Nuclear
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Committee

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Control Room Design Review Implementation Guideline

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CONTROL ROOM DESIGN REVIEW

IMPLEMENTATION GUIDELINE

Developed by

Nuclear Utility Task Action Committee

for

Control Room Design Review

July 1983

Publications produced by a Nuclear Utility Task Action Committee (NUTAC) represent a consensus of the utilities represented in the NUTAC. These publications are not intended to be interpreted as industry standards. Instead, the publications are offered as suggested guidance with the understanding that individual utilities are not obligated to use the suggested guidance.

This publication has been produced by the NUTAC on control room design review (CRDR) with the support of the Institute of Nuclear Power Operations (INPO). The officers of this NUTAC were Chairman Hamilton Fish (New York Power Authority) and Vice-Chairman Bill Gainey (Carolina Power and Light Company.) The following utilities and service organizations have actively participated in the NUTAC:

Alabama Power Company
Arizona Public Service Company
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FOREWORD

This Control Room Design Review (CRDR) Implementation Guideline was developed by the Nuclear Utility Task Action Committee (NUTAC) for CRDR to assist individual utilities in developing a plan for the implementation of their CRDR.

The INPO Analysis and Engineering Division Industry Review Group identified the need for a utility committee to deal with the CRDR item of the TMI Task Action Plan. The charter for such a group was approved by INPO management. The CRDR NUTAC, formed after this approval, identified several areas in which individual utilities could use assistance in the implementation of CRDRs.

This document is the first product of the CRDR NUTAC. Other supporting documents addressing human engineering principles, survey guidelines, and task analysis for control room design review are also being developed by the CRDR NUTAC.

CHARTER

NUCLEAR UTILITY TASK ACTION COMMITTEE

ON

CONTROL ROOM DESIGN REVIEW

The Nuclear Utility Task Action Committee (NUTAC) on CRDR has been established by a group of representative utilities in recognition of the need for guidance on performing a CRDR. The principal objectives are (a) to determine the boundaries of the CRDR, (b) to develop a methodology, (c) to define terms, (d) to integrate other initiatives with the CRDR (e.g., SPDS development, EOP development, staffing, and training), and (e) to provide practical implementation guidelines that include but are not limited to the following:

- a CRDR methodology and implementation guideline
- a guideline on the development of CRDR survey checklists
- a CRDR task analysis guideline
- a set of human engineering review principles
- a guideline for validating the effectiveness of the control room in supporting emergency operation given the current EOPs, operating crew, and their training

The NUTAC will consider the need for other activities of generic benefit to the industry after the CRDR requirements are issued.

The NUTAC will establish liaison and solicit support from industry groups such as NSSS owners groups, AIF, INPO, and EPRI. Communication on this industry initiative will be maintained with the NRC. Providing the NUTAC consensus to the NRC will help shape both the regulator and industry perspective on CRDR integration issues.

SUMMARY

This CRDR Implementation Guideline has been developed by the CRDR NUTAC to assist individual utilities in developing their CRDR program plans in response to NUREG-0737, Supplement 1. The implementation guideline was written in response to a utility industry request for assistance in the area of human factors, in general, and the CRDR, in particular. The implementation guideline, as its name implies, is offered as guidance only. There is no obligation for any nuclear utility to follow the recommendations in the guideline.

The implementation guideline is divided into two distinct but complementary parts. The first part, the guideline portion, lists specific functional areas that should be addressed in some form by utilities developing a CRDR program plan. The second part is an example CRDR implementation program plan provided as the appendix.

The first part of the implementation guideline addresses the specific functional areas, or groupings, considered by the NUTAC to be the minimum necessary to formulate a workable and effective CRDR program plan. Within each functional area, specific characteristics are listed to help guide each utility during program development. There is no guidance provided concerning how a utility should address the topic in question--that is left up to the individual utility. The purpose in listing the topics is to provide a checklist so that all aspects are considered during the program plan development process.

The second part of the implementation guideline is an example CRDR implementation program plan developed around a fictitious nuclear utility. The purpose of this example is to show in detail how a utility might develop a program plan using the guidance provided in the body of the guideline. It is not the

intent of this example to provide a prototype program plan or to force all utilities to conform to the structure of the fictitious plan. It is simply an illustrative example for the information of the reader and, hopefully, user of the implementation guideline. The example is the appendix to this document.

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1. INTRODUCTION

1.1 PURPOSE AND SCOPE

This guideline identifies and describes the basic elements of an implementation process for control room design review (CRDR). The major aspects of a sound and workable CRDR implementation plan are represented by these elements. Each element was selected and reviewed by the Nuclear Utility Task Action Committee (NUTAC) for Control Room Design Review. Each element is described, and some major items applicable to each element are presented.

Development of a CRDR implementation plan by an individual utility can be assisted by reviewing the basic elements presented in this guideline and by evaluating how each element is addressed by the utility in the CRDR implementation process. Plant-specific elements can be identified and added to the basic elements if necessary. Existing programs and activities then can be used as part of the resulting CRDR implementation plan. An implementation plan developed with the aid of this guideline can be sufficiently detailed to provide the basis for an audit of an individual CRDR.

1.2 DOCUMENT ORGANIZATION

This document, Control Room Design Review Implementation Guideline, is presented in three sections and one appendix.

1.2.1 Section 1 - Introduction

The introduction explains the purpose and scope, organization, and use of this document.

1.2.2 Section 2 - Definitions

This section provides definitions of the terms associated with control room design review as used in this document.

1.2.3 Section 3 - Implementation Elements

This section describes the basic elements associated with the following phases of a control room design review:

- o planning phase
- o execution phase
- o assessment phase
- o correction phase
- o effectiveness phase
- o documentation phase

The description of each element is followed by an identification of some major items that should be considered as part of the element.

1.2.4 Appendix - Example Control Room Design Review Implementation Plan

The appendix contains an example of a plant-specific CRDR implementation plan. The approach adopted and illustrated in this plan is not to be construed as the only possible approach.

1.3 RECOMMENDED USE OF THIS DOCUMENT

The elements presented in Section 3 should be organized consistent with the guidance contained in Subsection 3.1.1, "Organization of elements," to develop a plant-specific CRDR implementation process and plan. Plant-specific aspects of the implementation process should be added to the plan, and the elements should be modified as necessary.

The example CRDR implementation plan is provided for information and to be used in forming a plant-specific plan. It can be modified by the plant-specific process.

Once the element order and interaction are established by the utility, a schedule can be developed to identify the time-critical elements. With this information, an implementation date for each element can be identified, and utility resources can be assigned to support the implementation plan and schedule.

In this implementation guideline, brackets ([ ]) are used after each section title to identify the section of the example program plan in which the guidance is addressed.

2. DEFINITIONS AND ACRONYMS

2.1 DEFINITIONS

Control Room Design Review (CRDR) - 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-0600, as Task I.D.1.

Control Room Survey - One of the activities that constitutes a CRDR. The control room survey is a static verification of the control room performed by comparing the existing control room instrumentation and layout with selected human engineering design criteria, i.e., checking the control room match to the physical capabilities and limitations of the human operator.

Elements of a Utility CRDR Implementation Process - Necessary parts of a cohesive CRDR implementation process that a utility should consider in developing and reviewing its implementation plan and schedule.

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

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

Human Engineering Discrepancy (HED) - A characteristic of the existing control room that does not comply with the human engineering criteria used in the control room design review.

Nuclear Utility Task Action Committee (NUTAC) for CRDR - Representatives from various nuclear utilities and INPO who are organized to define areas of CRDR implementation for which an overall industry effort can provide assistance to individual utilities in completing Task I.D.1, NUREG-0737.

Operational Experience Review - One of the activities that constitutes a CRDR. The operating experience review screens plant operating documents and operator experience to discover human engineering shortcomings that have caused, or could have caused, actual operating problems in the plant.

Review Team - A group of individuals responsible for directing the CRDR of a specific control room. (See Survey Team.)

Safety Parameter Display Systems (SPDS) - An aid to the control room operating crew for use in monitoring the status of critical safety functions (CSFs) that constitute the basis for plant-specific, symptom-oriented EOPs.

Survey Team - A group of individuals responsible for conducting the control room survey. The survey team may or may not include individuals from the review team. (See Review Team.)

System Function Analysis - The determination of system functions required to meet system goals.

Task Analysis - The systematic process of identifying and examining operator tasks in order to identify conditions, instrumentation, skill, and knowledge associated with the performance of a task. In the CRDR context, task analysis is used to determine the individual tasks that must be completed to allow successful emergency operation. In addition, this activity can verify and validate the match of information available in the control room to the information requirements of the emergency operating tasks.

Validation - The process of determining whether the control room operating crew can perform their tasks effectively given the control room instrumentation and controls, procedures, and training. In the CRDR context, validation implies a dynamic performance evaluation.

Verification - The process of determining whether instrumentation, controls, and other equipment exist to meet the specific requirements of the emergency tasks performed by operators. In the CRDR context, verification implies a static check of instrumentation against human engineering criteria.

2.2 ACRONYMS

APLC - Acworth Power and Light Company (fictitious)
CRDR - Control Room Design Review
CRO - Control Room Operator
CRT - Cathode Ray Tube
CSF - Critical Safety Function
EOP - Emergency Operating Procedure
EPG - Emergency Procedure Guideline
ERF - Emergency Response Facility
HED - Human Engineering Discrepancy
HFS - Human Factors Specialist
HNP - Horizon Nuclear Plant (fictitious)
I&C - Instrument and Control
INPO - Institute of Nuclear Power Operations
LER - Licensee Event Report
NRC - Nuclear Regulatory Commission
NSSS - Nuclear Steam Supply System
NUTAC - Nuclear Utility Task Action Committee
OFP - Operational Feedback Program (fictitious)
P&ID - Piping and Instrumentation Diagram
PAM - Post-Accident Monitoring
PSER - Plant Significant Event Report (fictitious)
PDSF - Personnel Demographic Summary Form
PTR - Plant Trip Report (fictitious)
PTRB - Procedures and Test Review Branch (of NRC)
PWR - Pressurized Water Reactor
QISF - Questionnaire Item Summary Form
RO - Reactor Operator
SEE-IN - Significant Event Evaluation and Information Network
SER - Significant Event Report
SME - Subject Matter Expert
SOER - Significant Operating Experience Report
SPDS - Safety Parameter Display System
SRO - Senior Reactor Operator

TMI - Three Mile Island

TVA - Tennessee Valley Authority

WOG - Westinghouse Owners Group

3. IMPLEMENTATION ELEMENTS [2.3]

Many elements should be taken into account when developing a CRDR implementation plan. The following list represents the basic elements of any cohesive CRDR implementation process.

Each element is described briefly, followed by an identification of some major items that should be considered as part of the element. Many of the elements may be addressed previously by existing utility activities and need only be coordinated with the CRDR process.

The following elements, grouped by implementation phase, are identified and described in this guideline:

- o Planning Phase
  - -- organization of elements
  - -- focus and extent of the review
  - -- review team composition
  - -- review team orientation
  - -- use of EPGs/EOPs

- o Execution Phase
  - -- survey
  - -- operating experience review
  - -- task analysis
  - -- inventory

- o Assessment Phase
  - -- human engineering review principles
  - -- assessment of HEDs
  - -- effect of operator aids
  - -- effect of current modifications
  - -- prioritization of HEDs

- o Correction Phase
  - -- enhancements and modifications
  - -- procedure changes

-- operator training

-- crew staffing

-- scheduling corrections

o Effectiveness Phase

-- validation

-- feedback

-- upkeep

o Documentation Phase

-- document control

-- working documents

-- summary report

3.1 PLANNING PHASE

The planning phase establishes the organization and focus for the entire CRDR.

3.1.1 Organization of Elements [2.3]

The elements of a CRDR should be organized as a planning aid for CRDR project personnel and to provide criteria for post-CRDR review. A CRDR implementation plan is the framework within which the implementation elements are organized. The organization of elements must be comprehensive, adaptable to changing conditions, and consistent with the utility organization. Through a logical, plant-specific organization of elements, the utility can identify where the function of each element is performed. In addition, each element can be ordered within the implementation process, and individuals within the utility can be assigned responsibility for each element's performance. After the order of the process is identified, timing requirements can be projected, and a tentative schedule can be developed. Many of the

elements might provide necessary or important feedback to other elements, requiring certain assumptions in developing an initial CRDR implementation plan. It is recommended that these assumptions be specified as part of the documentation associated with each of the applicable elements in the plan.

3.1.2 Focus and Extent of the Review [2.3.1]

The CRDR implementation plan should describe explicitly the focus and extent of the CRDR. The extent of the CRDR should be described in as much detail as possible so that no misunderstanding will arise as to the area being reviewed.

It is very important to recognize that the results of the CRDR are logically dependent on the emphasis placed on various activities during the review. For example, if heavy emphasis is placed only on the arrangement of instruments and controls, it is not appropriate to expect the CRDR to help restructure a utility's training program. Likewise, if the task analysis is focused only on delineating the requisite knowledges, skills, and aptitudes for normal operation, then one should not expect much information concerning the instrument layout.

The main focus of the CRDR should be on the adequacy of the control room indications and controls to support operation under emergency conditions.

This perspective is taken because a utility must ensure the success of risk management and correct operation during emergencies. The analytic

resources used for the CRDR are directed toward this success in emergency operation. Beyond emergency operation, a secondary focus of the CRDR is the documentation of problems known to exist during normal operations. The CRDR should extend beyond the control room only to those operating systems needed under emergency conditions and should focus on those systems with plant safety implications.

Each activity in the CRDR is meant to gather information concerning the ability of the control room design to support emergency operation and sustain normal operation. The control room survey does not discriminate among normal, abnormal, and emergency operation but does compare control room design characteristics with human engineering criteria. The operating experience review will define problems encountered during actual plant operation, which generally is conducted under normal conditions. The task analysis activity addresses emergency operation only.

3.1.3 Review Team Composition [3.2]

The CRDR is best approached as a multidisciplinary team activity since the support of plant operation is itself a multidisciplinary activity. The purpose of a CRDR is to assess the control room in terms of human engineering design characteristics. However, many aspects of the physical control room layout are not analyzed easily without input from fields other than human factors.

The formation and maintenance of a review team can be facilitated by using a core group of individuals as the review team and supplementing this core group as necessary throughout the CRDR. The individuals in the core group should assume overall responsibility for the CRDR, whereas any supplementary people can serve as limited duration team members with responsibility for a particular aspect of the CRDR, as the situation dictates.

When addressing the review team composition in the formulation of a CRDR implementation plan, it is suggested that personnel from the following disciplines be available to the review team--even if only in a part-time advisory role:

- o human factors engineering
- o plant operations
- o design engineering
- o training
- o maintenance
- o procedures
- o instrumentation and control (I&C)

It should be recognized that the CRDR is, in essence, a human factors review. As such, the input of human factors expertise is essential to the conduct of a meaningful review. Each utility review team will be different, depending on the focus of the review (Section 3.1.2) and the availability of qualified individuals in each field.

3.1.4 Review Team Orientation [3.5]

Each utility review team should have some common level of understanding with respect to the plant operations, the focus of the review, the

techniques to be used during the review, and the perspective of other team members. Some orientation will be required to achieve such a basic level of understanding. Execution of the actual CRDR activities will fill in gaps in this basic level of understanding. If the gaps are extensive, the time required for execution and effectiveness will be increased.

The type, depth, and duration of orientation should be assessed in the formulation of the CRDR implementation plan. When addressing this element, consideration of the following major items should be included:

- o minimum level of understanding of plant operations and normal plant evolutions acceptable for the review team members
- o composition of the review team
- o division of labor among the team members
- o compatibility of experience of review team members
- o focus of the CRDR
- o use of orientation programs in each area of expertise
- o time frame for the CRDR, including any necessary orientation

3.1.5 Use of EPGs and EOPs [4.3]

Since the focus of the task analysis portion of the CRDR is on operation under emergency conditions, the new symptom-oriented EPGs (and the resultant, plant-specific EOPs) should figure prominently in any implementation plan. The EPGs are the logical basis upon which the CRDR can be built. Even if the focus of a particular utility CRDR extends beyond emergency operation, the

symptom-oriented EPGs should still serve as the basis for the emergency operation portion of the review.

It is possible, even probable, that plant-specific, symptom-oriented EOPs will not be implemented by the time the CRDR begins. However, it has been shown in the INPO/TVA Pilot Systems Review report (INPO 82-014) that the guidelines for such procedures can be used effectively as the basis for the systems review portion of the CRDR. In fact, the task analysis conducted for the CRDR can be used to develop plant-specific EOPs from generic EPGs.

When considering the use of EPGs and EOPs in formulating a CRDR implementation plan, the following major points should be addressed:

- o availability of approved EPGs
- o schedule for implementation of new plant-specific EOPs
- o review team understanding of symptom-oriented emergency procedures
- o incorporation of changes in the EPGs and EOPs into the task analysis

3.2 EXECUTION PHASE

The execution phase is associated with the performance of activities that can identify human engineering discrepancies (HEDs).

3.2.1 Survey [4.2]

The control room survey is an explicit, well-defined control room design verification activity within the CRDR. The survey consists of comparing the characteristics of the existing control

room with commonly accepted human engineering design criteria.

The major items to be considered when addressing this element in the formulation of a CRDR implementation plan are the human engineering criteria to be used in the review and the extent of the survey. Criteria should be developed to support the focus and extent of the CRDR. Reference criteria can be found in Section 6, NUREG-0700, "Guidelines for Control Room Design Reviews." Other applicable human engineering criteria also may be used to support the desired focus (see Control Room Design Review Survey Development Guideline, also being developed by this NUTAC). Although the survey guidelines could be applied to any operational area of the plant, the control room survey should be focused on the operating panels and environment inside the control room.

Whatever criteria are chosen for use, they should be referenced explicitly in the implementation plan. The following aspects of the survey should be considered:

- o completeness of the survey criteria
- o applicability of survey criteria to the focus of the CRDR
- o training of the survey team(s) in the use of the selected criteria
- o availability of equipment to measure the parameters necessary to meet the selected criteria
- o auditability of the technique(s) used to apply the survey criteria
- o documentation of survey results
- o description of the specific operating areas to be surveyed

3.2.2 Operating Experience Review [4.1]

This element is also a well-defined activity within the CRDR, meant to review the experience gained through actual plant operation. The motivation for this activity is to determine what problems have occurred (and recurred) during actual plant operation by questioning operating personnel and reviewing operating documents. For plants that have operated some time, this element of the CRDR is very effective in providing details concerning normal and abnormal operating modes. For new or "near-term" plants, this element is not as productive, although experience from plants of similar design will still be useful.

An operating experience review may consist of operator interviews, a review of plant trip logs, and possibly a review of Licensee Event Reports (LERs). INPO Significant Event Evaluation and Information Network (SEE-IN) reports, such as Significant Event Reports (SERs) and Significant Operating Experience Reports (SOERs), can provide generic information on operating experience. The best use of LERs is as a means of confirming problems uncovered during the operating experience review. When addressing this element in the formulation of a CRDR implementation plan, the following major items should be considered:

- availability of experienced operators
- type of interview technique to be used
- availability of skilled interviewers
- willingness of management to allow the operators' interview responses to be anonymous
- willingness to forego punitive action based on interview results

- availability of reactor trip reports or plant significant event reports
- availability of operator logs

3.2.3 Task Analysis [4.3]

The use of the term "task analysis" in the CRDR has caused some confusion. Of all implementation elements, the task analysis is probably the least understood and, hence, may require more time and effort to be integrated properly with other CRDR activities. It is vital to the outcome of the CRDR that adequate attention be given to task analysis, since it can integrate the operational, dynamic aspects of plant operation with the results of the survey and the operating experience review.

The task analysis is used to delineate the specific actions (automatic and manual) that must take place to accomplish system functions. For the CRDR task analysis, the emergency procedure guidelines (EPGs) can be the technical bases for emergency operation. Task analysis is addressed in more detail in the "CRDR Task Analysis Guideline," developed by the CRDR NUTAC.

The level of detail and types of information collected during task analysis are dependent on the focus of the CRDR. When addressing this element in the formulation of a CRDR implementation plan, the following major items should be considered:

- focus and desired output of the overall CRDR
- availability of personnel to conduct task analyses

- o definition of how the implementation plan can make use of industry and owners group task analyses
- o verification of instrumentation and controls
- o validation of control room functions
- o extent of training required by review personnel in the use of task analysis
- o degree to which ongoing control room activities will be disrupted by task analysis
- o documentation necessary to use data from the task analysis in defining potential control room deficiencies

3.2.4 Inventory

Developing an inventory of control room instruments and controls only creates a list and does little to support the main focus of the CRDR. This main focus is on the adequacy of the control room indications and controls to support operation under emergency conditions. The function intended for an inventory is to determine whether the instrumentation and controls needed to support operation under emergency conditions actually exist. An inventory, when combined with the output of task analysis, is only one means of accomplishing this function. It also can be accomplished by performing a walk-through verification of the task analysis in a mock-up, simulator, or control room. In an effort to reduce duplication during the execution phase, it is recommended that the function intended for an inventory be accomplished as part of the task analysis.

3.3 ASSESSMENT PHASE [5.]

Following the identification of human engineering discrepancies, the review team must assess each HED to determine if it represents an actual problem or only a deviation from accepted standards. An HED is a problem only if it deviates from the principles of design upon which the standards are based and cannot be offset by other considerations.

3.3.1 Human Engineering Review Principles [5.2]

During any design process, certain principles are used to define the specific characteristics of the item being designed. Due to the trade-offs made during the design process, the finished product may not comply with some desirable design criteria. During the survey phase of the CRDR, the existing control room is reviewed for compliance with commonly accepted human engineering design criteria. These criteria can be found in many source documents, such as NUREG-0700, MIL-STD-1472C, etc. Aspects of the control room that do not conform to design guidelines are classified as HEDs. The next implementation element (Section 3.3.2) deals with the assessment of HEDs to determine the potential seriousness of errors that might result from such discrepancies.

It can be useful during the assessment phase of the CRDR to keep in mind the human factors principles on which detailed survey guidelines are based (see "Human Engineering Review Principles," also being developed by this NUTAC). During the control room survey, it is easy to lose sight of where the detailed survey criteria originated and why they were developed. The inclusion of basic human engineering principles in the development

of the CRDR implementation plan serves as a reminder that the measurements and values contained in detailed guidelines are not to be interpreted as absolute, inflexible numbers.

When addressing this element in the CRDR implementation plan, the following major points should be considered:

- o the level of detail of the principles
- o the applicability of particular principles to the control room
- o cross-reference of principles to the detailed survey guidelines
- o the behavioral criteria used to judge that a principle has been met
- o the population to which the principle is to be applied
- o the experience of review team members in interpreting human factors principles
- o the completeness of the set of principles used

3.3.2 Assessment of HEDs [5.2]

During the review phase of the CRDR, HEDs are attributed to design characteristics that deviate from certain human engineering criteria. However, not all HEDs will affect operator performance adversely. During the assessment phase of the CRDR, each HED should be evaluated against the appropriate task requirements (Section 3.2.3) and human engineering principles (Section 3.3.1). If it is determined that an HED does not affect operator performance adversely, it can be either discarded or greatly reduced in priority (Section 3.3.5).

When developing an implementation plan for the CRDR, the following items regarding HED assessment should be addressed:

- o criteria to be used for assessing HEDs
- o review team members responsible for HED assessment
- o provisions for documenting dissenting opinions regarding the assessment of specific HEDs
- o procedure for determining the disposition of HEDS that do not affect operator performance

3.3.3 Effect of Operator Aids [7.]

The presence of operator aids such as SPDS can profoundly affect the way control room operators handle emergency situations. Some utilities may have installed their SPDS prior to the start of the CRDR. Many utilities will not have installed SPDS hardware; however, some major design decisions for the SPDS may be made before completion of the control room review. Other aspects of SPDS design may, in fact, depend on the outcome of the CRDR. For instance, the results of the CRDR systems review can have a significant impact on the definition of the SPDS data base. Regardless of the specific design process used to define an SPDS, the CRDR and SPDS activities are interrelated in many ways.

When formulating an implementation plan for the CRDR, the following major items should be addressed:

- o schedule for SPDS implementation
- o interaction of SPDS with new EPGs and other computerized operator aids
- o intended function of SPDS in the control room environment

- o SPDS design decisions already made
- o SPDS design decisions requiring input from the CRDR
- o inclusion of the SPDS expertise on CRDR review team
- o potential use of computerized operator aids to mitigate deficiencies found during CRDR

3.3.4 Effect of Current Modifications [5.3]

A nuclear power plant control room is not a static entity. Even without certain requirements being issued by the NRC, control room modifications would still be required as a result of the utility engineering change and upgrade process. It is important to consider any pending modifications during the CRDR, since they might affect the assignment and disposition of HEDs. Eventually, some process should be established whereby human engineering input is part of the engineering change process (Section 3.5.3).

Consideration of current control room modifications during the development of a CRDR implementation plan should include the following major items:

- o determination of anticipated control room modifications already in the engineering change process
- o schedule of current modifications with respect to CRDR schedule
- o utility resources common to both current modifications and CRDR
- o determination of human factors impact of current modifications

3.3.5 Prioritization of HEDs [5.2]

One of the most perplexing problems associated with the CRDR is prioritizing the HEDs resulting from the review. The development of an adequate prioritization scheme is critical to the proper disposition of HEDs. The proper disposition depends on the focus of the CRDR and the analysis activities. If the focus of the review is to ensure the adequacy of control room design for emergency operation, then the disposition of certain HEDs may well be different than if the focus of the CRDR is to improve normal operation.

Whatever prioritization scheme is used to rank HEDs, many considerations should enter into the determination of HED priority. The effect of HEDs on safe plant operation must be given the greatest weight during the assessment phase of the CRDR. When considering this element in the development of a CRDR implementation plan, however, the following major items should be considered:

- o potential effects on safe plant operation during emergencies
- o potential solutions for multiple HEDs (e.g., many HEDs on one panel)
- o available methods of mitigating HEDs
- o related regulatory issues
- o use of SPDS or other operator aids to mitigate HEDs
- o methods for determining when HEDs are not real deficiencies
- o possibility of grouping HEDs for common solution
- o methods for assigning costs/benefits to HEDs
- o effects of negative transfer of training

- o interaction of HEDs with new symptom-oriented procedures
- o availability of generic or plant-specific PRA results

3.4 CORRECTION PHASE [5.3]

During the correction phase, enhancements and modifications to the control room are coordinated with the required operating procedure changes, operator training and crew staffing.

3.4.1 Enhancements and Modifications [5.3, 5.4]

Enhancement and modification are two methods of eliminating or mitigating HEDs. Enhancements are changes to the control room, boards, and instruments that do not require the movement of instruments, controls, or annunciators. Some common enhancements are the addition of mimic lines to panels, color padding functionally related instruments, changing indicator scales, and replacing labels on panels. Modifications are changes that involve physical movement of instruments or changes in the way systems operate. Modifications also may require changes to the layout of the control room and the structure of the control boards.

Some enhancements are relatively inexpensive and straightforward, whereas others can be time-consuming and costly. Likewise, certain types of modifications can be done fairly easily, while extensive modifications may require the redesign and reanalysis of entire boards.

During the assessment phase of the CRDR, the review team recommends methods for mitigating or

eliminating HEDs that are judged to have serious consequences. Enhancement and modification are two such methods and should be included in the development of the CRDR implementation plan by considering the following major items:

- o the existence of various methods for control board enhancement and modification
- o the resources and time required for different methods
- o the durability and suitability of control board enhancement materials
- o the extent of modification allowed before seismic reanalysis is required
- o the classes of HEDs that are amenable to mitigation through enhancement and modification
- o trade-offs among enhancement, modification, redesign, and retraining
- o the relative cost of different enhancement techniques
- o the effect on operator performance of enhancing or modifying a few selected parts of the control board versus large areas (slight changes can have detrimental effects)
- o the in-house resources available for carrying out enhancements modifications
- o scheduling control room changes to coincide with plant outages
- o other scheduling constraints
- o the human engineering review of planned changes
- o verification of planned enhancements and modifications before they are finalized

3.4.2 Procedure Changes [7.]

Changes in the control room may require procedural changes. This applies to both normal and

emergency procedures, since some control room equipment is referenced by both types of procedures. Omission of this element can invalidate even the most conscientious CRDR, since operator training is based largely on plant procedures. If control room changes are not incorporated promptly into procedures, then operators trained with those procedures will not be able to take advantage of CRDR-instituted improvement and may, in fact, be more prone to error than before the changes were made.

Though often overused, procedural changes should not be overlooked as a method for correcting HEDs. When used sparingly and consistently, procedure changes can be very effective in correcting or mitigating HEDs. Overuse of this method will be ineffective and can even degrade operator performance.

When addressing this element during the formulation of a CRDR implementation plan, the following major items should be considered:

- o mechanism for incorporating control room changes into procedures
- o use of actual plant procedures in operator training programs
- o time delay for procedural change
- o methods used to ensure all procedures available in the control room are up to date
- o guidance for procedure format and content

3.4.3 Operator Training [5.5]

As changes are made to the control room, the control room operators must be kept abreast of those changes. Therefore, one of the CRDR

implementation elements addresses the training necessary to account for control room changes. The type and extent of operator training will depend on the timing and extent of control room changes as well as the structure of the existing training program within each utility. Such training should take advantage of any lessons learned during the CRDR. Due to the interdependence of several post-TMI activities and any ongoing utility-mandated control room changes, operator training activities must be sensitive to areas where coordination is important to maintaining plant operational safety.

The following major items should be considered when addressing operator training in the CRDR implementation plan:

- o types of personnel to be trained on changes
- o type of training (initial, refresher)
- o method of training (simulator, on-the-job, self-study, classroom)
- o operator knowledge and skill requirements
- o operator licensing requirements
- o effect of training for multiple units where changes are made on one unit at a time
- o effect on plant operation while training operators on changes not yet in place
- o effect of training operators on "piecemeal" changes versus training on all changes implemented at one time
- o effect of "piecemeal" implementation of changes
- o schedule of operator training to coincide with major outages
- o method for ensuring operator feedback into training program

3.4.4 Crew Staffing

One area that should be considered when developing corrections to HEDs is crew staffing and qualifications. Current crew staffing levels and qualifications should be reviewed to determine whether changes in staffing can correct certain HEDs. Although increasing the number of people in the control room crew can give a false sense of security, it can be very effective for short-term mitigation of specific HEDs. A design change then can be implemented in a reasonable time frame and the staffing returned to the previous level. However, it also should be noted that the control room design often limits the number of operators who can be utilized effectively.

When addressing this element during the correction of HEDs, the following major items should be considered:

- o if the crew members were added for specific emergency tasks, how additional crew members will be used during normal operation
- o long-term cost of additional crew members versus a design change
- o qualification and training requirements for additional crew members
- o acceptance of additional crew members by current crew
- o restrictions placed on activities to be performed by additional crew members

3.4.5 Scheduling Corrections [7.1]

Developing a schedule for HED corrections is a separate and distinct task from HED prioritization. Many corrections can be implemented

quickly regardless of their assigned priority. Corrections for some of the highest priority HEDs may require a good deal of time for engineering design, purchasing, and installation. If the safety significance of such an HED is determined to be high, an interim correction may reduce the priority of the ultimate change.

When scheduling corrections, the following major items should be considered:

- o plant outage schedule (e.g., refueling)
- o manpower requirements
- o integration of corrections with other planned station design changes
- o integration of corrections with training requirements for those changes
- o development of procedural changes
- o time requirements for engineering, purchasing, installation, and testing

3.5 EFFECTIVENESS PHASE

The effectiveness phase is concerned with evaluating the control room design enhancements and modifications. This phase is an ongoing process to determine if the changes were effective and to ensure that future changes maintain this same level of effectiveness.

3.5.1 Validation [4.3]

As with feedback (Section 3.5.2), some type of validation process should occur in which changes are evaluated to determine whether they have mitigated the problems for which they were developed. Validation and feedback are closely related concepts, but validation is a more structured technique to determine that the proposed modifications produce the desired result. The

validation referred to here is a hardware system validation in which changes or modifications on certain systems or components are assessed to see whether or not they have alleviated specific human engineering problems.

It is important to consider validation early in the implementation process, although the validation itself starts during the assessment phase of the CRDR. The ultimate success of the CRDR in improving operations within the control room depends in large part on the assurance that problems actually have been corrected. More guidance in this area will be provided by the Component Verification and System Validation Guideline, developed by the Emergency Response Capability NUTAC.

When addressing this element during the formulation of a CRDR implementation plan, the following major items should be considered:

- familiarity of the review team with validation methods
- extent of validation considered adequate
- ability to validate proposed changes before they are put into place
- use of operational personnel in validation
- use of design aids, such as mock-ups, to validate proposed changes
- use of training aids, such as a full-scale simulator, to validate proposed changes
- the extent to which validation will be used as a CRDR audit criterion
- integration with EOP validation
- integration with validation of training

3.5.2 Feedback [5.5]

The CRDR can be completed in about one year. However, changes made as a result of the CRDR will have long-term effects on plant operation. As HEDs are identified and changes are made, some mechanism is needed to feed back the effects of any changes. At least one feedback path should lead to the design engineering organization where it is treated as input for future designs. Without a feedback mechanism, it is entirely possible that changes can go unreported and have adverse effects on plant operation.

Feedback can take many forms. The mechanism for feedback can be something as simple as verbal operator reports of control room problems. Some plants already have fairly elaborate procedures in place whereby the effects of control room changes can be reported. The important idea represented in this element is that changes should not be made and then simply closed out with no provision for operational feedback based on experience. Some of the techniques used in the operating experience review (Section 3.2.2) can be incorporated as feedback mechanisms.

When addressing this element during the formulation of a CRDR implementation plan, the following major items should be considered:

- o procedures for soliciting operator comments
- o the ability of operators to report problems
- o inclusion of feedback into the engineering change procedures
- o training operators as to the criteria by which changes should be judged

- o the extent to which resistance to control room change (e.g., ego involvement) can be overcome
- o the involvement of operational personnel in the early stages of the change process
- o industrywide feedback programs

3.5.3 Upkeep [5.5]

Completion of the CRDR and implementation of the resulting control room changes will establish a benchmark for control room operability. If efforts are not instituted to maintain this basis, in time, the control room design basis will be altered, just as the initial design basis was modified by backfits.

When addressing this element during the formulation of a CRDR implementation plan, the following major items should be considered:

- o the assignment of an individual or group within the utility organization who will be responsible for maintaining the control room design basis
- o the use of the control room survey and human engineering review principles to maintain the control room design basis
- o the use of task analysis to maintain control room design basis
- o the use of operator review during the control room design modification process

3.6 DOCUMENTATION PHASE [6.]

The CRDR must be documented. The CRDR documentation should describe the methodology used in the review and the results obtained. Adequate documentation fulfills two purposes. First, it provides an historic record of the review process itself, not just the outcome. This

has been the missing piece in many nuclear design efforts in the past. Second, good documentation provides an audit path for the utility and the data necessary to maintain the control room design basis.

Documentation must be designed properly and must be accessible to the utility review team. Such documentation can be used to generate a summary report and to provide audit criteria for the CRDR.

3.6.1 Document Control [6.1, 6.2]

The CRDR will generate many documents. To manage this information and to make it accessible, adequate document control procedures should be in place prior to the start of the review.

When addressing document control during the development of the CRDR implementation plan, the following points should be considered:

- o existing document control procedures
- o availability of generic documentation for specific plant type
- o process used by review team to generate working documents
- o approval cycle for "final" documents
- o ability to extract summaries and abstracts from CRDR documentation
- o design of documentation to ensure its usability for future control room changes
- o ability to reference documents used in the CRDR, such as documents from training, design, operations, etc.

3.6.2 Working Documents [6.2, 6.3]

The review team will use many first- and second-generation documents as working papers during the

review. It is important that an adequate level of documentation is retained to describe the review process and to preserve intermediate and final results. It is left to each utility to define the level of documentation adequate for its use.

The major goal of this element in the implementation plan is to preclude redoing the CRDR each time some retrofit or new instrument is proposed. If such documentation is available following the CRDR, then future control room changes can be based on a technically defensible analysis of the current control room design. A second goal of maintaining adequate working documentation of the review is to be able to answer specific questions during any audit of the CRDR.

When addressing the documentation of working papers during the development of a CRDR implementation plan, the following major items should be considered:

- o definition of an acceptable minimum set of review-related documentation
- o specification of the level of detail to be used in each document
- o specification of the generation level of each document to be retained (e.g., original handwritten, intermediate summary)
- o designation of personnel responsibility for each type of working document (for further explanation of the document contents)
- o integration of working documents into the overall document control scheme for later accessibility

3.6.3 Summary Report [6.4]

Eventually, each utility will need to submit a summary report describing its CRDR methodology and major results. The contents of this report should give an outside observer an adequate explanation of what was done, why it was done, the general results of the review, and the status of any changes or modifications.

When addressing this element during the formulation of a CRDR implementation plan, the following major items should be considered:

- documentation to be supplied with the report
- kind of HEDs to be described individually in the report
- kind of HEDs to be summarized in the report
- level of detail on schedule for HED correction to be included in the report
- level of detail on CRDR activities to be included in the report

APPENDIX

EXAMPLE
PROGRAM PLAN FOR IMPLEMENTATION
OF
CONTROL ROOM DESIGN REVIEW

PROGRAM PLAN FOR IMPLEMENTATION
OF
CONTROL ROOM DESIGN REVIEW

ACWORTH POWER AND LIGHT COMPANY
HORIZON NUCLEAR PLANT

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1. INTRODUCTION

The control room design review (CRDR) is part of a broad effort within the industry and the Nuclear Regulatory Commission (NRC) to upgrade control rooms, emergency response facilities, and procedures. Although the CRDR is directed toward the existing control room, it is recognized that other areas of concern, such as the design of a Safety Parameter Display System (SPDS) and the inclusion of post-accident monitoring (PAM) instrumentation, will be coordinated with the CRDR.

Guidance for the CRDR and related activities has been provided by the NRC in the form of various NUREGs and Regulatory Guides. While there are differences between utility industry and NRC positions on some of the specific criteria in these documents, the basic objectives are worthwhile. However, a CRDR implementation plan oriented only toward meeting the detailed criteria of NRC guidance documents does not guarantee an adequate or coordinated approach to improving control room operability and plant safety.

The purpose of this implementation plan is to describe the manner in which Acworth Power and Light Company (APLC) intends to conduct a review of the Horizon Nuclear Plant (HNP) control room. APLC does not intend to wait for NRC approval of this implementation plan before commencing the review. However, APLC expects that any major deficiencies in the plan noted by the NRC staff will be brought to APLC's attention in a timely manner.

A second function of this implementation plan is to provide a basis upon which to judge that an adequate CRDR will indeed be conducted. It is intended that any audit of APLC's CRDR by NRC personnel or contractors will use this implementation plan as its reference document and that the criteria for

completeness and adequacy will be taken from this document and supporting Horizon Nuclear Plant CRDR procedures.

This implementation plan contains no schedule. A flowchart is included to show the relative placement of certain activities within the CRDR process. An overall schedule for the CRDR, SPDS installation, and new emergency operating procedure implementation will be submitted as required by Supplement 1 to NUREG-0737.

2. OVERVIEW

2.1 PURPOSE

The purpose of the APLC CRDR is to ensure that the HNP control room and remote shutdown panels will support operation during emergency conditions. The operator tasks required during emergencies will be based on the new emergency procedure guidelines (EPGs) when approved for implementation at HNP by the NRC staff.

2.2 OBJECTIVES

To ensure that the CRDR fulfills its stated purpose, several objectives will be met during the review. The following specific objectives are defined for the CRDR:

- o to perform a control room survey that compares the existing control room design with accepted human engineering criteria
- o to identify human engineering discrepancies (HEDs)
- o to review relevant plant operational experience using appropriate documentation and a questionnaire with follow-up operator interviews
- o to determine the input and output requirements of control room operator tasks during emergency conditions
- o to evaluate the extent and importance of any identified discrepancies
- o to formulate and implement resolutions for significant discrepancies (as judged above)
- o to ensure that the proposed resolutions do, in fact, eliminate or mitigate the discrepancies for which they are formulated without creating new discrepancies

2.3 DESCRIPTION OF CRDR ACTIVITIES

To achieve the stated objectives of the CRDR, several activities will be completed during the review. A flowchart of these activities is presented in Figure 1. This flowchart is not intended to show the start and stop times for each activity, but rather, the interrelationships of the information needed and obtained by each activity. Note that the CRDR has been split into six nominal phases: planning, execution, assessment, correction, effectiveness, and documentation. The planning phase of the CRDR is represented by this implementation plan. The documentation phase is actually concurrent with all other phases.

The activities within each phase will be described in more detail later, but a brief synopsis of these activities will help give a general picture of the review process.

2.3.1 Execution Phase

The execution phase will constitute the investigative, data gathering portion of the CRDR. During this phase, a control room survey will compare the characteristics of the existing control room with appropriate human engineering design guidelines. An examination of operating experience, both generic and plant-specific, will be conducted by a review of historical operational documents, such as plant trip reports and control room operator logs, and through questionnaires and interviews with control room operators. During the systems review, the new symptom-oriented EPGs and the plant systems called for in the EPGs will be analyzed to determine the tasks required of operators during emergencies. The instrumentation and control requirements for

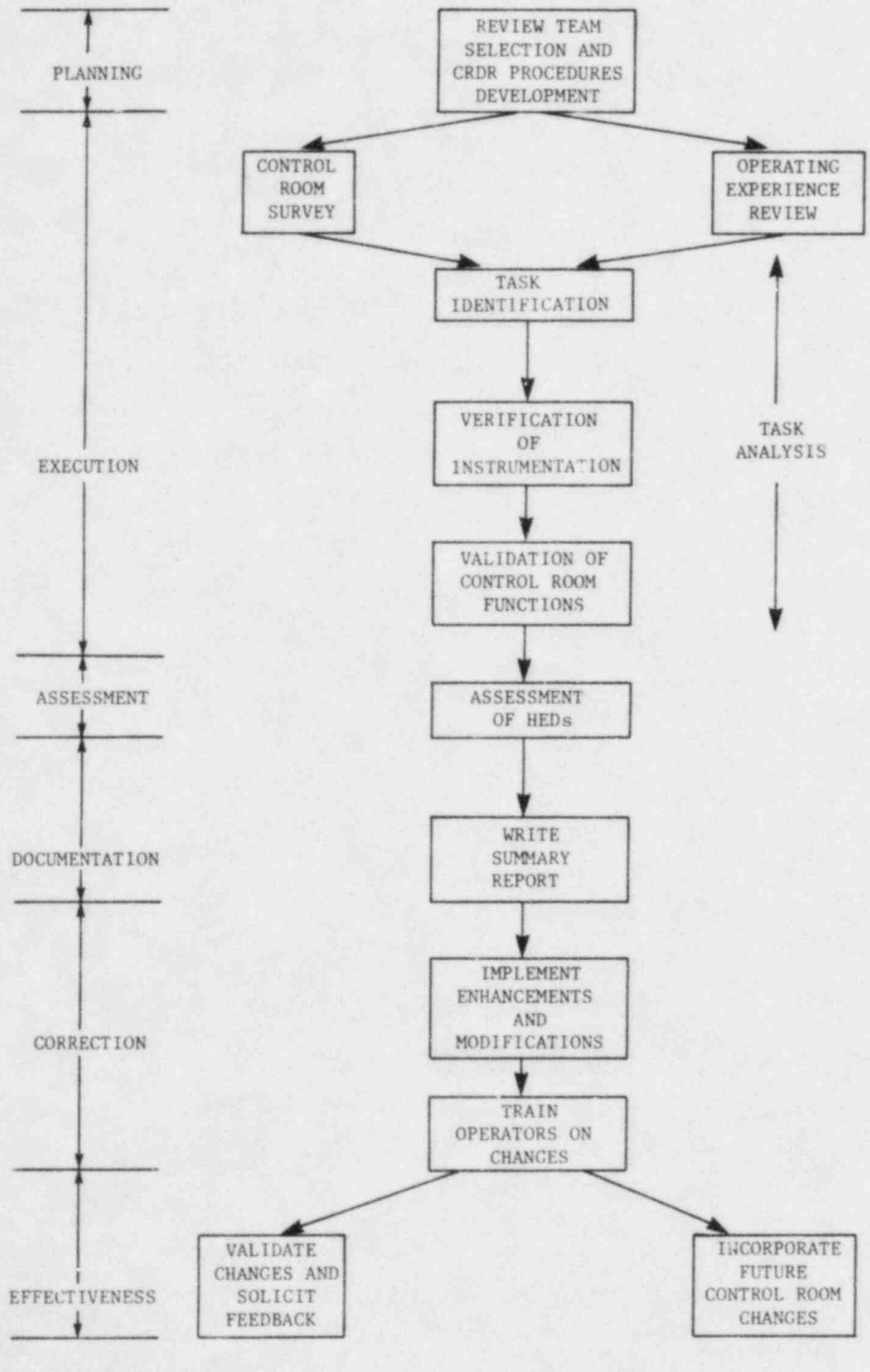

Figure 1. Schematic of Control Room Design Review Activities

those tasks will be established, and the adequacy and completeness of existing instrumentation and controls will be determined.

2.3.2 Assessment Phase

During the assessment phase, all discrepancies identified in the execution phase will be analyzed, and the potential impact of each discrepancy on emergency plant operation will be evaluated. Discrepancies will be classified according to their potential impact on emergency plant operation. Significant discrepancies will be resolved through enhancement, modification, or other means, such as changes to procedures, staffing, and training. Any actions proposed to resolve significant discrepancies will be analyzed for their effect on operation. In particular, proposed solutions that affect procedural changes will be examined thoroughly for their potential impact on related procedures.

2.3.3 Documentation Phase

A summary report will be submitted at the conclusion of the assessment phase of the CRDR that will summarize the overall review process, summarize the identified human engineering discrepancies, describe the disposition of discrepancies for which no changes were made, describe control room design improvements implemented during the course of the review, identify existing design characteristics that are beneficial, and identify proposed design improvements that were not implemented during the review and their schedules for

implementation if those schedules are known at the time the report is written. The summary report will be submitted to the NRC.

2.3.4 Correction Phase

A plant-specific plan will be developed that ensures the integration of proposed control room changes with other post-TMI programs, as well as plant operating status. A schedule will be developed for the orderly introduction of proposed changes. The schedule will take into account the required training of operators on pending changes. Administrative follow-up will be instituted to ensure the successful completion and integration of all control room changes.

2.3.5 Effectiveness Phase

A program is already in place at HNP to solicit, evaluate, and act on operational feedback concerning plant system design and plant procedures. This process will be further delineated to make certain that changes resulting from the CRDR are evaluated for their effectiveness.

2.4 DEFINITION OF TERMS

Control Room Design Review (CRDR) - 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.

Control Room Survey - One of the activities that constitutes a CRDR. The control room survey is a static verification of the control room performed by comparing the existing control room instrumentation and layout with

selected human engineering design criteria, i.e., checking the control room match to the physical capabilities and limitations of the human operator.

Critical Incident Technique - An interview technique in which job incumbents and subject matter experts (SMEs) are asked to describe situations they have witnessed where either they or someone else committed an error that led or almost led to an abnormal operational status.

Elements of a Utility CRDR Implementation Process - Necessary parts of a cohesive CRDR implementation process that a utility should consider in developing and reviewing its implementation plan and schedule.

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

Emergency Procedures Guidelines (EPGs) - Guidelines developed from system analysis of transients and accidents that provide sound technical bases for plant-specific EOPs.

Human Engineering Discrepancy (HED) - A characteristic of the existing control room that does not comply with the human engineering criteria used in the control room design review.

Human Engineering Suitability - An attribute of a system, component, or procedure that determines its compliance with the human engineering requirements of its users and the job in which it is used.

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

Operational Experience Review - One of the activities that constitutes a CRDR. The operating experience review screens plant operating documents and operator experience to discover human engineering shortcomings that have caused, or could have caused, actual operating problems in the past.

Review Team - A group of individuals responsible for directing the CRDR of a specific control room. (See Survey Team.)

Safety Parameter Display Systems (SPDS) - An aid to the control room operating crew for use in monitoring the status of critical safety functions (CSFs) that constitute the basis for plant-specific, symptom-oriented EOPs.

Subject Matter Expert (SME) - An individual who, by virtue of training and experience, possesses in-depth knowledge in a specific subject area.

Survey Team - A group of individuals responsible for conducting the control room survey. The survey team may or may not include individuals from the review team. (See Review Team.)

System Function Analysis - The determination of system functions required to meet system goals.

Task Analysis - The systematic process of identifying and examining operator tasks in order to identify conditions, instrumentation, skill, and knowledge associated with the performance of a task. In the CRDR context, task analysis is used to determine the individual tasks that must be completed to allow successful emergency operation. In addition, this activity can verify and validate the control room match of information available in the control room to the information requirements of the emergency operating tasks.

Validation - The process of determining whether the control room operating crew can perform their tasks effectively given the control room instrumentation, procedures, and training. In the CRDR context, validation implies a dynamic performance evaluation.

Verification - The process of determining whether instrumentation, controls, and other equipment exist to meet the specific requirements of the emergency tasks performed by operators. In the CRDR context, verification implies a static check of instrumentation against human engineering criteria.

3. PLANNING PHASE

3.1 CRDR MANAGEMENT REVIEW TEAM

The ultimate responsibility for the HNP CRDR will reside with the APLC vice president of nuclear operations. The day-to-day conduct of the review, however, will be the responsibility of a review team established specifically for this CRDR. The review team will provide the management oversight to ensure the integration of the project objectives and to fulfill the intent of the review. The review team is responsible for planning, scheduling, and coordinating the total, integrated CRDR. The review team will include members from APLC line organizations, consultants, and the architect/engineering firm that designed HNP.

3.2 REVIEW TEAM STRUCTURE

The review team is a multidisciplined team of individuals with the wide range of skills necessary to perform the design review. The team will include the following personnel:

- o review team leader
- o human factors specialist
- o reactor operator (or operations technical advisor with operating experience)
- o instrumentation and controls specialist
- o design engineer

The core team will be supplemented, as required, by other disciplines such as mechanical, electrical, and industrial 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 has the review team leader as its key person. This individual provides the administrative and technical direction for the project and has responsibility for the project. Access to information, facilities, and individuals providing useful or necessary input to the team is coordinated by the review team leader. Because of the detailed knowledge of HNP systems and methods, this individual provides a cohesive force for the various APLC department personnel and vendor organizations involved with this project. Plant operations personnel provide input to the review team through daily contact with the review team leader.

It will be the responsibility of the review team leader to resolve human factors opinions on methodology, technique, review findings, assessment, and HED corrective actions that dissent with the majority opinion of the CRDR Review Team. The minimum qualifications for the review team leader will include the following:

- o bachelor's level degree (or equivalent) in an engineering discipline OR
- o SRO-certification and
- o five years' experience in nuclear plant operations or engineering

3.2.2 Human Factors Specialist (HFS)

The human factors specialist will work closely with the review team throughout each phase of the control room review and share with the team the human factors technical leadership of the entire CRDR project. 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.

Minimum qualifications for human factors specialist include the following:

- o M.A. or M.S. in human engineering or related discipline
- o five years' experience in human factors, one of which is in nuclear control room review or a closely related systems area

3.2.3 Instrument and Controls (I&C) Specialist

The I&C specialist will assist in the identification of plant system design features and will serve as the review team expert on the capabilities and limitations of controls and instruments. The I&C specialist also will provide input to the team during the assessment phase of the review, especially when the review team considers proposals for mitigating HEDs.

The minimum qualifications for the I&C specialist will include the following:

- o B.S. degree (or equivalent) in engineering or applied science field
- o five years of I&C engineering experience, at least two of which are in the nuclear design area

3.2.4 Reactor Operator (RO)

At least one RO from HNP will serve as a member of the core review team. The RO will assist in identifying operator tasks and will serve as the review team expert on the operational constraints for manipulations of plant systems.

The minimum qualifications for the RO include the following:

- o a reactor operator's license at HNP
- o at least two years' experience as a licensed nuclear operator

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 the design decisions at the plant. The design engineer will provide input to the review team during the analysis of functions and tasks for any plant systems and during the assessment, implementation, and effectiveness phases of the CRDR.

The minimum qualifications for the design engineer will include the following:

- o B.S. degree in an engineering or applied science field
- o five years of design experience, at least two of which are in the nuclear design area

3.3 REVIEW TEAM ACTIVITIES

Review team activities will include developing the methodologies for the review and assessment of discrepancies, establishing the overall plan and schedule for the CRDR, 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 CRDR and ensure that appropriate reports are submitted to APLC management for review and approval.

3.4 REVIEW TEAM ORGANIZATIONAL INTERFACES

3.4.1 Line Organization Interface

In order to perform the CRDR expeditiously while utilizing and broadening the experience in our existing organizations, control room review tasks will be performed by the line organizations as often as possible. Specific tasks in the CRDR will be delegated to line organizations supplemented as necessary with technical specialists. The relationship between the review team and line organizations will be established as follows:

- o Based upon the objectives defined by the review team, the line organization will submit a plan to the review team for each assigned activity. The review team will ensure that the line activities are coordinated with and support the overall effort. This plan will address the major steps required to perform assigned activities as well as the interfaces between the line element and the review team, especially with regard to the level of detail of information exchanged, schedules, etc.

- o Elements of the line organization will be responsible for producing a final report for each assigned activity in a format approved by the review team.

- o The review team leader will have the authority to contact the appropriate manager of each line area to establish a cooperative working relationship with the line organization.

3.4.2 Corporate Interface

The review team will exist as an independent entity in the APLC corporate structure. The review team leader will report to the APLC vice president of nuclear operations. The work of the review team will not be restricted arbitrarily in any area without written justification.

It is essential that the CRDR be coordinated with other ongoing activities that involve potential physical changes to the plant, such as the construction and manning of emergency response facilities (ERFs). To ensure that such coordination takes place, the review team leader will be a part of the HNP coordination committee that oversees all ongoing work on ERFs and the control room.

3.5 REVIEW TEAM ORIENTATION

Each member of the review team will bring his or her own in-depth knowledge of specific topics to the team. It is important, however, that the review team be able to conduct the CRDR from a common basis of understanding. The entire review team will undergo an orientation program designed to provide each team member with certain basic knowledge requirements. The purpose of the orientation is to acquaint each team member with the other disciplines represented on the team, not to make each team member an expert in all specialties.

The orientation program will consist of the following minimum instructional areas:

- o Human Factors - Orientation provided for the review team will familiarize the team with principles of human factors and their application to the control room review. Included in this area will be a brief

synopsis of the history of the CRDR requirement and its ultimate goals. This orientation area will be slanted toward those review team members with little or no background in human engineering.

- Plant Familiarization - The review team members will receive approximately one week of plant familiarization. This orientation will consist of observing normal plant operation and the use of emergency procedures. Some of this orientation may take place at the plant, and some will take place on the simulator used to train the HNP operators. Since APLC does not maintain its own simulator, APLC will try to reserve time on the Sunrise Plant Simulator for this purpose. The Sunrise Plant is similar but not identical to HNP.

- Miscellaneous - During the course of the review, other areas requiring orientation will be identified and obtained to meet the needs.

3.6 USE OF CONSULTANTS

Some of the skills required during certain review activities may not be represented within APLC and may be contracted. For example, APLC may contract with an appropriate consulting firm to obtain additional skilled interviewers for the control room operator interviews.

It is envisioned that the human factors specialist will be used part-time during the development of the CRDR methodology and procedures. After this activity is complete, this human factors individual will be retained on an "as-needed" basis as indicated in the remainder of this plan.

4. EXECUTION PHASE

The objective of the APLC CRDR is to determine the extent to which the HNP control room provides the operators with sufficient information to complete their required functions and task responsibilities efficiently under emergency conditions. The review also will determine the human engineering suitability of the designs of the instrumentation and equipment in the HNP control room. This section of the implementation plan describes the process that will be used to accomplish those overall objectives.

4.1 OPERATING EXPERIENCE REVIEW

The Horizon Nuclear Plant is a one-unit Westinghouse pressurized water reactor (PWR) designed in the late 1960s. The plant has been operating commercially since 1974 with no unplanned major outages. The unit is a four-loop, high-head design with a net electrical output of 765 MW. With such a relatively long operating history, the experience of operational personnel and data from plant operation documents should be a rich source of information for the CRDR.

The review of operating experience should provide information on potential problem areas in the control room by studying actual occurrences (and near misses) in the plant. Two separate steps are involved in reviewing operating experience. The first is to review available and applicable historical documentation pertaining to plant-specific and generic occurrences. The second step is to survey operating personnel. Operating personnel surveys should identify specific problem areas in the HNP control room and, in particular, should point out problems that occur in normal operation.

4.1.1 Historical Documentation Review

Since APLC is most concerned with events that have occurred at HNP, the major portion of the documentation review will involve plant-specific documents. Two applicable plant documents that will be examined are the plant trip reports (PTRs) and plant significant event reports (PSERs). A plant trip report is filed each time either the turbine or reactor is tripped by an automatic system <u>or</u> by control room operators. They will be examined for instances of incorrect control room operation that may have led to a plant trip or turbine trip.

PSERs are required whenever significant personnel injury, radiation exposure, or equipment damage is caused by some operating event. PSERs are also required when an error is committed that, in the opinion of the shift supervisor or plant manager, might have led to personnel injury, exposure, or equipment damage.

It is recognized that documentation originating elsewhere in the industry should be reviewed to ascertain whether or not generic problems have been found that might relate to HNP. A mechanism exists at HNP for reviewing all Significant Operating Experience Reports (SOERs) and Significant Event Reports (SERs) distributed by the Institute of Nuclear Power Operations (INPO). These reports are screened routinely for applicability to HNP systems.

The final generic documentation to be reviewed will be Licensee Event Reports (LERs) from HNP and plants of the same design vintage and vendor type as HNP. Since INPO maintains a complete LER data base, they will be requested to provide APLC with a printout of LERs sorted using the following characteristics:

LERs from:	Westinghouse PWR
Designed from:	1960 thru 1975
Listing errors by:	licensed operators
Involving either:	human error or procedural deficiency

The CRDR team leader, with the assistance of a human factors specialist, will review the PTR, PSER, and appropriate SOER and SER reports from the most recent three-year period and the LER Summary. Copies of those involving control room operator, procedural, and/or control board equipment failure and/or design arrangement errors will be obtained. The reports obtained will be screened by a human factors specialist with the assistance of an operations subject matter expert (SME) to determine if the report describes and documents a control room problem. A control room problem is defined as one that meets one or more of the following criteria:

- o Equipment referenced (valve/pump controls, displays, indicators, etc.) must be in the physical confines of the control room or remote shutdown panel.

- o Procedure steps referenced should be accomplished within the physical confines of the control room or remote shutdown panel.

- Personnel error referenced must have occurred in the control room on equipment in the control room or remote shutdown panel or entailed a deviation from procedures that were to be accomplished in the control room or remote shutdown panel.

  Reports that pass the above selection criteria will be retained for further analysis.

4.1.2 Operating Personnel Survey

Probably the most valuable source of data on operational problems is the person who has operated the plant. The intent of the operating personnel survey is to gain as much firsthand information as possible on actual and potential operational errors. The survey will consist of a self-administered questionnaire and a follow-up structured interview.

4.1.2.1 Questionnaire

An open-ended, self-administered questionnaire approach will be adopted. APLC feels that by employing this method, most of the operating personnel can be questioned and that this maximizes the use of their time and that of the human factors specialists. The survey will cover 10 content-topics. Specifically, the areas covered will be as follows:

- workspace layout and environment
- panel design
- annunciator warning system
- communications
- process computers

- corrective and preventive maintenance
- procedures
- staffing and job design
- training
- other areas for operator comment

The questionnaire orientation will be predominantly along the lines of the Critical Incident Technique. As much as possible, the questions will be formulated to meet the following criteria:

- Simplicity - Questions will be direct, employ common, everyday language, and be as brief as possible.

- Clarity - Questions will be unambiguous so that the response received will be unbiased and accurate.

- Objectivity - Questions will not provoke subjectivity and will be free of emotionally charged words such as good/ bad, strong/weak, horrible/horrendous, stupid/ marvelous, etc.

- Error Free - Surveys are susceptible to social desirability, leniency, central tendency, and halo-effect errors. Questionnaire items will have the minimum tendency toward these types.

As the questionnaire is being compiled, a cover letter to be attached to each questionnaire will be prepared. The cover letter will (1) explain the purpose, (2) describe the questionnaire and provide instructions, (3) ensure respondent confidentiality, (4) convey what will be done with the results, and (5) request biographical information. A preliminary draft of the questionnaire and cover letter is included as Attachment 1.

Questionnaires will be given to non-licensed operations personnel, licensed operations personnel, licensed non-operations personnel and licensed/certified simulator instructors early in the CRDR process. At the time of distribution, the questionnaire recipients will receive a briefing by the station assistant superintendent for operations, or designee, and the CRDR team leader. The briefing will emphasize the major elements discussed in the cover letter. Respondents will be instructed to return the completed questionnaire in the envelope provided within two weeks after distribution.

After the questionnaires have been completed, retrieved, and logged in, they will be examined and reviewed on an item-by-item basis. Responses will be summarized on a Questionnaire Item Summary Form (QISF) (A-93).

It is anticipated that both positive and negative control room features will be identified by the respondents. Further investigation, therefore, will be carried out for each item on the responses to determine whether they are in accordance with sound human engineering conventions and practices. Positive responses that are in accordance with sound human engineering conventions and practices will be recorded and disseminated to every member of the CRDR team for consideration in subsequent review processes (e.g., as possible recommendations for corrective action to HEDs). Negative responses will be investigated further in the interviews and in other phases of the CRDR.

The biographical information collected in the questionnaire cover letters will be summed and averaged to provide the review team with an indication of the demographics of the population upon which the survey response data is predicated. This information will be recorded on the Personnel Demographic Summary Form (PDSF) (A-94) and will be submitted as part of the final CRDR report.

4.1.2.2 Follow-up interviews

There are several suitable methods to obtain detailed operator comments. APLC will use one such method--

structured interviews. As the name suggests, structured interviews are conducted according to a pre-designed outline. The outline may even have specific questions that should be answered during the interview. A structured interview helps to reduce the variability of interview results caused by asking different questions of each interviewee or by allowing the interview topics to appear more or less randomly during the interview. Structured interviews will be developed to obtain more detailed information in areas of control room design that prompted negative questionnaire responses. The interview outline also will allow detailed follow-up in areas of general interest to the review team.

This particular activity will be assigned to contract personnel instead of APLC review team or line organization persons. There are two principal reasons for contracting this activity. First, APLC does not maintain a staff of individuals proficient in interview techniques. Although some departments within the company do use interviews, e.g., personnel, the particular techniques used in operator interviewing are sufficiently unique to warrant using outside help.

The second reason for using contract people for the operator interviews is

the belief that the amount and quality of the information from the interviews will be greater if no APLC management representative is present during the interviews. It is not the intent of APLC to use any interview information punitively. However, it may be difficult to convince the control room operators to be completely frank and open with management present.

While a contractor will be used to conduct operator interviews, it is essential that the interview team have experience in a control room environment. Unless such experience is present, the importance of certain responses might be missed by the interviewer. Also, responses might lead an experienced individual to probe deeper in specific areas seemingly unrelated to the response. Therefore, an outside SME with control room experience will be provided to assist the interviewers.

Interviews will be conducted using a structured technique that helps ensure all important areas will be addressed. The structure will be flexible enough to allow added emphasis on certain topics if necessary. The operating personnel to be interviewed will be selected on a random basis from each

shift. At least 50 percent of all licensed operators at HNP will be interviewed.

4.1.3 Personnel Assignments

The personnel requirements for the operating experience review are noted in the description of each activity. The requirements will be summarized here for clarity.

For the historical documentation review, the CRDR team leader and a human factors specialist from the review team will be responsible for the initial document screening. They may use additional people if, in their opinion, they require expertise in any area beyond their own specialties. Distribution of the personnel survey questionnaires will be the responsibility of the CRDR team leader and the assistant station superintendent. The returned questionnaires will be examined by a committee of review team members designated by the CRDR team leader. The questionnaire committee will include a human factors specialist and will be responsible for summarizing and categorizing questionnaire responses. Some of these responses will be distributed to the entire review team as described in Section 4.1.2.1.

The follow-up interviews will be conducted entirely by contract personnel who then will summarize the interview responses for the review team's use.

4.2 CONTROL ROOM SURVEY

A survey of the existing HNP control room will be conducted during the CRDR. The purpose of the survey will

be to compare the design features of the existing control room with applicable human engineering design guidelines. The survey will be conducted by a CRDR survey team, to be described later, approved by the review team leader. The survey team will use questionnaires, checklists, and surveys to compile information regarding the as-built characteristics of the HNP control room.

4.2.1 Questionnaires, Checklists, and Surveys

The NUTAC on CRDR has developed a set of questionnaires, checklists, and surveys that addresses the human engineering design considerations applicable to nuclear power plant control rooms. APLC intends to use these survey instruments with as little modification as possible. These documents are included in the CRDR Survey Development Guideline, being developed by INPO and the CRDR NUTAC. The individual survey instruments are described below.

4.2.1.1 Questionnaires

There are two questionnaires among the NUTAC survey instruments: the Engineering Department Questionnaire and the Operator Questionnaire. The Engineering Department Questionnaire is designed to compile information concerning the function and optional operation of various plant systems, such as the annunciator and emergency lighting systems. This questionnaire also solicits information on the failure modes of indicators and opinions about the adequacy of certain existing system characteristics.

The purposes of the Engineering Department Questionnaire are to educate the review team concerning the design attributes of certain plant systems and to provide an engineering input for the assessment of HEDs later in the review process. The review team leader will distribute the Engineering Department Questionnaire to the APLC Design Engineering Department and to the HNP Plant Engineering Department. Each department will be requested to complete and return the questionnaires within three weeks.

The Operator Questionnaire is designed to collect information on operating personnel's experiences--good or bad--with control room characteristics. The items on the Operator Questionnaire solicit information that depends on actual operation of the controls and displays in the control room. This information is not easy to obtain using specific criteria for height, location, and scaling but depends on the interaction among control room instruments, procedures, layout, and staffing. Some of the information collected during the operating experience review is similar to that obtained with the operator questionnaires. However, the experience review solicits more general information.

The purpose of the Operator Questionnaire is to tap the operational knowledge of HNP personnel and relate that knowledge

to the human engineering characteristics of the HNP control room. It is not feasible to keep all subjective opinion out of the responses to such a questionnaire. However, the individual questions are posed as objectively as possible and, by using data from many individuals, isolated individual "pet peeves" will be weighted lightly during the analysis of the information obtained.

The review team leader will distribute the Operator Questionnaire to all licensed operators, shift supervisors, and STAs at HNP. The instructions will stipulate that the questionnaire items concerning controls, indicators, and labels should be answered on a panel-by-panel basis. A separate set of these questions will be included (and tagged) for each control board panel. It also will be stressed that the questionnaires should be completed during periods when the respondent is in or has access to the control room but does not have operating responsibility for the unit. If no such time can be found, APLC will authorize up to four hours off shift for each individual to complete the questionnaire.

Each respondent will be requested to complete the questionnaire within one month of the date it is distributed. Each respondent also will be assured that responses will never be used to

judge job performance or for any other punitive purpose.

4.2.1.2 Checklists

Five checklists are included in the NUTAC survey instruments. These are an overview checklist; operator-assisted checklist; a labeling, mimics, and demarcation checklist; a general panel checklist; and a process computer checklist. Each checklist is designed to allow one or two people to walk around the control room and determine whether individual checklist items are satisfied by the existing control room design.

The checklists are very simple to use and, except for specific items, require very little operator time. Each item in a checklist is a simple declarative sentence describing an acceptable design characteristic. For example, item two in the overview checklist states: "Sanitary Facilities and Drinking Water Are Easily Accessible." If the individual(s) using the checklist make(s) the judgement that the statement is true or correct for the control room under review, then that item is checked off, and no further action is necessary concerning the characteristic. However, if the survey team member makes the judgement that the control room is not designed to be acceptable for a particular

checklist item, an HED is written for that particular facet of the design.

Some degree of judgement is involved in various checklist items. However, the nature of these judgements is such that a commonsense approach should result in a consensus among individuals on the survey team concerning questionable items. If situations arise where two or more judgements cannot be reconciled, an HED will be written, and the dispute will be resolved by the review team, not the survey team, during the assessment phase.

As noted above, the checklist evaluation will not require extensive operator involvement. Obviously, the amount of operator time required will depend on which checklist is being used and who is evaluating the checklist. Most of the required operator input will concern the location and existence of certain procedures or equipment and the meaning of label markings. The requirements of the on-shift operators can be minimized if the survey team leader, a control room operator at HNP, evaluates the operator-assisted checklist himself. This is not absolutely necessary and will depend on other demands on the survey team leader's time.

4.2.1.3 Surveys

Eight separate surveys will be completed during the CRDR Survey Activity. The individual surveys are the following:

- General Design Convention Survey
- Design Convention Survey for Repetitive Groupings
- Lighting Survey
- Noise Survey
- Anthropometric Survey
- Communication Survey
- Abbreviation and Acronym Survey
- Color-Coding Survey

These surveys can and will be done independently. They function as a framework within which various measurements can be recorded. Some of the surveys consist of simply describing control room conventions such as color usage and instrument arrangement. The information obtained in these surveys will be used in other CRDR activities to determine where particular instruments or systems depart from the overall convention. For these surveys, in particular, operator input will be required to describe how certain controls function and the meaning assigned to particular colors. It should be noted that, in general, HEDs will not be written during convention surveys. Instead, the information obtained will be used during assessment.

Other surveys direct survey team members to measure certain physical quantities, such as illumination and sound level, and to compare these measurements to acceptable upper and lower limits for such quantities. HEDs will be written for characteristics that fall outside the acceptable band. The individuals conducting these surveys must be able to operate the appropriate measuring instruments and interpret the output properly. APLC may elect to retain outside specialists to operate the measuring equipment. If not, selected survey team members will be trained to use such equipment. Regardless of who actually makes the measurements, survey team members will be responsible for writing any HEDs resulting.

4.2.2 Personnel Assignments

It is not necessary that the CRDR review team be involved in the day-to-day conduct of the control room survey. The members of the review team will be responsible for distributing the Engineering Department and Operator Questionnaires, as described in Section 4.2.1.1. The actual survey, with its documentation requirements, will be conducted by members of various APLC line organizations. Personnel selected to conduct the survey will be designated as members of the survey team and trained to use the survey checklists and surveys properly.

The leader of the survey team will be a control room operator (CRO) from HNP Operations. Other

members will be drawn from Design, Maintenance, and Operations. At least one member of the survey team will be an outside human factors professional, hired with the recommendation of the human factors specialist. The survey team human factors person need not be a senior level professional, nor is it necessary for this individual to have extensive project-related experience.

The survey team will interact with the review team on a daily basis through the survey team leader. Thus, any clarification of checklist or survey items will be immediate and interactive.

4.3 TASK ANALYSIS

The operating experience review and the control room survey will identify as HEDs control room characteristics that have caused, or nearly caused, problems during normal operation or HEDs that do not conform to certain human engineering design criteria. The final activity in the CRDR execution phase, the task analysis, will identify the tasks operators must perform during emergency operation and determine whether the instrumentation, controls, and equipment are available to perform those tasks. In addition to determining the availability of appropriate instrumentation, controls, and equipment, the systems review will validate that the emergency tasks identified can be performed under simulated emergency conditions in the HNP control room. The task analysis will use as its basis the Emergency Response Guidelines (ERGs) developed by the Westinghouse Owners Group (WOG). These ERGs have been designed to generate plant-specific emergency operating procedures (EOPs) for Westinghouse nuclear plants. Although the HNP-specific EOPs have not yet been developed, the ERGs are specific enough to be usable if certain HNP-specific

information is supplied. An added benefit to using the ERGs is that the analysis done as part of the systems review can be applied to generating the plant-specific EOPs for HNP.

4.3.1 Task Identification

The methodology to be used in the HNP task analysis is very similar to that developed by the Tennessee Valley Authority (TVA) and INPO in a pilot project at the TVA Browns Ferry Nuclear Plant (INPO/TVA Pilot Systems Review, INPO 82-014, June 1982). Starting with specific Westinghouse ERGs, all tasks within the ERGs will be identified and analyzed to determine the instrumentation and controls required. Specifically, APLC will analyze Westinghouse optimal recovery guidelines E0, E1, E2, E3, and all six function restoration guidelines.

Beyond the ERG tasks to be analyzed, certain plant systems are referenced in the ERGs as resources to be used during emergency operation. As part of the task identification, the tasks necessary to use the plant systems, as they are required to be used in the ERGs, will be delineated. Any instruments and controls necessary to complete these tasks will be determined. It is probable that the operator tasks required for specific system operation can be determined using existing HNP documentation. Where this is not the case, any additional analysis required to determine system-specific tasks will be performed and documented.

After the required tasks are delineated and the necessary instruments and controls identified, a

two-step process will be undertaken that will (1) verify that the required instruments and controls are present in the control room and are of the appropriate range with the appropriate scales and labels and (2) validate, with dynamic walk-through-talk-throughs, that all ERG and system-specific steps can be completed in the HNP control room by the normal complement of operating personnel.

The methodology contained in the Emergency Response Capability (ERC) Nuclear Utility Task Action Committee (NUTAC) Component Verification and System Validation Guideline will be used to develop the actual validation procedures.

4.3.2 Verification of Instrumentation

The process of verifying that the HNP control room contains appropriate instruments and controls will be completed in two somewhat overlapping steps. First, a determination will be made as to whether the instrumentation and controls necessary to make the decisions and implement the tasks identified previously are, in fact, present in the control room. If not, any such instance will be defined as an HED and documented accordingly.

The second step of the verification process consists of an examination of the instrumentation and controls located in the first step (above) to determine its human engineering suitability for the task or decision it is supposed to support. Although the control room survey examined all 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 a particular ERG task or system-specific task.

4.3.3 Validation of Control Room Functions

The final analytical step in the task analysis is to validate that the tasks delineated earlier are indeed the tasks that must be performed to carry out emergency functions and that those tasks can be completed in the existing HNP control room by the normal operating crew. This evaluation will be accomplished in two phases using two different types of equipment. First, the HNP control room mock-up will be used to determine if the instrumentation called for in the ERGs is located so it can be used with the number of individuals normally on shift. Next, specific transients will be selected that will require operators to use the ERGs. These transients will be run on the Sunrise Plant Simulator, and an HNP operating crew will walk through the actions that are required by the ERGs. Both activities are described more fully below.

4.3.3.1 Walk-through using mock-up

A full-scale mock-up of the HNP control room is being built to support CRDR activities. This mock-up consists of styrofoam core material that has been built into the physical outline of the existing HNP control boards. Individual instruments and controls are presented by full-size, color photographic prints of the corresponding

instruments and controls in the real control room. The arrangement of panel sections and of the instruments and controls within each panel section is identical to the real HNP control room.

For each ERG the walk-through procedure will be the same. A complete operating crew will be assembled at the mock-up, and the crew members will take their normal positions relative to the control boards. An observation team will be assigned to lead the crew through the specific instructions in the ERG and to record crew comments and movements in response to those instructions. The crew will be encouraged to move about the mock-up just as they would move about the control room and to verbalize what they are doing, why they are doing it, and which instruments and controls they are using for each activity.

This is not a dynamic check of the adequacy of the control room layout, but it will indicate whether or not appropriate instrumentation is available in the primary control area to carry out the tasks called for in the ERGs. In addition, the instruments and controls used to operate specific plant systems can be recorded. At least two operating crews will participate in the mock-up walk-throughs. The activities

of observational personnel are described in Sections 4.3.4 and 4.3.5.

4.3.3.2 Walk-through using simulator

The mock-up walk-throughs will verify the existence and location of instruments and controls, but the HNP mock-up is not capable of altering indicators or annunciators dynamically. A dynamic validation of the operating crew's ability to carry out emergency operations in the HNP control room will be conducted at the Sunrise Plant simulator. The Sunrise and Horizon Plants are sisters with only slight differences in their control rooms. All HNP operator requalification is conducted at the Sunrise simulator. These validation runs will be conducted while one or more HNP crew is undergoing requalification training.

The transients to be run on the simulator have been chosen from the list of scenarios used by the Westinghouse Owners Group to validate their ERGs on the Callaway Nuclear Power Plant Training Simulator (<u>Summary Report - Emergency Response Guidelines Validation Program</u>, Westinghouse, WCAP-10204, September 1982). The following specific transients will be run during the simulator walk-throughs:

- o reactor trip
- o spurious SI

- anticipated transient without scram (ATWS)
- stuck open pressurizer PORV
- small break LOCA with loss of off-site power
- failed open S/G safety valve
- steam line leak inside containment
- steam generator tube rupture (SGTR) with secondary break
- SGTR with stuck open S/G PORV
- feedline break inside containment and SGTR
- loss of all feedwater
- spurious SI followed by LOCA

The SMEs who selected these particular events from the list of 37 Westinghouse scenarios included HNP senior reactor operators, Sunrise simulator instructors, and HNP nuclear safety engineers.

As with the mock-up walk-throughs, a complete operating crew will be assembled at the Sunrise simulator during their requalification training. The crew members will take their normal positions relative to the control boards. An observation team will be assigned to record the crew's movements and to note any deviations from the appropriate ERGs. If needed to gather appropriate data, two runs will be made for each transient. The first run will be made at real time so that the events in the simulator will occur in the same time frame as in the actual plant. The

second run will be made in slow time so the operating crew members can describe their actions to the observation crew and tell the observation crew which instruments are being used at any given time.

It appears that it will require about two eight-hour shifts to complete two runs for each transient. At least two requalification crews will be run through all the scenarios. The simulator walk-throughs will not be videotaped or sound recorded. This decision is based on the fact that the simulator walk-throughs will be done during the requalification training of HNP crews at the Sunrise simulator. During such training, crews from other utilities also are undergoing initial and requalification training on the Sunrise simulator. The Sunrise Training Center management feels that the equipment needed for video and sound recording in the simulator will be distracting to the crews not participating in the HNP validation. Also, the experience of other utilities that have used videotape for simulator walk-throughs is that the tapes serve mostly an archival purpose. In addition, they do not impart adequate detail for fine-grained analysis and cause distraction.

4.3.4 Data Recording and Analysis

Various data will be recorded by the members of the observation team (see Section 4.3.5) during the simulator walk-throughs. During the real time run, the movements of each crew member will be traced on a control room outline drawing by an observer. This information will be analyzed to determine the main paths between panels and panel sections and also to identify any significant need to access back panel indications or controls. In addition to crew movements, observers will trace the path of the crew through the appropriate ERGs and plant systems. Notations will be made of significant communication links used during each transient and any instances of crew member conflict (either physical access problems or communication problems) will be noted.

During the slow time run of each transient, the observation team will question the operating crew concerning the instrumentation they are using at any point in time and their strategy for dealing with the particular transient. This information will be cross-checked with similar information from the mock-up walk-throughs and any obvious discrepancies noted.

The review team will use the output from the mock-up and simulator walk-throughs to determine if HEDs were manifested due to the layout of the control room and the dynamic interaction of the operating crew during emergency operation.

4.3.5 Personnel Assignments

The task identification described in Section 4.3.1 is characterized by extensive analysis of

ERGs and emergency resource systems before any walk-through validation is done. The analysis of system function and operator tasks is just the type of multidisciplinary activity that the review team is designed to handle. With representatives from design, operations, procedures, and human factors, the review team will have all the expertise required to perform such a pre-analysis.

After the pre-analysis is complete, the mock-up and simulator walk-throughs will require the intermittent participation of certain review team members. The CRDR team leader will be responsible for scheduling crews to run through the selected ERGs in the mock-up and for scheduling both crew and simulator time during requalification for transient runs in the Sunrise simulator.

A group of trained observers will be required for the walk-through activities, although the number of people in this group will change, depending on whether the mock-up or the simulator is being used. For the dynamic simulator validation, each crew member will be tracked by a separate observer, whereas the mock-up walk-throughs will not be as time-critical. Specific expertise will be required to determine the human factors suitability of instruments and controls used by the operators during the walk-throughs. The review team will have at least one human factors specialist, and some of the additional personnel involved in the walk-through validations will be hired on a contract basis from an outside consultant.

5. ASSESSMENT PHASE

5.1 OBJECTIVES

The objectives of this phase of the CRDR are as follows:

- o Evaluate the significance of the HEDs defined in the previous phases of the CRDR.

- o Where HEDs are found to be of minor significance, describe the technical and operational basis for such a finding.

- o Where HEDs are found to be of potentially major significance, formulate changes to the control room, procedures, operator training, or any combination thereof to mitigate those HEDs.

Of these objectives, the most conceptually difficult is to evaluate HED significance. A fairly straightforward set of criteria for HED evaluation is described in the next section.

5.2 EVALUATION CRITERIA

Human engineering discrepancies found during the control room survey, the operating experience review, and the task analysis will be evaluated by the review team for their potential to affect emergency operation adversely. A categorization scheme will be used that requires each HED to be assessed by the review team and prioritized for resolution. The following four categories are designed to be unique so a consensus can be obtained from the review team as to which category each HED should be assigned.

- o Category 1 (Highest Priority) - HEDs that are judged likely to affect adversely the management of

emergency conditions by control room operators. Most of the HEDs placed in this category probably will be found during the systems review and may be supported by the results of the survey and operating experience review.

- Category 2 - HEDs that are known to have caused problems during normal operation. The HEDs placed in this category will emerge during operator interviews and reviews of incident reports. Some support may come from the control room survey.

- Category 3 - HEDs that can be "fixed" with simple and inexpensive enhancements, so-called "paint, tape, and label" (PTL) fixes. This may seem to be an implementation rather than an assessment category. However, there probably will be HEDs that the review team feels are very easy to fix but difficult to assess as to effect on emergency operation. This category is for such HEDs.

- Category 4 (Lowest Priority) - HEDs that do not fit into Categories 1 through 3. These HEDs are judged by the review team as unlikely to affect emergency operation, not documented as causing problems during normal operation, and not simple or cheap to fix.

The precise method to be used to put HEDs into these categories has not been delineated. It is envisioned that comparing HEDs to higher level principles, such as those listed in the CRDR NUTAC document Human Engineering Principles for Control Room Design Review, will help determine which HEDs are likely to result in actual performance problems. Those HEDs that are likely to affect performance will be further categorized as described above.

Any review team member who feels strongly that an HED has been assessed with a too low priority will be able to put that opinion in writing and have the written statement included in the permanent record of the CRDR.

5.3 RESOLUTION OF HEDS

One of the final responsibilities of the review team will be to propose solutions to the HEDs that have been identified and categorized. There are, in general, many ways to solve specific human engineering problems. In some cases, a change in training or procedures may suffice, although this solution is sometimes overused and inadequate to address the root causes of a particular problem.

If it is determined that the correction must involve movement, modification, addition, or deletion of instrumentation, then these corrections will be evaluated with respect to their impact on the existing control room, including operator performance, training, and procedures. Before any large-scale changes are approved, the proposed modifications will be built into the existing mock-up of the affected panel section and evaluated to determine their effectiveness. Before any changes are made, even small-scale changes, a review by operations personnel will be obtained.

Criteria related to several characteristics will be used by the review team when evaluating candidate proposals for HED correction. At least the following characteristics of each proposal will be considered:

- o impact on operating effectiveness
- o system safety
- o cost

- impact on plant availability
- consistency with existing features
- compliance with regulatory design requirements
- impact on control room staffing
- impact on operator training programs

6. DOCUMENTATION PHASE

The importance of data management before, during, and after the CRDR cannot be overemphasized. Adequate documentation and document control creates a traceable and systematic translation of information from one phase of the CRDR to the next. It is mandatory that the CRDR team have immediate access to a complete, up-to-date library of documents to provide the following:

- o a support base to manage and execute the various steps and phases of the control room reviews
- o a design data base from which future control room modifications may be drawn

Therefore, a data base library will be established to ensure the success of the CRDR process.

This section describes the functional requirements that will be fulfilled by the documentation system APLC will use to support its control room design review.

6.1 GENERAL DOCUMENTATION REQUIREMENTS

Many documents will be referenced and produced during the CRDR project.

The documentation system will meet the following requirements:

- o provide a record of all documents used by the review team as references during various phases of the CRDR
- o provide a record of all correspondence generated or received by the review team during the review
- o provide a record of all documents produced by the review team as project output
- o allow an audit path to be generated through the project documentation

- retain project files in a manner that allows future access to help determine the effects of control room changes proposed in the future

6.2 REFERENCES

The following documents have been identified as possible reference material to be used during the review project. As the review progresses, it is anticipated that additional material and references will be identified.

- Horizon Nuclear Plant Final Safety Analysis Report
- Westinghouse Emergency Response Guidelines (ERGs)
- Regulatory Guides (e.g., RG 1.97 and RG 1.47)
- NRC guidance documents (e.g., NUREG-0700)
- APLC training documents
- control room drawings (floor plan, panel layout, etc.)
- control room photographs (panel photographs, etc.)
- human factors design information
  - Van Cott & Kinkade
  - McCormick
  - MIL-STD-1472C
- existing system descriptions
- piping and instrumentation diagrams (P&IDs)
- operating training materials
- computer software descriptions
- results of preliminary control room review activities
- instrument tabulations
- annunciator and label engraving lists
- INPO/TVA Pilot Systems Review (INPO 82-014)
- CRDR NUTAC documents
- APLC abbreviation and acronym list

6.3 REVIEW DOCUMENTATION

Throughout the review process, documents will be processed to record data, analyses, and findings. Whenever practical and appropriate, standard forms will be

developed and used. The bulk of the documentation generated by the review process will be necessary to do the following:

- o document the criteria used for each review activity
- o record the results of the survey, operating experience review, and systems review
- o compile HEDs and associated data for review and assessment

In order to facilitate systematizing and recording control room design review activities, APLC has developed several standard forms. These forms appear as samples in Attachment 2. Page numbers appear in parentheses.

- o Operating Experience Review Problem Analysis Report (A-89)
- o Human Engineering Discrepancy Record (A-90)
- o Questionnaire Item Summary Form (A-93)
- o Personnel Demographic Summary Form (A-94)

Any or all of these forms may be revised based on the experience gained during the CRDR.

6.4 SUMMARY REPORT

Upon completion of the CRDR, a summary of the results will be prepared and submitted to the NRC for review. The summary report will describe the results of the CRDR and will be submitted within six months after completion of the review. This report will summarize the review process, provide descriptions of the identified human engineering discrepancies (HEDs), detail proposed corrective actions and present implementation schedules for each action. Details of the CRDR, along with complete documentation, will be available for NRC evaluation and review.

The final report will specify the personnel who participated in the Control Room Design Review and delineate their qualifications. It also will indicate any modifications or revisions made to the implementation plan submitted to the NRC. These may become necessary periodically throughout the CRDR and will be described by the review team in the report.

A summary of the Operating Experience Review processes and results will be contained in the final report. The types of historical reports reviewed and the period of time they covered will be provided. The experience levels of the surveyed operators as well as the procedures used to conduct the survey will be summarized.

The final report for the CRDR will provide a summary of processes involved in the system function review and task analysis and will contain the following:

- o charts or list of major systems and subsystems, and their major components
- o task descriptors, organized by system

Data management procedures used to record review data and provide a data base for the system review will be described.

Samples of forms used in the control room survey will be provided. Procedures used for verification of task performance capabilities and validation of control room functions will be summarized.

Findings of the CRDR will be organized according to chapter headings that correspond to major topics in this plan. Each chapter heading will describe identified discrepancies and potential safety consequences and will identify the proposed corrective action. Details of the

assessment procedure used in this process will be summarized and supporting documentation provided. Changes that do not provide a full and complete correction of an identified HED or decisions to allow a discrepancy (which was assessed to be corrected) to remain will be justified, and information pertinent to such decisions will be provided. Identified design improvements, whether safety-related or not, will be described.

The summary report will address findings at the individual control room system level based on the the control room survey or task analyses. Further discussion will be directed to review findings and solutions identified during the operating experience review, task performance capability verification, and operating crew function validation. A copy of the Operations Personnel Questionnaire used to collect the personnel data, as well as copies of other pertinent forms, will be contained in the appendixes.

Implemented or proposed design solutions and implementation schedules will be described. Such scheduling will be governed by priorities, and any departure from this prioritization will be explained. This tentative implementation schedule will include a plan to ensure adequate review of planned improvement. Any deviation from the proposed CRDR methodology described herein will be discussed and appropriate explanation provided.

7. CORRECTION PHASE

The actions required to resolve significant HEDs will vary, as will the time required to complete proposed changes. It is essential, however, to set some end point for completing the proposed changes for each HED category.

7.1 SCHEDULING

The following schedule will become goals for APLC when planning the activities appropriate to resolve significant HEDs.

Category	Completion
1	As soon as practical after a specific solution has been approved by APLC management. No later than one year after such approval.
2	No specific completion date. Corrective action will be based on economic judgement.
3	As soon as practical. No later than first refueling outage after the review.
4	No specific completion date.

It should be recognized that these completion dates are goals and that some changes may still be pending after these dates. APLC will make all reasonable efforts to meet these goals.

7.2 IMPLEMENTATION

Modifications required to resolve significant HEDs will be implemented through the existing station modification process. The station modification process is described by the Administrative Policy Manual for Nuclear Stations in the Production Department and by the Quality Assurance Program in the Design Engineering Department.

Since the station modification process for selected HEDs may take a considerable amount of time for implementation, the implementation and follow-up activities will rely upon normal line organizations both at the station and in the General Office. Therefore, it is imperative that the HED(s) and the resulting modification request(s) are very explicit as to what is to be done.

The use of existing station modification procedures ensures that plant operators will be made aware of impending changes and will be trained to use the modified control panels and systems, since the current station modification process is to involve the HNP training department in the early stages of the modification.

This approach to the implementation of changes will help ensure the success of the modifications and will give the line organization a tool for developing their techniques for long-term support of the control room.

8. EFFECTIVENESS PHASE

During the correction phase of the CRDR, proposed modifications and enhancements were evaluated for their effectiveness in solving the deficiencies that prompted them. However, no feasible evaluation method can account beforehand for all the circumstances encountered during actual operation. Recognizing the need for operational feedback on the usability of control room changes resulting from the CRDR, APLC will further delineate an operational feedback path that already exists at HNP.

8.1 VALIDATION OF CHANGES

The validation of control room changes will be accomplished using two different methods. First, after changes are installed and have been operational for approximately 60 days, the review team from the CRDR will inspect the control room to ensure that, as installed, the changes accurately reflect their original recommendations regarding particular HEDs. If the review team consensus is that any or all of the installed changes do not meet the intent of their recommendations or for some other reason do not mitigate the HEDs for which they were designed, the review team leader will report those findings. This report will be sent directly to the APLC vice president of nuclear operations.

Each installed change will be placed in one or more of four categories by the review team. These categories are as follows:

- o The change reflects the intent of the recommendation and appears to mitigate the associated HED(s).

- o The change reflects the intent of the recommendation, but the problem associated with the HED(s) appears to still be present.

- o The change does not reflect the intent of the recommendation.

- o The change has created an HED other than the HED that prompted the change.

Any HED still present after the changes or created by the changes will be treated as a problem reported during operation (see below), and it will be evaluated by the plant engineering staff (see next section).

The second method to be used to validate control room changes is the operational feedback program (OFP) now used at HNP with one slight modification. As it is implemented currently, the APLC OFP is a non-punitive method to gather feedback on the operational characteristics of the HNP. All plant personnel are encouraged to submit their observations in writing regarding real or potential problems encountered during operation. This is done by completing a pre-printed form and placing it in one of a number of special locked containers in the various break areas of the plant. All plant personnel are encouraged to complete the OFP forms in enough detail to define the problem as they perceive it.

The only identification required on the forms is the individual's general job specialty, e.g., operations, instrument maintenance. Other than that, the forms are submitted anonymously.

All OFP forms are collected on a biweekly basis by a representative of the vice president for nuclear operations. The OFP forms are typed in the vice president's office, and the originals are destroyed to prevent using an individual's handwriting to trace the report. One copy is given to the supervisor of the specialty referenced in the report, and one copy goes to the manager of plant engineering. The affected supervisor must respond to the vice president within 30 days describing his interpretation of the report and what, if any, action is contemplated concerning the potential problem.

This system functions quite well, especially for discovering operational problems in the control room. For the changes implemented as a result of the CRDR, all control room operations personnel will be asked to pay particular attention to the operational characteristics of those changes. In addition to the standard OFP forms, an additional summary form listing the changes will be made available to allow any of the changes to be flagged for attention. From that point, the reported problems will be treated just like other OFP reports.

8.2 FUTURE CONTROL ROOM CHANGES

In order to ensure adequate human factors considerations for control room changes that are considered after the CRDR is completed, a group will be established within the plant engineering department to integrate all such changes. To evaluate the human factors acceptability of all proposed control room modifications, the integration group will adopt criteria, procedures, and controls similar to those used during the CRDR. Any proposed control room change will have to be examined by the integration group and approved by them before such change can be implemented.

The control room basis, or current configuration, will be reflected in a detailed mock-up to be maintained at the HNP site by the plant engineering integration group. This mock-up will provide a tool for the integration group to use when evaluating proposed control room changes before the changes are actually implemented.

9. COORDINATION WITH OTHER ACTIVITIES

The CRDR process described in this implementation plan will be coordinated with other post-TMI activities in several ways. These activities include the following:

- o upgrading emergency operating procedures
- o upgrading emergency response facilities, including the development and installation of an SPDS
- o installation of post-accident monitoring instrumentation (RG 1.97)

The systems review portion of the CRDR will use the new Westinghouse ERGs as its starting point. Thus, the task of upgrading emergency procedures is inherently integrated into the CRDR.

The integration of the SPDS into the CRDR is a bit more problematic since APLC already has issued a bid specification for the SPDS computer and cathode ray tube (CRT) display terminals. However, the system that will be purchased will be very powerful and flexible. It is the intent of APLC to use the task analysis phase of the CRDR to define the operator information requirements during conditions of emergency operation. These requirements will define many of the plant inputs to the SPDS and the display format for the CRTs.

It is anticipated that some HEDs defined during the review and judged to be significant by the review team may be resolved by incorporating certain features into the SPDS and associated displays. This will serve to further integrate the SPDS into the CRDR.

The coordination of these activities was described in the schedule submitted to the NRC as part of Supplement 1 to NUREG-0737.

10. ACCEPTANCE CRITERIA

This implementation plan was developed to describe the process whereby APLC will conduct the human factors review of the HNP control room. A sincere effort has been made by APLC to ensure that all major aspects of an effective CRDR have been considered during the development of this implementation plan. Since APLC is committed to perform their CRDR as described in this document, the acceptability of the CRDR also should also be judged against this document and supporting procedures.

ATTACHMENT 1

PRELIMINARY OPERATING EXPERIENCE
REVIEW QUESTIONNAIRE
AND
COVER LETTER

OPERATING EXPERIENCE QUESTIONNAIRE

The purpose of this questionnaire is to help APLC determine which characteristics of the HNP control room you find helpful in your job and which characteristics, if any, have caused you problems. Your input is essential if we are to find and correct aspects of the control room that have caused actual operating problems. This questionnaire, as well as the other control room review activities, is not in any way meant to judge your ability to do your job. Your name will not appear anywhere on this questionnaire unless you want to write it somewhere.

The first sheet of the questionnaire asks for some biographical and physical information about you. This information will be used only in the aggregate to characterize the group of individuals responding to the questionnaire. The front page will be separated from the rest of the questionnaire so there will be no chance of anyone associating an individual to a particular response. Your supervisor will not see individual questionnaire responses, only summaries of responses to each item.

Thank you in advance for your input and for your patience during the control room review process.

BIOGRAPHICAL AND PHYSICAL DATA

JOB TITLE: DATE:

EDUCATION: (Include High School and Technical Schools)

PRIOR POSITIONS HELD: (Include Positions Held With Other Utilities)

ESTIMATED TOTAL YEARS OF EXPERIENCE: ______________

AGE: ___________ HEIGHT: ___________ WEIGHT: ___________

SEX: ___________ MARITAL STATUS: ________________________

DO YOU WEAR CORRECTIVE LENSES? ______________
IF "YES," MOST OF THE TIME OR JUST FOR READING? (Please Circle)

INSTRUCTIONS

The following questions are grouped into 10 content areas. Specifically, the areas to be covered are the following:

- o workspace layout and environment
- o panel design
- o annunciator system
- o communications
- o process computers
- o corrective and preventive maintenance
- o procedures
- o staffing
- o training
- o other

The main idea in this questionnaire is to get you to tell us two things about each topic. First, and most important, we want to know if the particular characteristic of the HNP control room has ever caused or almost caused an operation problem. Specifically, has the design led or allowed you to do something that you didn't intend to do? If so, we want you to describe one or two such incidents. If not, have you seen someone else do something wrong or misoperate a piece of equipment because of the design? We are particularly interested in incidents that caused plant transients or challenged a safety system. If equipment was misoperated, but the error was discovered quickly and corrected, we want to know that, too. Remember, we do not want names--just enough detail to identify the specific equipment and the circumstances of operation.

The second thing we would like to know is any aspect of the systems covered in a topic area that has helped you during plant operation. These might be characteristics of particular systems

that let you operate more quickly or efficiently. Perhaps there are features that let you know when a transient is eminent. If you personally do not know of any such features, have you seen someone else benefit from specific design features?

One thing to keep in mind during completion of this questionnaire is that this is an operatirg experience review. If you do not have firsthand knowledge of occurrences in an area, just state that fact and go on with the next topic. We understand that this is a fairly tedious task, but we want to assure you that we will do something about control room features that have caused or nearly caused operational problems at HNP. Thank you in advance for helping us make HNP a better place to work.

NOTE - The following questions are listed in a format designed to minimize space requirements. The actual questionnaires will contain no more than two questions per page, single-sided.

WORK SPACE LAYOUT AND ENVIRONMENT

1. Has the layout of the control panels in the control room ever caused you or someone you have seen to either misoperate or be unable to operate any plant system? If so, please describe. This question refers only to the placement of the panels themselves, not to the arrangement of controls and displays on the panels.

2. Is there some aspect of the panel layout that helps you operate particular systems or the plant in general? Please describe.

3. Has the layout of control room equipment other than panels (e.g., computer console) ever caused you or someone you have seen either to misoperate or be unable to operate any plant system? If so, please describe.

4. Does the layout of control room equipment help you operate particular plant systems or the plant in general? Please describe.

5. Has the arrangement of furniture in the control room ever hindered your access to the operating area or obstructed your view of important displays? If so, please describe.

6. Does the furniture arrangement provide easy access to the operating area and allow you to see the plant instrumentation? Please describe any features that are particularly helpful.

7. Has the lighting in the control room, either normal or emergency, ever caused you or someone you have seen to either misoperate or be unable to operate any plant system? If so,

please describe. This question refers to both the level of control room lighting and to other characteristics such as glare, color, etc.

8. Is there some feature of the control room lighting that helps you operate particular systems or the plant in general? Please describe.

9. Has the noise level in the control room ever caused missed verbal communication or misinterpretation of instructions between you and other members of the operating staff? If so, please describe. This question refers both to the ambient (plant) noise and to the noise caused by alarms, phones, etc.

10. Has the temperature and/or humidity in the control room ever reached a level, either high or low, at which you were very uncomfortable? Please describe.

11. Has the temperature/humidity ever reached the level, either high or low, that control room instrumentation or equipment malfunctioned? Please describe.

PANEL DESIGN

1. Has the layout of controls and displays on any particular panel(s) ever caused you or someone you have seen to misoperate any plant system? If so, please describe.

2. Does the layout of controls and displays on any panel(s) help you operate particular systems or the plant in general? Please describe.

3. Have you ever activated a piece of plant equipment by accidentally bumping a control that is placed in a precarious location? If so, please describe.

4. Have you ever had to leave the main operating area to activate a control or read a display during an emergency or time-critical situation? If so, please describe. This question refers mainly to back panel controls and indicators.

5. Have you ever had to put temporary labels, Dymo tape, grease pencil markings, or other clarification on a control room panel to make systems easier to operate and understand? If so, please describe.

ANNUNCIATORS

1. Has the layout or operation of the annunciator system ever caused you or someone you have seen to misoperate any plant system? Please describe.

2. Has the layout or operation of the annunciator system ever misled you as to what is happening in the plant? If so, please describe.

3. Are there any features of the annunciator system that you find helpful for plant operation or for diagnosing off-normal occurrences? Please describe.

4. In general, have you used the information supplied by the annunciator system more for normal, abnormal, or emergency operation?

5. Are there any annunciators that you consider essential for operating during emergency or post-trip conditions? If so, please list them.

COMMUNICATIONS

1. Has the plant communication system ever caused you or someone you have seen to misoperate any plant system? If so, please describe. This question refers to the telephones, sound-powered phones, walkie-talkies, and PA system in the plant.

2. Is there any feature of the communication system that helps you operate a particular system or the plant in general? Please describe.

3. Has the use of the communication system ever caused control room instrumentation to operate improperly (e.g., nuclear instrumentation picking up walkie-talkie signals)? If so, please describe.

4. Is there any general problem with the plant communication system that degrades its usefulness during plant operation (for example, absence of a protocol requiring walkie-talkie users to identify themselves)? If so, please describe.

PLANT COMPUTER SYSTEM

1. Has any feature of the HNP plant computer system ever caused you or someone you have seen to misoperate any plant system? If so, please describe.

2. Has the plant computer system ever misled you as to what is happening in the plant? Please describe. This question refers to computer output that is misleading because of inaccuracies, incorrect status indications, time delays, etc.

3. Is there any feature(s) of the plant computer system that you have found particularly useful during plant operation? Please describe.

4. In general, have you used the plant computer system more for normal, abnormal, or emergency operation?

5. Do you believe that you understand how the plant computer system works well enough to use the system to its potential? Please explain.

6. Although it is not absolutely required, do you think the plant computer system is necessary for normal operation? How about emergency operation?

MAINTENANCE

1. Has maintenance performed in the control room ever caused you or someone you have seen to misoperate or be unable to operate any plant system? If so, please describe. This question refers to such activities as surveillance testing, indicator light replacement, chart paper replacement, etc.

2. Has miscommunication between you or other operations people and maintenance ever caused the misoperation or unavailability of a plant system? If so, please describe.

3. Is there some feature of the HNP maintenance program that you have found helpful in operating the plant (e.g., direct accountability for clearing work orders)? If so, please describe.

4. Do you use job aids to perform the required maintenance in the control room? For example, is a special tool provided for indicator light replacement?

PROCEDURES

1. Has using a procedure ever caused you or someone you have seen to misoperate any plant system? If so, please describe.

2. Are there particular procedures that you tend to use more than others? Please list them.

3. Are the emergency procedures usable as they are now written? Please explain.

4. Has a procedure, normal or emergency, ever left you in doubt as to what your next action should be? If so, which procedure(s)?

5. Are there procedures that are particularly easy to use during normal or emergency operation? Which ones and why?

STAFFING

1. Has the number of people on duty in the control room ever caused you or someone you have seen to misoperate or be unable to operate any plant system? Please describe.

2. Has the division of responsibility in the control room ever left you in doubt as to what you should do next or who was in charge? If so, please explain.

3. Is there some feature of the control room staffing policy that helps or allows you to operate the plant more effectively than you might otherwise? If so, what?

4. In your experience, has the STA provided worthwhile input to the operations staff during transients?

5. Have you or someone you have seen ever been misled by anything the STA said? Please explain.

TRAINING

1. Has the training you received ever led you or someone you have seen to misoperate or be unable to operate any plant system? If so, please describe.

2. Has the training you received been applicable to the operating situations you have encountered? If not, please describe the deficiencies.

3. Is there some feature of the APLC training program that has been especially helpful to you during plant operation? Please describe.

4. Has your training placed too much or too little emphasis on emergency operation? Please suggest a balance between normal and emergency emphasis during training (e.g., 60/40).

5. Have there been instances when the transients you see during requalification actually occur at the plant? Please cite an example.

6. Do you feel that more practice handling transients would be beneficial for operating during such transients? Can you give an example where such practice was or would have been helpful?

ATTACHMENT 2

CRDR DATA COLLECTION FORMS

ATTACHMENT 2

CRDR DATA COLLECTION FORMS

OPERATING EXPERIENCE REVIEW

PROBLEM ANALYSIS REPORT

Name(s) of Investigator: ______________________________

Station: ______________________ Date: ______________

Unit: ______________________ Index Number: __________

Report Type and Number: ______________________________

Date of Incident: ______________________________

Unit Operating Status: ______________________________

Documented Problem: ______________________________

____

Sequence of Events: ______________________________

____

____

____

Effect on Unit: Unit Derated ____ hrs. Unit Shutdown ____

Unit Trip (Scram) ____ hrs.

Corrective Actions Taken or Proposed: ______________

____

____

____

Subsequent Action Taken of a "Corrective" Nature: __________

____

____

____

Problem Identified and Corrected: Yes ____ No ____

Control Room Human Engineering Discrepancy Index/Log

Number: ________

HUMAN ENGINEERING DISCREPANCY RECORD

No: __________ Plant Unit: ____________________ Date: _________

Reviewer Name: ____

a) HED title: ____

____

____

b) Items Involved:

Item Type	Nomenclature	Location	Photo No.

____

c) Problem descriptions (guidelines violated):

d) Specific operator error(s) that could result from HED:

e) List the procedures or operations that use the listed items in a manner to induce the operator error:

f) List the consequences of operator error during all modes of operation:

g) Suggestions for potential backfits:

	Name	Date
Reviewer ____________________	__________	__________
Data Coll. Mgr. ____________	__________	__________
HED Proc. Mgr. _____________	__________	__________
Eval. Dir. __________________	__________	__________

QUESTIONNAIRE ITEM SUMMARY FORM

1. HF Analyst: ______________________________
2. Content Area: ______________________________
3. Question #: __________
4. Question:

FREQUENCY/% TYPE OF RESPONSE/SPECIFIC EQUIP. REF. INVESTIGATION

PERSONNEL DEMOGRAPHIC SUMMARY FORM

1. HF ANALYST: ______________________________

2. STATION: ______________________________

POPULATION DEMOGRAPHICS AND STATISTICS

GROUP	N	SEX		MEAN STATISTICS					
		M	F	HEIGHT	AGE	NUCLEAR OPER EXP.	CONTROL BOARD OPER EXP.	#YRS RO	#YRS SRO
NON-LICENSED OPERATOR									
LICENSED OPERATOR									
LICENSED NON-OPERATOR									
SIMULATOR INSTRUCTOR									
OVERALL									

GROUP	N	SEX		MEDIAN STATISTICS					
		M	F	HEIGHT	AGE	NUCLEAR OPER EXP.	CONTROL BOARD OPER EXP.	#YRS RO	#YRS SRO
NON-LICENSED OPERATOR									
LICENSED OPERATOR									
LICENSED NON-OPERATOR									
SIMULATOR INSTRUCTOR									
OVERALL									

DOCUMENT USER FEEDBACK

QUESTIONNAIRE

GENERAL

We hope you have found this CRDR NUTAC document useful. If you have any suggestions for improvement or any comments regarding this document, you may use this form or send a letter providing feedback. This feedback will provide practical information on the applicability and use of the CRDR Implementation Guideline. The guideline's value can be judged only by you, the user. Please take a few minutes and comment on the four questions. Address your feedback to:

CRDR NUTAC
Communications Division
Institute of Nuclear Power Operations
Suite 1500
Circle 75 Parkway
Atlanta, GA 30339

QUESTIONS

1. Was this guideline useful? If not, why not?

____

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____

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2. How did you use this guideline (e.g., in total, as background, selected portions)?

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3. What would you recommend to improve this guideline?

4. What other sources (if any) did you use to develop your program? (Please include name and telephone number of a contact person.)

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