAM Reports

In the original BWROG control room survey, plant LERs and SCRAM reports for the preceding two years were examined by the survey team to identify human factors design aspects that could have contributed to operator error.

LERs and scram reports to be evaluated in the supplemental survey will be those issued from the end of the original BWROG survey to February 1, 1984.

The supplemental survey will use the same methodology and criteria in reviewing these documents that were used in the original BWROG survey. There will be no

additional review of the documents already reviewed in the original BWROG survey. The scope of the original BWROG survey was defined by the following criteria:

- Equipment referenced must be in the physical confines of the control room.

- Procedural steps referenced must be accomplished within the physical confines of the control room.

- Personnel errors referenced must have occurred within the physical confines of the control room, or have entailed a deviation from procedures that were to be performed in the control room.

4.2.2 Operator Interviews

Operator interviews were performed in the original BWROG survey to obtain information about problems and desirable features of plant design and operation. Nine operators were interviewed by the original survey team. These included four shift supervisors, two senior reactor operators, and three reactor operators. Results of these interviews were documented in the original BWROG survey, and will be included in the summary report.

No planned formal operator interviews will be conducted in the supplemental survey.

4.3 Control Room Survey

The original BWROG survey was conducted to compare control room design features to applicable HFE guidelines. The guidelines addressed in the original BWROG survey will not be reevaluated.

4.4 Supplemental Survey

The supplemental survey is intended to augment the original BWROG survey. lt will utilize a new BWROG control room survey checklist supplement (Appendix A) covering considerations supplemental to those covered in the original BWROG control room survey checklist. The additional items listed in the BWROG control room survey checklist suppplement have been drawn from human engineering guidelines recommended in NUREG-0700 and verified through the considerable experience of BWROG survey teams.

The supplemental survey is to be implemented in accordance with the methodology of the original BWROG survey.

4.5 Task Analysis

The objective of the task analysis is to identify displays and controls required by the operators for emergency operations,

according to the DAEC EOPs.

The task analysis will consist of three phases:

- Task identification, and specification of requirements.

- Verification by control room inventory that displays and controls required to perform the tasks are available, and

- Validation of operator effectiveness in performing control room functions using those displays and controls.

4.5.1 Task Identification and Specification of Requirements

The task identification and specification of requirements phase consists of two parts. The first part involves specification of the major steps (functions) to be accomplished by the given procedures; and within those, the detailed steps (tasks). The objectives and criteria of fulfillment must be clear in each case. The second part is to identify the type of display or controls necessary to accomplish the tasks delineated in the first part. This includes such information as to whether discrete or continuous indication or recording is necessary, and what range, units, resolution of measurement and display and dynamic characteristics are appropriate for a display; or what type

of selection, direction, and actuation are appropriate for a control.

Documentation of this second part will be in the form of a controls and displays requirements list which will be used in the verification of instrumentation step described below.

4.5.2 Verification of Instrumentation

This phase consists of two parts involving the displays and controls identified during the task identification phase. An inventory of existing control room instrumentation that fulfills all EOP task requirements will be prepared. The inventory will include instrument descriptions and control room locations and will be correlated with the requirements list of Section 4.5.1. Any instance of missing controls or displays will be cited as an HED.

The second part will be a comparison of the displays and controls found in the first part of this phase, based on the requirements in the EOPs for their use, with appropriate human engineering design criteria. Although the control room survey will have examined control room instrumentation for conformance with human engineering design criteria, this verification step is required to determine if a meter, for example, has the appropriate range and scale gradations to support the particular EOP under consideration.

4.5.3 Validation of Control Room Functions

Validation will be accomplished by talk-throughs. The talk-throughs will be used to determine whether the equipment called for in the EOPs is arranged so it can be used properly by the operators. A walk-through will also be performed if a portion of a procedure is judged by the review team to be time-critical.

5. ASSESSMENT PHASE

5.1 Objective

The objective of this phase of the DCRDR is to evaluate the significance of the HEDs identified in the supplemental survey, the review of the updated operating experience review, and the task analysis.

5.2 Evaluation Criteria

HEDs discovered during the supplemental survey, the review of the updated operating experience review, and the task analysis will be evaluated according to their potentially deleterious effects on emergency operation. Recommendations for modifications to the control room fall into two general categories as follows:

- Modifications that are relatively inexpensive but would still significantly improve operator effectiveness and plant operation. Such modifications have a high benefit-to-cost ratio.

- Modifications that are relatively expensive but would still significantly improve operator effectiveness and make overall plant operation safer. Such modifications have a relatively lower benefit-to-cost ratio (but benefits might still be cost effective).

Comments or observations made by the review team may not result in a recommendation for modification to the control room because of the following considerations:

- Technical feasibility.

- Creation of new HEDs.

- Operator confusion.

- Large increase in training requirements for operations with insufficient return.

- Prohibitively low benefit-to-cost ratio

The same numerical rating system for degree of compliance with checklist criteria as the one used for the original BWROG survey will be used.

5.3 Assessment of HEDs

The method to be used in the assessments of HEDs will be the same as the one that was used in the original BWROG survey. It will consist of:

- A review of the worksheets that were prepared by the review team.

- An assessment of each comment or categorization that was indicated to be in less than full compliance, using guidance provided by various publications. (See Section 10.)

- An assessment of the extent and priority of each HED.

- An examination of each control room panel to resolve any questions or differences of opinion among members of the review team.

- The establishment of recommended resolutions of all identified HEDs.

6. CORRECTION PHASE

6.1 Objective

The objective of the correction phase is to evaluate the HEDs with respect to safety and economic significance and to develop a program for their resolution that is coordinated with other post-TMI work at DAEC.

6.2 Resolution of HEDs

Corrections of significant HEDs will be implemented through existing IEL&P plant modification, training, and administrative procedures.

Prior to implementation, a walk-through or talk-through will be conducted to validate that the correction does not introduce an additional HED into the control room.

6.3 Future Modifications

In order to ensure that human factors are adequately considered for future control room modifications, and to ensure that these modifications do not result in new HEDs, IEL&P has adopted human engineering guidelines and design standards to be used when carrying out these modifications. These IEL&P procedures include

detailed human factors checklists, and now is being used to review modifications at DAEC, such as the SPDS and the alternate shutdown panel.

Existing plant modification procedures will be used to ensure that plant operators are made aware of impending changes and are trained to use the modified control panels and systems.

6.4 Implementation Schedule

The actions required to resolve significant HEDs will vary, as will the time required to complete the proposed changes. All proposed changes will be scheduled based on priority and ability to integrate with other planned modifications, and dates for completion will be included the final summary report. This additional schedule of proposed changes will be reflected in future updates of IEL&Ps "Plan for the Integrated Scheduling of Plant Modifications for the DEAC."

7. DOCUMENTATION PHASE

7.1 Objective

The objective of the documentation phase is to ensure a formal documentation and document control system that creates a traceable and systematic translation of information from one phase of the

DCRDR to the next. It is mandatory that the review team have immediate access to a complete and current library of documents to manage each phase of the DCRDR.

The specific objectives of the documentation phase are to:

- Provide a record of all documents used by the Review Team for reference during various phases of the DCRDR.

- Provide a record of all documents produced by the Review Team as output.

- Retain the DCRDR file in a manner that allows further access and retrievability.

- Provide formal documentation for submittal to the NRC (i.e., the program plan report and the final summary report).

7.2 Final Summary Report

Upon completion of the DCRDR, a detailed final summary report of the results will be prepared and submitted to the NRC for review. The final summary report will describe the results of the DCRDR and will be submitted within six months of the SPDS becoming operable. This report will summarize the review process, provide descriptions of the identified HEDs, detail proposed corrective

actions, and proposed implementation schedules for each action not already implemented. Any deviations from the proposed DCRDR methodology described herein will be discussed. The final report will also identify the personnel who participated in the DCRDR and delineate their qualifications.

8. COORDINATION WITH OTHER ACTIVITIES

Several post-TMI activities will be in progress concurrently with the DCRDR. One such task, the upgrading of EOPs, will be directly related to the DCRDR in that the EOPs for DAEC will provide the technical basis for the DCRDR task analysis.

Other tasks, such as SPDS design and installation, will benefit because participation in the DCRDR will upgrade human factors expertise within IEL&P. The SPDS human factors review is not part of the DCRDR since it will not be available at the time the DCRDR is completed. The SPDS will be reviewed from a human factors viewpoint separately. In addition, the methodologies developed for the DCRDR will provide a foundation for the incorporation of human factors criteria in future equipment design and in development of guidelines and standards.

9. ACCEPTANCE CRITERION

This program plan was developed to describe the manner in which IEL&P will conduct a human factors review of the DAEC control room. Using

NUTAC guideline documents as a basis, this plan addresses the major aspects of an effective DCRDR and meets the requirements of Supplement 1 to NUREG 0737, as modified by Generic Letter 83-18. Since the DCRDR is intended to be performed as described in this document, the acceptability of the DCRDR should be judged against this document and Supplement 1 of NUREG 0737 only.

10. REFERENCES

The following documents have been identified as possible reference material to be used during the review. As the review progresses, additional material and references may be identified:

- Duane Arnold Energy Center - UFSAR
- NRC Regulatory Guides (1.47, 1.53, 1.62, 1.75, 1.89, 1.97)
- NRC guidance documents (NUREG 0700, 0800, 0801, 0737, 0899)
- Supplement 1 to NUREG 0737
- DAEC original BWROG survey
- Control room drawings and photographs
- P&IDs
- Training Programs Administrative Manual
- INPO 83-026 (NUTAC) Control Room Design Review Implementation Guideline

10. REFERENCES (Cont'd.)

- INPO 83-036 (NUTAC) Human Engineering Principles for Control Room Design Review
- INPO 83-042 (NUTAC) Control Room Design Review Survey Development Guideline
- INPO 83-046 (NUTAC) Control Room Design Review Task Analysis Guideline
- NRC Generic Letter 83-18
- DAEC LERs
- DAEC SCRAM reports

APPENDIX

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