DETAILED
CONTROL ROOM DESIGN REVIEW
PROGRAM PLAN

R.E. Ginna Nuclear Power Plant

Submitted by:

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PREFACE

The following document was prepared by Rochester Gas and Electric (RG&E) Corporation in conjunction with the Applied Systems Technology Division of the Advanced Resource Development (ARD) Corporation, Columbia, Maryland. This report contains the Program Plan for performing a Detailed Control Room Design Review (DCRDR) for the Ginna Station. The plan was developed by specialists with experience in the fields of plant operations (licensed operators), instrumentation and control engineering, nuclear engineering, training and human factors engineering.

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1.0 BACKGROUND AND OBJECTIVE

Rochester Gas & Electric Corp. (RG&E) has initiated a control room review program for the R.E. Ginna Power Plant in response to NUREG-0737 Supplement 1, which requires that all licensees conduct a detailed control room design review (DCRDR) to identify and correct design deficiencies. The NUREG-0700, "Guidelines for Control Room Design Review", issued in September of 1981, provides human engineering guidelines to assist each licensee and applicant in performing a detailed control room review. The RG&E program emphasizes determination of the adequacy of information available to the operator to effectively mitigate emergency conditions. The review program is also designed to correct human factors problems and to improve controls and displays determined to be in discrepancy with good human factors practices. The review scope will encompass known future control room design changes (e.g., new plant process computer, the Safety Assessment System (SAS)) as well as the existing design. The DCRDR process, as suggested by NUREG-0700, is divided into four major activities:

- Planning
- Review
- Assessment and Implementation
- Reporting

This report reflects the RG&E approach to satisfy the planning

phase and details the human engineering processes developed to address the DCRDR requirements.

The following pages describe the overall review, the management and review staff, documentation and document control, and process for assessing Human Engineering Discrepancies (HEDs).

1.1 Reporting Requirements for DCRDR and Other Improvement Programs

Supplement 1 to NUREG 0737 contains reporting requirements that must address:

- the specifics of the Ginna DCRDR; and,
- "Other Improvement Programs" which relate to and must be integrated with the Ginna DCRDR.

Paragraph 1.1.1 details the specific DCRDR reporting requirements. Paragraphs 1.1.2 to 1.1.5 specify those "Other Improvement Programs" that, in RG&E's opinion, are technically related to the DCRDR and provide appropriate document cross references.

1.1.1 Control Room Design Review

Supplement 1 requires the submittal of a Program Plan containing the following elements:

- A qualified multidisciplinary review team
- Use of function and task analysis
- Control room verification
- Control room survey
- HED assessment
- Verification of design improvements

- Coordination with other programs

The purpose of this Program Plan is to describe how each of the requirements listed above has been or will be accomplished.

1.1.2 Safety Parameter Display Systems (SPDS)

Supplement 1, paragraph 4.2.a requires that the licensee submit a "written safety analysis describing the basis on which the selected parameters are sufficient to assess the safety status of each identified function for a wide range of events, which include symptoms of severe accidents." RG&E submitted that basis in a report dated June 1981. RG&E's SPDS is a subset of the SAS which is currently under design.

1.1.3 Regulatory Guide 1.97

Supplement 1, paragraph 6.2 requires the submittal of a report describing how the licensee meets the requirements of Regulatory Guide 1.97. RG&E submitted a report on its current status in January 1984.

1.1.4 Emergency Operating Procedures (EOPs)

Supplement 1, paragraph 7.2.b requires the submittal of a Procedures Generation Package including a description of the development of the Plant Specific Technical Guidelines, the Writer's Guide, the program for validation of EOPs, and the training program for EOPs. That document will be submitted by 28 February 1985.

1.2 Summary of Supplement 1 Human Factors Activities to be Performed

1.2.1 DCRDR Activities

The control room will be reviewed regarding the system status information, control capabilities, feedback, and performance aids necessary for personnel to accomplish their functions and tasks effectively. In addition, any characteristics of the existing control room's instrumentation, controls, other equipment and physical arrangements will be identified that may detract from operator performance. Six review processes will be used to identify HEDs within the control room:

- Operating experience review
- System review, function review and task analysis
- Control room inventory
- Control room checklist supplement
- Verification of task performance capabilities
- Validation of control room function

The first three are foundation processes in which frames of reference and benchmarks for discrepancy identification will be established. The last three are investigative processes in which the benchmarks will be applied and HEDs identified.

1.2.1.1 Foundation Processes

Industry-wide reviews of Licensee Events Reports (LERs) for similarly designed power plants will be analyzed. Since these reports have generic applicability, they will be used to identify conditions which affect the probability for operator error and the safe operation of the generating station. In addition, operating personnel will be interviewed to obtain feedback based on previous operating experience.

Concurrently, a systems review, function allocation review and task analysis will be conducted. These analyses will establish

the information flow and control requirements between the operator and the control boards. A summary of the approach is included in Section 4.

A control room inventory will also be prepared on a system-by-system basis to identify all instrumentation, controls and equipment within the control room. This information will be compared with the requirements identified through the analysis of operator tasks.

1.2.1.2 Investigative Processes

Using the foundation processes as a basis, the investigative processes will provide the appropriate information necessary to determine the adequacy of the control room from a human engineering perspective. Discrepancies that may exist will be identified and documented during this part of the review.

A survey of the control room consisting of a human factors engineering examination of the control boards using the guidance in NUREG-0700, Section 6 and other related guidelines and environmental considerations will be conducted. This step will be followed by a verification of task performance capabilities which includes:

- the availability of the instrumentation and controls;
- and, the efficient interface between the operator and the control board.

Subsequent to the verification process, a validation of the control room functions will be conducted. This procedure will determine whether the functions allocated to the operating crew can be accomplished within the structure of the defined

emergency procedures and the design of the existing control room.

1.2.1.3 Assessment, Implementation and Scheduling

Upon completion of the Investigatve Processes, an examination of the HEDs will be conducted by the Human Factors Assessment Team (Section 5.0). This review will serve to identify the significance of each of the HEDs, as well as to determine the appropriate corrective actions. It is expected that some HEDs may not require corrective action. A schedule will be developed that will implement the human engineering resolutions that are identified as being necessary.

1.2.1.4 Final Report

A report will be submitted at the conclusion of the Ginna DCRDR which will:

- summarize the overall review process;
- describe the identified HEDs;
- describe human engineering improvements implemented during the course of the review;
- and, identify the remaining proposed improvements and their schedules for implementation.

1.2.2 Safety Parameter Display System

Operator interfaces with the SPDS will be evaluated using guidance provided in NUREG-0835 and NUREG-0700, Section 6.

1.2.3 Regulatory Guide 1.97

The examination of Regulatory Guide 1.97 instrument layout on

the control boards will be accomplished during the validation review.

1.2.4 Emergency Operating Procedures (EOPs)

RG&E will perform a validation of the upgraded EOPs to ensure that the functions of control room operators in emergencies can be accomplished (i.e., that the individual items of NUREG-0737, Supplement 1 have been integrated sufficiently to meet the needs of control room operators and provide adequate emergency response capabilities). Efforts for the EOP and CRDR validation processes will be integrated. Additional sequences than those selected for the CRDR validation will need to be analyzed for the EOP validation. The EOP validation criteria will be applied to all sequences. In addition to the EOP validation criteria, the data collection efforts described in Section 4.6 will be performed for those sequences selected for CRDR validation.

1.2.5 Training

There are no outstanding human factors activities relating to training that will require dispositioning. However, the DCRDR review team (discussed in Chapter 2) will have Ginna Training Department representatives.

2.0 MANAGEMENT AND STAFFING

The Ginna DCRDR activities will be implemented by experienced Operating, Engineering and Human Factors Engineering personnel. These individuals will perform the DCRDR with input from other studies; analyses and concerns involving human factors engineering considerations discussed in Supplement 1.

2.1 DCRDR Team

The Ginna DCRDR team consists of a select group of professionals with the wide range of skills necessary for the performance of the design review and includes:

- Nuclear Engineering
- The EOP Upgrade Project Liaison Engineer
- A senior reactor operator or operations supervisor with operating experience
- An Instrument and Control Supervisor
- Human factors specialists

This core group will be supplemented, as required, by other disciplines such as mechanical, electrical and I&C engineering, training and visual performance assessment. During the course of the review, any additional specialists (e.g., lighting, acoustics) required for specific tasks will be made available as needed.

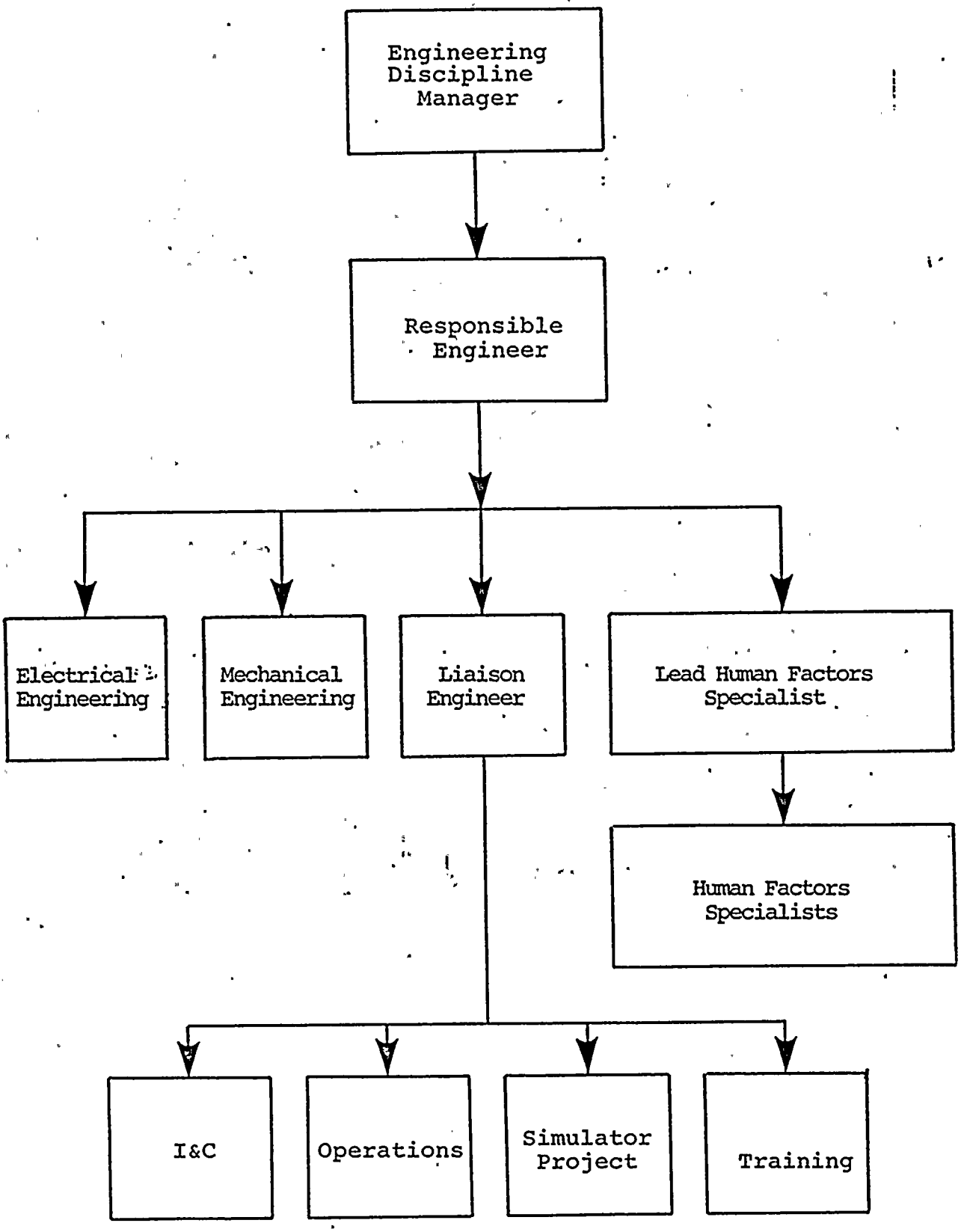

Figure 2.1
Structure and Management of the DCRDR Review Team

The structure and management of the review team is illustrated in Figure 2.1.

Prior to conducting the review, team members will be briefed on the methods and content of relevant NRC reports (i.e., NUREG-0700, NUREG-0801) and general human factors engineering principles and methodology. Team members will also be provided the opportunity to familiarize themselves with the general design and operation of the plant.

The review team members will be encouraged to document dissenting opinions and will be provided access to required plant facilities or personnel and necessary documents or information to perform their assigned tasks.

2.2 Program Manager

The lead for the DCRDR has been assigned to the Engineering Department. The Engineering Discipline Manager has the overall responsibility for the planning and administration of the DCRDR project. This responsibility includes scheduling for the project and coordinating review activities with corporate management.

2.3 DCRDR Project Manager

The Responsible Engineer (RE), who will serve as the DCRDR Project Manager, is responsible for the execution of the DCRDR. He will coordinate the DCRDR activities with the technical review leaders and will be responsible for scheduling and directing the evaluation and reporting process.

The RE for this project shall have a degree in an engineering

discipline with at least 10 years utility experience in the nuclear power industry.

2.4 Human Factors Engineering

ARD Corporation will support RG&E in the area of human factors engineering and will insure that human factors principles are not compromised during the DCRDR and provide assurance of the quality of results of each DCRDR conducted. The following individuals will participate in the DCRDR. Should it be necessary to substitute another individual for one of these, comparable experience will be maintained.

2.4.1 Lead Human Factors Specialist (LHFS)

Mr. Donald F. Taylor of ARD Corporation, the LHFS, will work closely with the RE and other technical review leaders throughout each phase of the control room review and share with them the human factors technical leadership of the entire DCRDR project. The LHFS will coordinate all activities of the HFS(s) and verify that task performance quality is maintained at a level necessary for a valid and comprehensive review. In addition, it will be the responsibility of the LHFS to record dissenting opinions on methodology, technique, review findings, assessment and HED corrective actions that he has from the majority opinion of the DCRDR Review Team and report those opinions, in writing, to the RE.

Mr. Taylor's qualifications for Lead Human Factors Specialist include:

- B.S. Industrial Engineering & Operations Research (I.E.O.R.), Virginia Polytechnic Institute and State University

- M.S. I.E.O.R. (Human Factors), Virginia Polytechnic Institute and State University
- Twelve years of experience in human factors engineering, five of which have been in nuclear control room review

2.4.2 Human Factors Specialists

The HFS will work with the review team and will be involved directly in the system function review, task analysis, control room survey, verification, and validation process. The HFS will provide support in the assessment and implementation phase and the writing of the final report.

Human Factors Specialists supporting the Ginna DCRDR are:

Richard L. Horst

- Ph.D. Experimental Psychology, Carnegie-Mellon University
- M.S. Experimental Psychology, Carnegie-Mellon University
- B.S. Biology-Psychology, Bucknell University
- Five years experience in human factors engineering, two of which have been in the nuclear power industry.

Robert C. Munson

- M.A. Experimental Psychology, Towson State University
- B.S. Psychology, University of Maryland
- Five years experience in human factors engineering, three of which have been in the nuclear power industry.

Cynthia F. Weiss

- M.SE. Industrial Engineering, University of Michigan
- B.S. Industrial Engineering, University of Michigan
- Four years experience in human factors engineering, two of which have been in the nuclear power industry.

J.B. Winter

- M.S. Psychology, Virginia Commonwealth University
- B.S. Psychology, Virginia Commonwealth University
- Five years experience in human factors engineering, three of which have been in the nuclear power industry.

2.5 Other Review Team Members

The remainder of the technical review team will consist of experienced Operating and Technical personnel at Ginna and Engineering personnel who will be directly involved in various aspects of the review. Personnel from Ginna will assist in the identification of the event sequences, functions and tasks for review of the system functions and operator task requirements. They will assist in the control room inventory and validation as well as the assessment and implementation of changes in response to the identified HEDs.

Experienced personnel from the Operations area of Ginna will assist in identifying operator tasks, conducting the control room inventory, verifying task performance capabilities, validating control room functions and assessing and implementing changes in response to the identified HEDs.

Experienced personnel from the Engineering Department will assist in identifying equipment design criteria, providing data

concerning related near term modifications, and assessing and implementing changes in response to HED.

3.0 DOCUMENTATION AND DOCUMENT CONTROL

Documentation and document control creates a traceable and systematic translation of information from one phase of the DCRDR to the next. It is important that the DCRDR team have ready access to a library of documents to: a) provide a support base to manage and execute the various steps and phases of the control room reviews; and b) provide a design data base from which future control room modifications may be made. Therefore, a data base library will be established to ensure the success of the DCRDR process.

This section describes the documentation system (input/output documents) and documentation management/control procedures which RG&E will use to support its DCRDR. Ultimately, all documentation will be maintained in accordance with existing RE&E procedures.

3.1 Input Documentation

Initially, the review team will have at its disposal the reference documents listed below:

- System Lists
- System Descriptions
- Control Room Floor Plan
- Panel Layout Drawings
- Panel Photographs

- List of Acronyms, Abbreviations
- Description of Control Room Coding Conventions
- Samples of Computer Printouts
- Emergency Operating Procedures
- Guidelines for Procedural Development
- Other Human Factors/Control Room Studies

As additional documents are acquired or written, they will be added to the data base library. Forms are referenced in their applicable program plan sections; reports too cumbersome for inclusion are described and referenced in each applicable section and will be physically maintained by RG&E.

3.2 Output Documentation

In order to facilitiate systematizing and recording control room design reviews, a series of standard forms have been developed. These forms appear in their entirety in the Appendix, except where indicated by an asterisk; Appendix page numbers appear in parentheses.

- Historical Report Review Problem Analysis Report (A-2)
- Control Room Human Engineering Discrepancy Record (A-3)
- Questionnaire Item Summary (A-4)
- Personnel Survey Summary (A-5)
- Control Room Review Task Development (A-6)
- Task Analysis Form (A-7)
- Validation Review Worksheet (A-8)
- Air Velocity Survey Record (A-9)
- Humidity/Temperature Record (A-10)
- Lighting Survey - Luminance and Reflectance Record (A-11)
- Lighting Survey - Illuminance Record (A-12)
- Sound Survey Record (A-13)

- Photographic Log (A-14)
- Inventory Form (A-15)
- Index of Reviewed Reports (A-16)
- Historical Report Problem Status Report (A-17)
- Operations Personnel Questionnaire*
- Pre-Assessment Form*
- Assessment Rating Form*
- NUREG-0700 Section 6 Checklist*

3.3 Document Control

DCRDR document control is required for traceability, retrievability and assurance of quality. RG&E intends to implement a Data Base Management System (DBMS) for this project to collect, update, analyze and provide the information necessary to fulfill the requirements of DCRDRs. An example of a method for using the DCRDR DBMS is illustrated in Figure 3.1. Implementation of the DBMS will minimize the number of manual transformation steps currently required in the data collection/analysis effort. Furthermore, it will afford the Ginna DCRDR team the capability of rapid data analysis. Through the use of the DBMS parameters, any number or combination of data points will be accessed and analyzed on an as needed basis.

3.4 Data Base Management System

The DBMS will be available on a DEC VAX 11-730 mini-computer with HENCO INFO/INFO Text software and will consist of a master program with memory storage to hold the data extracted from various source documents. The program performs, electronically, those functions which previously were performed manually. Because manual handling of data is largely eliminated after data is entered into the system, the DBMS

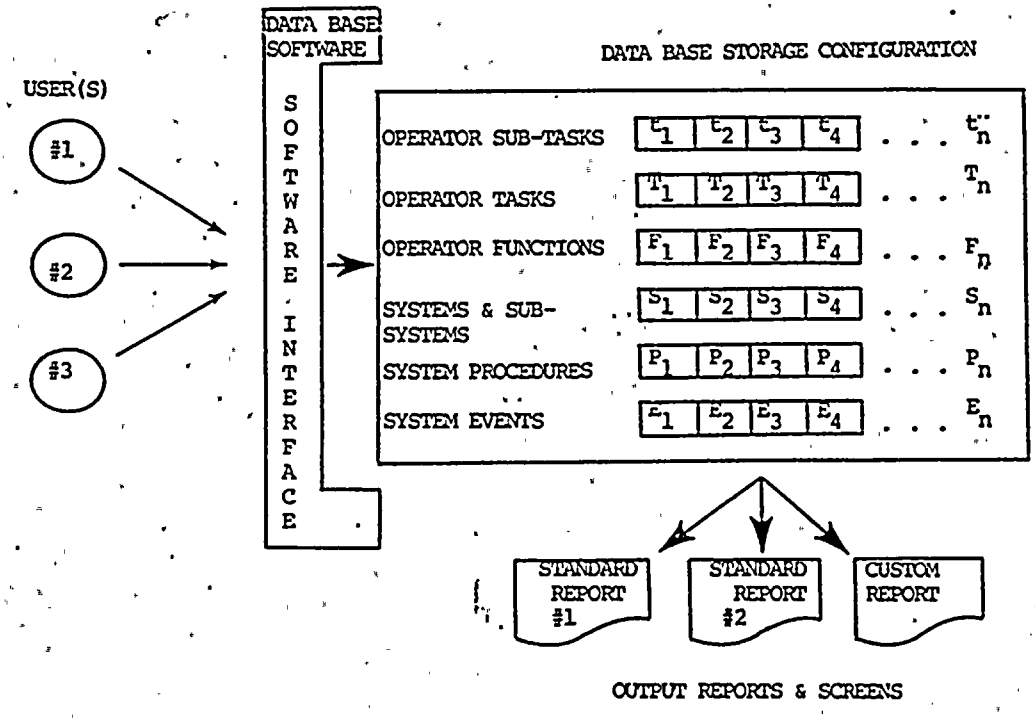

Figure 3.1

Sample Human Factors Evaluation Data Base Management System

greatly reduces duplication of efforts, document loss and errors resulting from unnecessary handling of data.

When the review is begun, the HFS will create a series of data files and records using information derived from various source documents. Each source document contains specific forms, charts, schedules, etc., required for the Ginna DCRDR and each will constitute a single data file. Data files, in turn, will be comprised of individual records which represent the specific parameters contained in the file forms, etc. The file then serves as a model of the document from which it was created, as well as an area to store data records. Initially, the source documents will include those reports and forms listed previously in this chapter.

The RE and LHFS will be instructed in system structure, use and maintenance. Upon completion of training, each will be able to perform all necessary functions. These functions include: addition/deletion and editing of data records; creation of new files; selective examination of particular records, based on user-selected criteria; performance of analysis, based on user-selected criteria; creation of specialized and standard reports; creation of hard copies of data and system alteration, adjustment or expansion.

To avoid file damage and/or unauthorized data manipulation, access to the DBMS will be restricted by limiting user training and by issuing passwords to a limited number of users.

Since there will be limited access to the system, it will be set up so that direct access will be permitted according to how much training an individual has in its use and how great the individual's need for access is. In addition, a hard-copy, written log will be kept for system use. The log will make system use auditing easier, allow for more sophisticated use of

the system and will make it possible to use the files interactively.

Three levels of system users will be established. The highest level of user will be those who are fully trained in its use and are responsible for the system i.e., the RE and LHFS. The next level of user will be those who are fully trained but are not responsible for the system. The lowest level of user will be those with limited training.

The RE and LHFS will have the "master" passwords for all files, allowing them to perform all functions on the system. The mid-level user will have access to "read/write" passwords, allowing for all functions except for those involved with system alteration. The lowest level of user will have access to "read only" passwords, allowing only for calling up and reading information on the system; they will be unable to alter data. Also, "read only" users will be somewhat limited in handling data between files. The RE will determine which team members will be mid and low-level users.

The actual procedures for system use are concise and easy to understand. A minimum set of the main functions includes:

- Display, edit records
- Add records
- List records to the printer
- Create or load short forms of documents
- Print records
- Maintain file
- Close and exit from files

4.0 REVIEW PROCEDURES

The objective of a the Ginna DCRDR is to satisfy the requirement for performing a human factors engineering review of the control room to determine the extent to which the control room provides the operators with sufficient information to complete their required functions and task responsibilities safely. The review will also determine the suitability of the designs of the instrumentation and equipment in the control room. The procedures outlined in this section of the Program Plan describe the activities which have and will comprise the DCRDR.

4.1 Review of Operating Experience

This review will be done to ensure that problems encountered in either plant operation or in preparation for operation are addressed. This section of the Program Plan discusses the two methods that will be used to review operating experience; these are: 1) an examination of both in-house and industry-wide historical documents, and 2) a survey of control room operating personnel.

4.1.1 Examination of Available Historical Documents

Human error in performing complicated tasks is a well

documented fact and the potential for it is always present. Instances of past human performance error and/or equipment/ design arrangement problems are documented in plant and industry records and can be used as a data base. This section presents the approach that will be used to tap that archival information to identify areas of potential human performance problems so that the potential for problem occurrence/recurrence can be reduced. Specifically described herein are the approaches that will be used to: 1) identify, collect and select historical reports for review; 2) prioritize the reports to focus the review effort; 3) review and evaluate the reports; and 4) document and report the review's results (Figure 4.1).

Identifying, Collecting and Selecting Historical Reports

Industry-wide reviews of LERs for similarly designed Westinghouse plants having generic applicability will be investigated. The reports obtained will be screened by an HFS with the assistance of a Subject-Matter Expert (SME) to determine if the report describes and documents a control room problem that could relate to Ginna. A control room problem is defined as one that meets the following criteria:

1. Equipment referenced (valve/pump controls, displays, indicators, etc.) must be in the physical confines of the control room; and/or

2. Procedure steps referenced should be accomplished within the physical confines of the control room; and/or

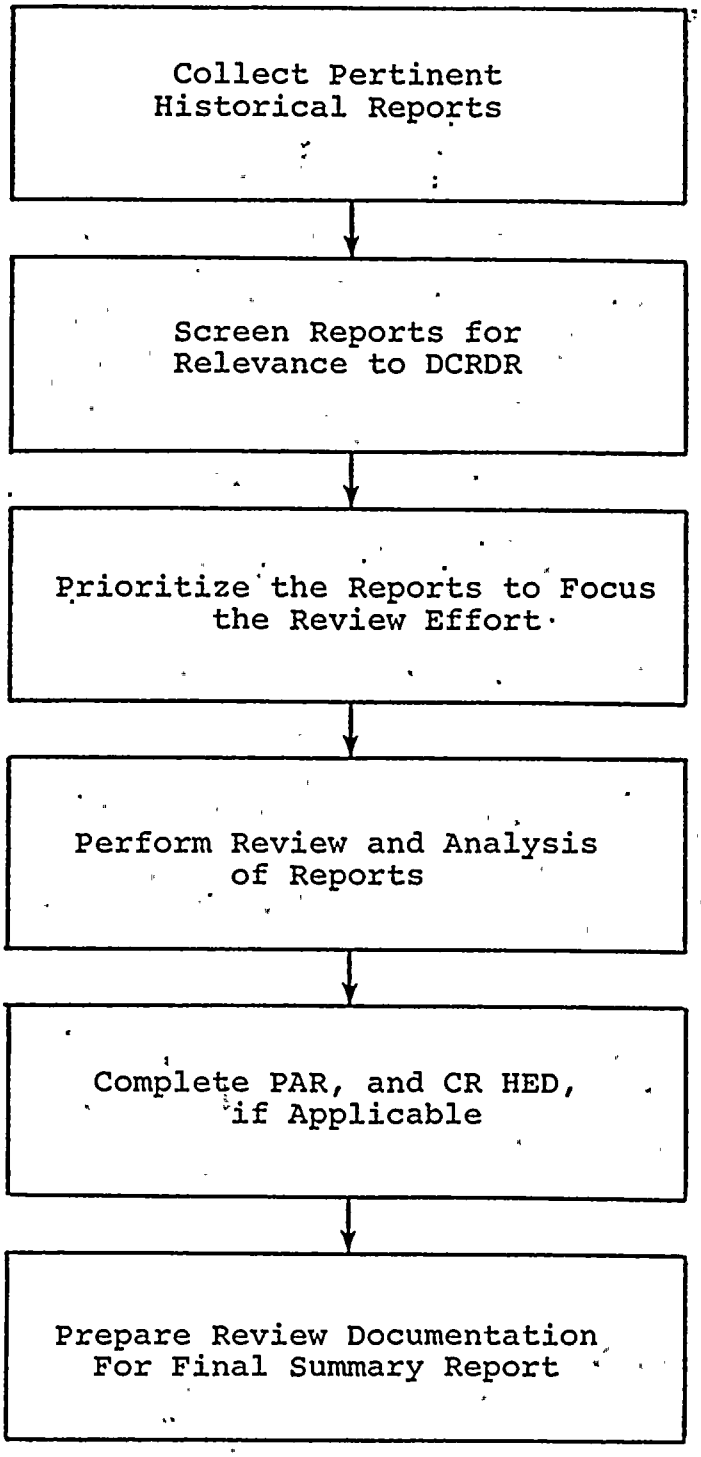

Figure 4.1

Activity Flow Chart for Examining Available Historical Documents

3. Personnel error referenced must have occurred in the control room or equipment in the control room, or entailed a deviation from procedures that were to be accomplished in the control room.

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

Report Review and Analysis

The review process will entail extracting and condensing the information so that an analysis of the problem can be made from a human engineering perspective. The review and analysis will be completed by an HFS, with SME assistance as needed.

Using the information collected in the review process, the HFS will analyze the problem to detemine if the corrective actions which were implemented address the problem adequately from a human factors perspective, or, in the case of industry-wide reports, whether the problem, as documented, could exist at Ginna. The HFS will complete a Problem Analysis Report (PAR) (Appendix p. A-2) for each problem type. In addition, it will convey the decision of the HFS regarding the corrective status of the problem. If the HFS determines that the problem has been adequately addressed, no further action will be taken on that problem. If the HFS detemines that the problem has not been adequately addressed and that additional human engineering corrective action could be taken to minimize the probability of the problem recurring, an HED form will be completed on the problem.

Result Documentation and Reporting

The PAR, discussed above, constitutes the primary reporting document for this aspect of the DCRDR process. When applicable, the HED will constitute the secondary reporting document and contain the information pertinent to an uncorrected problem report's resolution. Copies of completed PARs and HEDs will be distributed to other review team members.

4.1.2 Control Room Operating Personnel Survey

The objective of the Operating Personnel Survey is to obtain special, pertinent knowledge that operating personnel possess regarding both routine and positive and negative control room system features which they have experienced and/or observed in the course of preparing for operations or in the operations themselves. This section of the Program Plan delineates the process that RG&E is adopting to conduct the survey. The process, outlined in Figure 4.2, contains three basic elements: survey construction, survey distribution and data analysis.

Survey Construction

An open-ended, self-administered questionnaire approach has been adopted. Here, RG&E's approach deviates from the type of survey recommended in NUREG-0700 for the following reason: we believe that by employing this method, we can question a greater percentage of the operating personnel and maximize use of their time and that of the HFS. The survey contains nine content topics. Specifically, and in the order of presentation, the areas covered are:

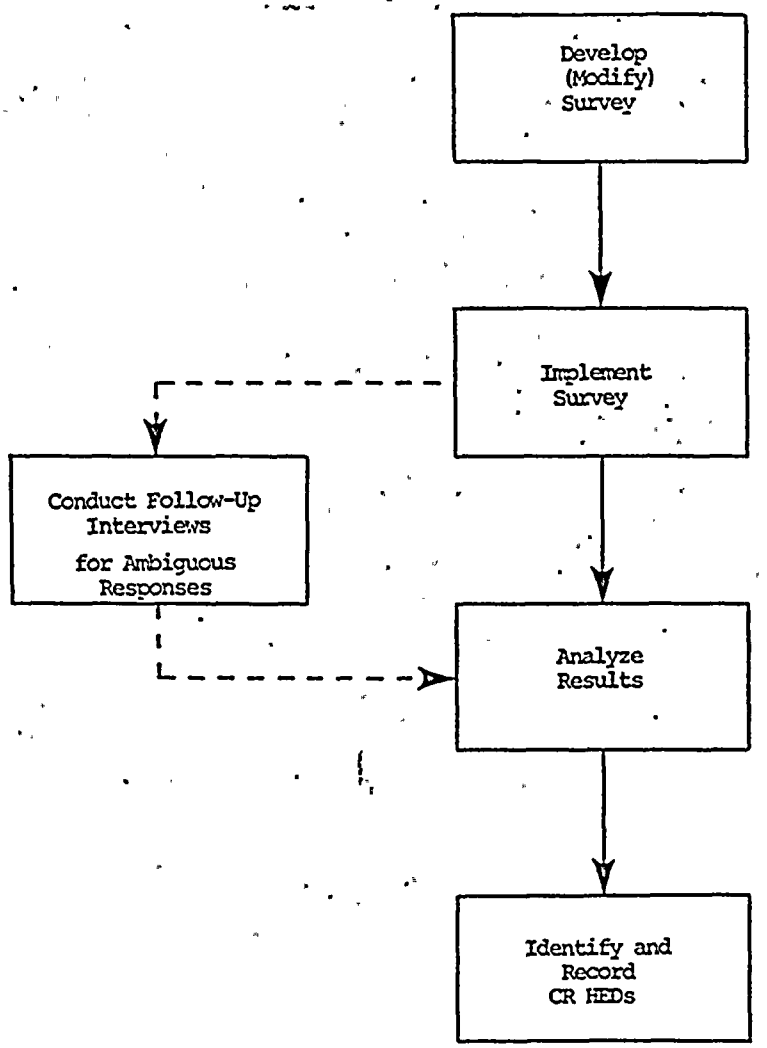

Figure 4.2

Activity Flow Chart for Control Room Operating Personnel Survey

- Workspace Layout and Environment
- Panel Design
- Annunciator Warning System
- Communications
- Process Computers
- Procedures
- Staffing and Job Design
- Training

Survey Distribution

Questionnaires have been given to a representative sample of non-licensed operations personnel, all licensed operations personnel, and a sample of licensed non-operations personnel early in the Ginna DCRDR process.

Data Analysis

After the questionnaires have been completed, retrieved and logged in, the Human Factors Specialist will examine and review them on an item-by-item basis. After the questionnaires have been reviewed, the HFS will obtain clarification on ambiguous responses by means of an interview. The results of the interviews will be recorded on the appropriate form and response frequency data will be generated for each questionnaire item.

It is anticipated that both positive and negative control room features will be identified by the respondents. Therefore, further investigation by an HFS will be carried out for each item on the responses to determine whether they are in accordance with sound human engineering conventions and practices.

4.2 System, Function Review and Analysis of Control Room Operator Tasks

The objective of these analyses is to determine, to the extent practical, whether system performance requirements can be met by combinations of the instrumentation, equipment, software and personnel to insure that operator performance requirements do not exceed operator performance capabilities. The approach will yield a comprehensive body of data regarding the task requirements imposed on the Control Room operators.

The Westinghouse Owner's Group has performed system function reviews and task analysis in the process of developing technical guidelines for emergency operating procedures. The Owner's Group efforts provide a good generic basis which can be used by RG&E in plant-specific evaluations. Since plant subsystems, operating practices and training philosophies may differ from plant to plant, the Westinghouse Owner's Group data cannot fulfill all the requirements of the requisite plant-specific evaluations. The efforts outlined below are designed to utilize the Westinghouse Owner's Group efforts to the fullest extent possible to eliminate duplication of effort, while yielding a comprehensive analysis within the realm of emergency event scenarios.

4.2.1 Task Identification

Figure 4.3 illustrates the event based procedural approach that will be used to conduct the System Review, Function Review and Task Analysis (SRTA). This approach is intended to yield a comprehensive body of data regarding the requirements imposed on the operators. A top-down approach, utilizing the Westinghouse Owner's Group High Pressure ERG SRTA and Ginna Plant-Specific EOPs, will be used as the basis for identifying

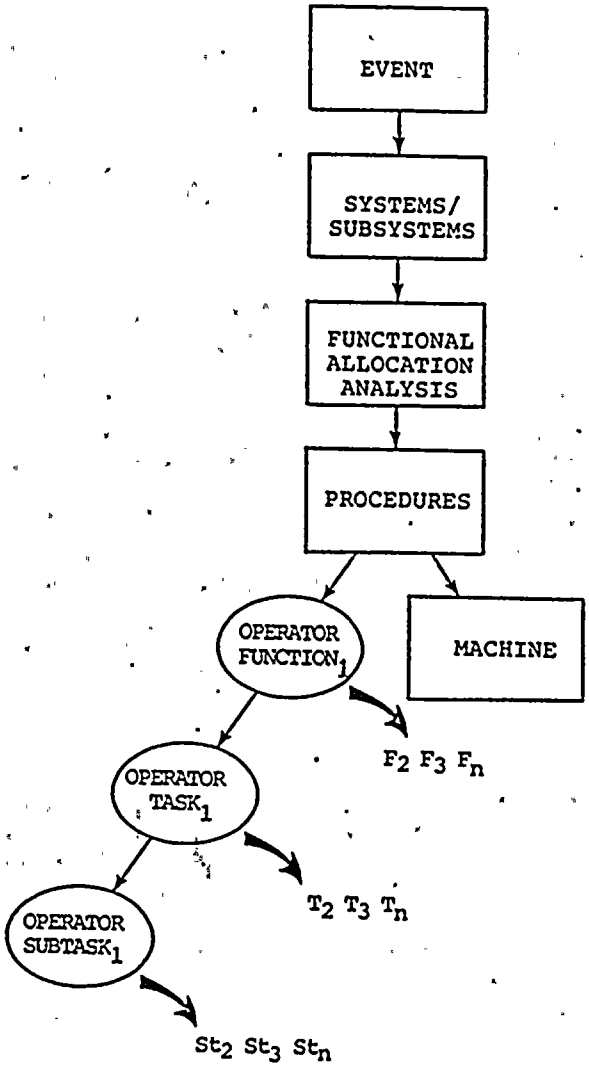

Figure 4.3

Task Analysis Fault Tree

*Operator subtasks must satisfy requirements for controlling the event under analysis.

plant functions and operator tasks. The event sequences to be analyzed will reflect plant operations with emphasis on emergency conditions.

The selection of events for the DCRDR will include events for which EOPs are being developed. The Westinghouse System

Function and Task Analysis generic documentation was reviewed by the NRC and considered acceptable as a basis for the identification of "high level" operator tasks for the DCRDR. All steps and contingencies represented in the Westinghouse Emergency Response Guidelines (ERGs) will be analyzed during this review resulting in a list of plant specific tasks in the accomplishment of all branches of the guidelines.

4.2.2 Task Analysis

Once the system criteria are identified from the appropriate documentation and the system and operator functions associated with each plant event are determined, the operator task needs will be defined. For each task, the display information necessary for an operator decision to activate a control or monitor a system state will be determined. Next, the operator control functions will be analyzed to document needed control characteristics. Environmental effects and constraints will also be noted.

The objective of the task analysis is to identify the information and control needs for task performance and will provide a template of operator activities in the task for use in verification and validation efforts.

The intent of the task analysis is to identify the behavioral requirements imposed on the operator where the task is defined

as a group of discriminations, decisions and activities related by temporal proximity, immediate purpose and common output.

The elements of the task considered for this review include:

- The stimulus to the operator, which triggers performance of the task
- The required response to that stimulus (i.e., the performance criterion)
- A procedure for performing this response (which includes the equipment to be used for performing the task)
- A goal or purpose that organized the whole task

The information to be collected to determine the operator control needs for each task includes:

- Parameter - The system parameter directly affected by the control operation
- Equipment - The name of the plant equipment involved in the control action noting the required type of control equipment (e.g., pump, isolation valve, governor valve, etc.)
- Position - The control position name which corresponds to the escutcheon label (e.g., ON, RUN, CLOSED, AUTO)
- Status - The actual status of the equipment as a result of the control action (e.g., ON, OFF, OPEN, CLOSED, etc.)

- Type - The required or desired type of control to suit the nature of the control action. (A key at the bottom of the form will provide the most common types.)

- Mode - The required mode (i.e., continuous or discrete) of control operation for the task

- Other - Other descriptive features or characteristics necessary or desirable for the control action

- Type of Feedback - The desired or needed type of feedback indication to assure the operator that the desired control action was initiated or established (e.g., control status lights)

- Feedback State - The desired or needed state of the indication for display of control feedback (e.g., color of control status lights)

The information needs for the operator task will be described in terms of the following categories of characteristics:

- Parameter - The system parameter which the display is monitoring

- State - The state of the parameter which is pertinent to the task accomplishment (e.g., less than 500 psig, At Low Level Limit, Lit, etc.)

- Type - The required or desired type of display to suit the nature of the information need (e.g., recorder, annunciator, graphic plot, etc.)

- Units - The units needed for the parameter display in order to accomplish the task without the need for conversion
- Range - The range of parameter values required for the accomplishment of the particular task under investigation
- Divisions - The required precision of the parameter value display in terms of the smallest scale division
- Other - Other descriptive features or characterisitics desirable or necessary for display of the information required

A Task Analysis form will be designed to support the DCRDR verification and validation efforts. The Task Analysis data will constitute a specification of operator needs to accomplish the operator functions. This specification will be used as a foundation reference point to verify the availability and suitability of control room instrumentation, to provide a context within which to survey the control room, and to provide a base of understanding on which to assess HEDs.

4.3 Control Room Inventory

A complete list of the control room instrumentation and controls will be compiled to assist the DCRDR. The inventory will be done by a HFS using the direct observation approach in the control room. Schematic drawings and equipment lists and specifications may be used as well, if and when their use would facilitate the inventory data collection process. The inventory will be accomplished on a system-by-system basis.

In performing the inventory, each item will be identified by its system. Equipment use and characteristic information will be recorded for each inventory item. In addition, the location and proximity to related items will be noted for use during the verification process. Information will be recorded on a Control Room Inventory Form. This form is designed to simplify the data-recording process and provide an equipment coding scheme to ensure that each item has a unique identifier. After pertinent information is recorded for a system, it will be transferred to a computer-based data management system.

The inventory form will comprise three major sections:

System Instrumentation
System Manual Controls
System Automatic Controls

Items/data to be inventoried are described below, by system. Where applicable, explanatory information is parenthesized after each item. This list may be modified during the performance of the review, if appropriate.

System Instrumentation

Nameplate data
Parameter measured
- What measured (flow, pressure)
- Units (kiloamperes, volts)

Type of instruments
- D - Digital readout
- C - Drum counter
- RM - Rotary meter

EM - Edgewise meter
SP - Single-point recorder
MP - Multi-point recorder
#P - Number of points recorded

Instrument data
Range (0 to 300, 20 to 100)
Div. (increment value between marks)

Instrument panel location
- Panel number
H - Horizontal section
V - Vertical section

System Manual Controls

Nameplate data
Type of control switch
JS - Joy stick switch
PS - Pushbutton switch
K - Keylock switch
RS - Rotary selector switch
TS - Thumbwheel selector switch

Number of switch positions
2 - Two positions
3 - Three positions
5 - Five positions
? - Enter appropriate number of positions if none of the above apply

Type of action
SR - Spring return to neutral
As-is - Stays where positioned

Type of control

SO, SC - Seal in Open, Seal in Close
SO, TC - Seal in Open, Throttle Close
TO, SC - Throttle Open, Seal in Close
TO, TC - Throttle Open, Throttle Close

System Automatic Controls

Nameplate data

Type of contol

M - Manual controller
M/A - Manual auto transfer station
AT - Master auto controller with setpoint adjustment
A - Auto controller without setpoint adjustment

Control data

Range (0 - 500)
Div. (5lbs., 15 rpm)

Component controlled

V - Valve
T - Turbine
M - Motor
O - Other

Parameter controlled

F - Flow
P - Pressure
S - Speed

Instrument data

Range (0 - 100, 20 - 50)
Div. (5lbs., 10 degrees)

Instrument panel location

- Panel number

H - Horizontal section

V - Vertical section

The equipment data collected in the inventory will be compared to the requirements as identified in the task analysis. Discrepancies will be recorded as HEDs.

4.4 Control Room Survey

The human factors engineering survey will follow the guidelines illustrated in Section 6 of NUREG-0700. This survey will consider the extent to which human performance characteristics are considered within the control room.

A comparison of instrument and control features to the human engineering guidelines will be conducted using the data yielded from the task analysis and visual examination.

Human Factors Specialists, in concert with experienced utility personnel knowledgeable of plant systems and control room instruments and equipment, and operations personnel, will observe and measure control room features. In addition, individuals skilled in lighting systems, HVAC and communication systems will be used for special measurements. The Human Factors Engineering guidelines will be addressed for the nine topic areas below:

1. Control Room Workspace
2. Communications
3. Annunciator Warning Systems
4. Controls
5. Visual Display

6. Labels and Location Aids
7. Process Computers
8. Panel Layout
9. Control-Display Integration

Discrepancies will be noted for each non-compliant item and a photographic log will be developed for reference.

4.5 Verification of Task Performance Capabilities

The objective of the task verification process is to assure that operator tasks can be performed in the existing control room with minimum potential for human error. This process will be completed in two steps. The first step will verify the presence (or absence) of instruments and equipment that provide the information and control capabilities necessary to implement each task. The second step will determine whether the man-machine interfaces provided in the control room are effectively designed to support task accomplishment.

In addition to verifying the availability of control room equipment, a verification of human engineering suitability will be conducted to identify interface problems that may affect task performance but may not be evident when the control room equipment is examined.

Personnel knowledgeable in plant systems, instrumentation and controls engineering, human factors engineering and operations will participate in the verification process. Also, system designers will be available for consultation.

The HEDs will be recorded on the same HED form used during the control room survey. A photographic log of discrepancy items will be maintained.

4.6 Validation of Control Room Functions

The objective of the validation review is to determine if the functions allocated to the control room operation crew can be accomplished effectively within both the structure of the established emergency procedures and the design of the control room as it exists.

RG&E recognizes the need to examine these interface dynamics. However, practical limitations will impact the nature of the validation process. The RG&E simulator will not be available until after completion of the CRDR. Therefore, RG&E will have three options by which to perform the validation. These methods are:

A) A walk-through talk-through, using the appropriate procedures, in the control room. It should be noted that, if the walkthrough is performed in the control room, that safe operation of the facility will be the first priority;

B) A walk-through talk-through, using the appropriate procedures, on the plant specific simulator which could be available but not on-line at the vendor's facility;

C) A talk-through on a control room mockup using uniform-scale, architectural drawings of the control room and the control room panels.

The availability of method A is dependent upon unit status. The availability of method B is dependent upon the availability of the simulator equipment and the availability of operating personnel to travel and participate in the validation. It is

estimated at this point that three to four six-hour shifts or three eight-hour shifts will be necessary.

Method C will be available but is the least desirable of the three because the geometry of the control boards, peripherals and desk stations will be abstract and not actual.

It is conceivable that a combination of approaches will be used. In these instances, the LHFS and RE will decide jointly which events to evaluate by which approach, taking into account the advantages and disadvantages of each approach compared against the number of work stations and tasks encompassed by each event. Use of option A will also be subject to approval of Ginna management.

4.6.1 Control Room Walk-Through Talk-Through Approach

If the walk-through is conducted in the control room, it will be accomplished according to the procedure steps listed below.

1. The RE will select an event for validation and obtain the appropriate procedure(s).

2. A HFS, with the assistance of the RE, will develop a floor diagram of the unit work space and identify work stations.

3. A trained operating crew will review the procedure(s).

4. The RE, or another qualified individual, will brief the participating control room operating crew. At this time, assumptions about the operating situation will be specified to the operator(s).

5. The control room crew will then talk through what they would do while following the appropriate procedure(s). (The crew and HFSs may go to the actual control room to walk through and talk-through a confusing or complicated procedure step or step sequence.) During the talk-through, the operator(s) will describe what they are doing.

6. The operator(s) will be accompanied and observed by an HFS during the talk-through of each event. The HFS will take observational notes on a procedural step-by-step basis, attending to the relation between operator performance and control board/control room design. In particular, the HFS will evaluate and critique the talk-through on the following criteria:

   - The indications and annunciators referenced in the procedure(s).
   - The units of measurements displayed should be appropriate and consistent with the procedure(s).
   - The labels associated with the various controls, displays and annunciators referenced/used should be identifiable.
   - The controls and displays necessary should be available.
   - The operator actions expressed or implied by the procedure(s) should be within the capability of the operator(s).
   - Any special job performance aids used by and described by the operator(s) should be specified in the procedure(s).
   - All controls, displays, annunciators and/or job performance aids used but not referenced in the procedure(s) will be identified and recorded.

7. An additional HFS will observe the talk-through to record work station work flow information using the unit floor diagram developed in step 2 above, as a guide. The information recorded will include:

   - Direction of movement
   - Sequence of movement
   - Frequency of the movement
   - Estimated time importance of the movement

4.6.2 Simulator Walk-Through Talk-Through Approach

If simulator walk-throughs are performed, they will be accomplished according to the following procedural steps:

1. The RE will select an event for validation and obtain the appropriate procedure(s).

2. A HFS, with the assistance of the RE, will develop a floor diagram of the unit work space and identify unit work stations numerically. Copies of the diagram developed for previous walk-throughs may be used.

3. A trained operating crew will review the procedure(s) for the event selected.

4. Video tape equipment may, if practical, be set up and tested to verify that the video and audio components function properly.

5. The RE, or another qualified individual, will assemble and brief the participating control room personnel on the

purpose and specific objectives of the event simulation for video tape walk-throughs and on the walk-through procedure. Any assumptions about the operating situation will be specified to the operator(s) during the briefing.

6. To facilitate the simulation fidelity, a HFS will not accompany the operator to take observational notes. Procedures will be available to the operating crew for reference but procedural steps will not be called out. A remote microphone will be attached to the operators and they will be asked during the event simulation to call out:

   - Actions they are taking
   - Direction of action movement
   - Display/indicator to which they refer, so as to identify system response to actions taken
   - What the response indication is and/or what it must be before the operator can take the next action step

7. The video tape, if used, will be started to ensure that the following guidelines are met:

   - The camera(s) should be positioned at a distance from the workstations to ensure that an unobstructed view of each station is obtained.

   - The lighting levels should be sufficient to record the details of the event being taped.

   - "Non-Performing" personnel will be instructed to be as quiet as possible during the taping of the event and not to distract the operating crew on camera in any way.

- A HFS should operate the video recording equipment and should have freedom of movement to follow the operator on camera.

- Ideally, a minimum of two cameras and recorders should be used to document the event simulation walk-through. One camera would be stationary with an angle of view encompassing the entire control panel work space. The second camera could then focus on an operator and follow him/her around the control panel during the simulation event. This would allow for the monitoring of head movement, verbal response and action response. A camera and recorder could be available for each reactor operator (RO) on the operating crew. If more than one RO is anticipated in the composition of the minimum control room staff, then the ideal minimum number of cameras and recorders should be increased accordingly. It is important to follow the operators as they perform their tasks. However, should the desired number of cameras not be available or practical to use, those that are should focus on the operator(s) and NOT the entire control panel work space.

8. The event simulation walk-through will begin.

9. During the event simulation, a voice-over narration by a SME may be performed on the video tape. The narration would convey what was transpiring and what the operator(s) should be performing and why.

10. During the event simulation, the HFS will observe the event to record workstation work flow information, using the floor diagram of the unit work space prepared earlier. The information recorded should include:

- Direction of movement
- Sequence of movement
- Frequency of movement
- Estimated time importance of the movement

11. At a cue from the operating crew performing the event simulation, the event will be terminated.

12. The video tape operator, at that point, will remove the tape from the recorder and log in:

- The event tape
- The date of taping
- The time of taping
- Any unusual circumstances surrounding the tape
- The names of the operating personnel taped
- The name of the event narrator (if applicable)
- The counter reading from the video tape recorder

4.6.3 Control Room Mockup Talk-Through Approach

The talk-through on the scale model control room mockup, if this option is chosen, will be accomplished according to the procedure steps listed below.

1. The RE will select an event for validation and obtain the appropriate procedure(s).

2. An HFS, with the assistance of the RE, will develop a floor diagram of the unit work space and identify work stations.

3. A trained operating crew will review the procedure(s).

4. The RE, or another qualified individual, will brief the participating control room operating crew. At this time, assumptions about the operating situation will be specified.

5. The control room crew will then talk through what they would do while following the appropriate procedure(s). The crew and HFSs may go to the actual control room to walk-through and talk-through a confusing or complicated procedure step or step sequence. During the talk-through, the operator(s) will describe what they are doing.

6. The operator(s) will be accompanied and observed by an HFS during the talk-through of each event. The HFS will take observational notes on a procedural step-by-step basis, attending to the relation between operator performance and control board/control room design. In particular, the HFS will evaluate and critique the talk-through on the following criteria:

   - The indications and annunciators referenced in the procedure(s).
   - The units of measurement displayed should be appropriate and consistent with the procedure(s).
   - The labels associated with the various controls, displays and annunciators referenced/used should be identifiable.
   - The controls and displays necessary should be available.
   - The operator actions expressed or implied by the procedure(s) should be within the capability of the operator(s).

- Any special job performance aids used by and described by the operator(s) should be specified in the procedure(s).

- All controls, displays, annunciators and/or job performance aids used but not referenced in the procedure(s) will be identified and recorded.

7. An additional HFS will observe the talk-through to record work station-work flow information using the unit floor diagrams developed in step B above, as a guide. The information recorded will include:

   - Direction of movement
   - Sequence of movement
   - Frequency of movement
   - Estimated time criticality of the movement
   - Real-time estimate of the time that the operator(s) spends at each work station.

4.6.4 Data Recording

The HFS, accompanying the operating crew during both evaluation processes, will be evaluating the operator performance versus the control board/control room design criteria, specified earlier, for each step of the procedure(s) being used for the event under consideration. A Validation Review Worksheet will be used to record the HFSs evaluation of each procedure step.

4.6.5 Data Analysis

A number of methods will be used to analyze and process the information obtained in the Validation review. The HFS will

cross-check the comments recorded on the Validation Review Worksheet with HEDs documented in previous review processes of the DCRDR. If a comment has not been previously addressed by existing HEDs, it represents a new discrepancy and will be reported as such. Diagramatical and/or mathmatical link analyses techniques will be employed on the observational data collected by the HFS on work station work flow.

4.6.6 Reporting of Analytical and Observational Results

Discrepancies identified in the evaluation of the data obtained will be recorded on an HED form. Work flow enhancements, training and/or procedural recommendations generated via the work station-work flow observational analyses will also be recorded and reported using the HED form.

5.0 ASSESSMENT, IMPLEMENTATION AND SCHEDULING

The DCRDR review process described in this Program Plan will result in the identification of a number of HEDs. RG&E recognizes that each HED identified represents a potential source of operator error. However, the potential for error will vary across HEDs. Therefore, the HEDs will be evaluated to determine the extent to which they may affect plant safety. This section of the DCRDR Program Plan outlines a systematic method for evaluating both the significance of HEDs and the feasibility/viability of the recommended improvements or corrections for the HEDs. The results of these evaluations will provide a deliberated, consensual and expert knowledge base for the Operations and Engineering Departments to employ in formulating their decisions to implement recommended improvements. The final portion of this section provides an approach for recommendation, scheduling and implementation (Figure 5.1).

5.1 HED Assessment

The Assessment Team will review and assess each HED generated based on its impact on plant safety and plant operability. This review will include a formal assessment of each HED and evaluation of any proposed design, training or procedure changes to determine the overall cost-benefit of the change

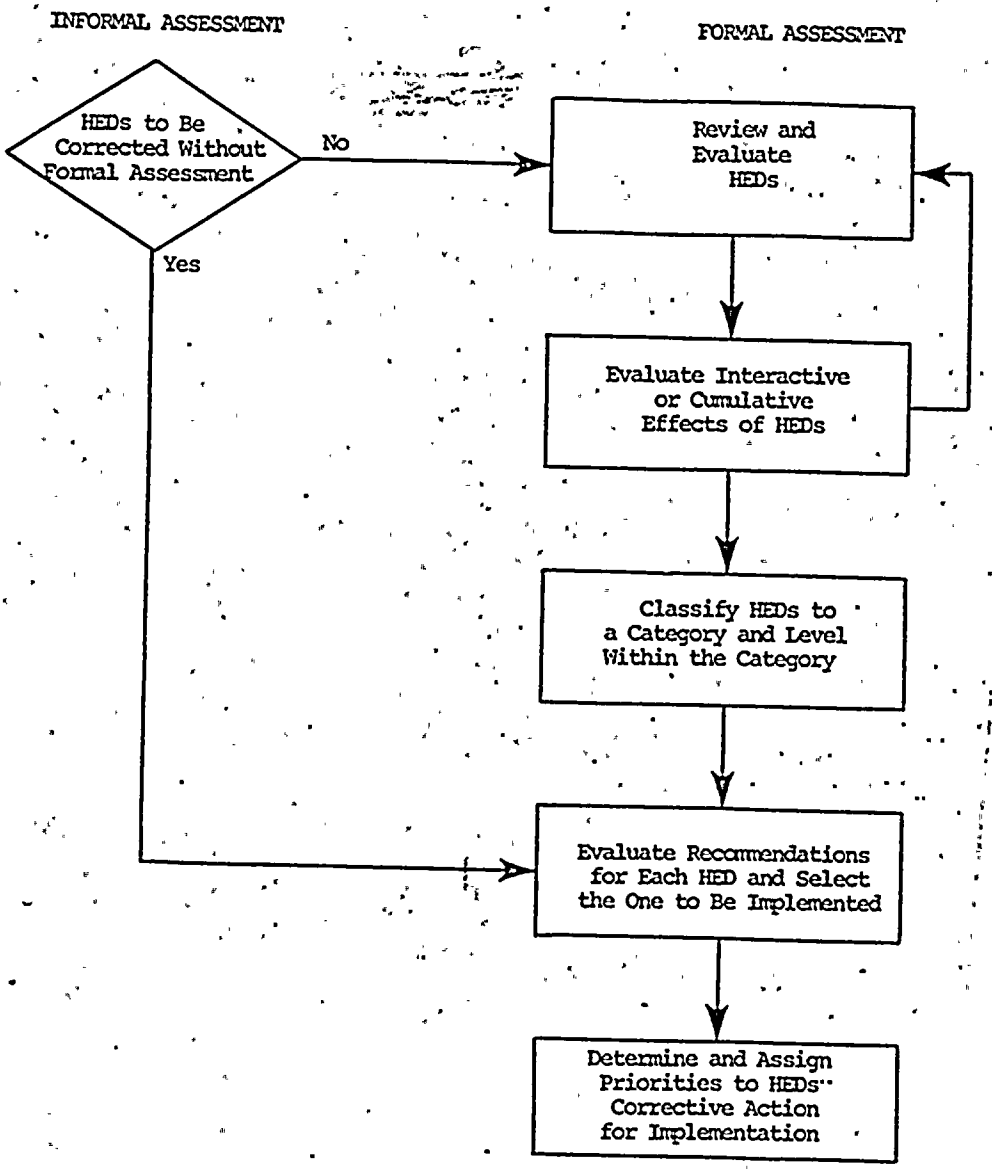

Figure 5.1

Activity Flow Chart for HED Assessment and Corrective Action Implementation

Figure 5.1

Activity Flow Chart for HED Assessment and Corrective Action Implementation

and impact on plant operations. The formal assessment will follow the procedure below:

1. The LHFS will seperate the HEDs into nine major categories of NUREG-0700 and compile them with an HED Assessment Rating Form attached to each HED.

2. Each Assessment Team member will be given the HEDs to review and will evaluate each HED independently, based on the attached HED Assessment Rating Form which addresses the following factors:

   - Impact on physical performance (fatigue, discomfort, injury, control suitability, etc.)
   - Impact on sensory/perceptual performance (distraction, visibility, readability, audibility, noise, display adequacy, inconsistency with stereotypes and conventions, etc.)
   - Impact on cognitive performance (mental overload, confusion stress, sequential/compound/cumulative/ interactive errors, etc.)
   - Interaction with task variables (communication needs, delay or absence of necessary feedback. concurrent task requirements, etc.)
   - Impact or potential impact on operating crew error
   - Impact or potential impact on plant safety (safety of plant equipment, operability of plant equipment, personnel safety, and health and safety of the public)

   Upon completing the review of the six factors, the Assessment Team member will evaluate the significance of the HED based on three categories of significance as follows:

I Highest Significance - could substantially affect a safety system or operator response during and emergency situation.

II Significant - could substantially affect or has substantially affected a non-safety system or operator response during routine non-emergency operation.

III Least Significant - could or has affected operator response in a non-substantial way.

Also, an evaluation of the cumulative impact of category III HEDs will be addressed in the assessment form to assure that the level of significance is fully considered. All ratings will be recorded on the HED Assessment Rating Form. Each Assessment Team member should fill in the HED number, their name and checkmark their evaluation of the HED on the form. When an Assessment Team member has finished the evaluation, he will submit the evaluations to the LHFS for compilation of the results. Upon completion of the compilation, the LHFS will provide the results of the compilation to each Assessment Team member.

3. The Assessment Team will then meet to discuss the ratings they assigned individually to the HEDs. The objective of the discussions is to reach a team consensus on the HED ratings. It will be the RE's responsibility to facilitate and monitor the team discussions. The following approach is currently envisioned:

- Begin the discussion with a summary of the compilation effort results and comments from the LHFS regarding the results.

- Scores which are in agreement by all team members do not require further discussion at this point. Scores that differ should be discussed by the team to establish a consensus among the team members.

- If a consensus cannot be readily obtained, cease the discussion in order to keep the meeting agenda flowing. In these instances, let it be known that the team will not return to the item until all others have been assessed. Re-evaluate those items by having each team member follow step 2 again.

4. As a consensus is reached, the LHFS will record the rating and maintain a list indicating the HED numbers and the final rating for each HED.

5. The Assessment Team will continue to meet until every HED has been addressed.

5.2 Recommendation Selection

A review of the HED recommendations will be performed by representatives from organizations identified in Section 2 under the direction of the RE. The procedure outlined below will be followed to assess HED recommendations:

1. The committee will meet to review the HEDs, one at a time, and discuss each HED's recommendations briefly to clarify any points of concern.

2. Each committee member will evaluate each recommendation on a number of factors. Among the factors will be viability, soundness and feasibility.

3. The committee may generate its own acceptable recommendations for those HEDs for which none of the proposed recommendations were acceptable. It will be the LHFS's responsibility to ensure that the recommendations developed and accepted by the committee are in accordance with applicable precepts of sound human factors engineering practice.

4. The recommendation with the best evaluation will be the committee's preferred recommendation and will be submitted to Management of the Operations and Engineering Departments.

5. If a decision is made by Operations or Engineering not to accept a recommendation, a justification for the alternate which is selected will be prepared.

5.3 Implementation and Scheduling of Recommendation

The HEDs that have been identified as requiring correction and their corrective action, as determined by the procedures outlined herein, will be delivered to the Ginna Operations and Engineering Departments for their review. A schedule for corrective actions will be established based on importance, the availability of equipment, outage time availability, engineering design lead time, and integration with other activities.

6.0 FINAL SUMMARY REPORT

Upon completion of the Ginna DCRDR, a detailed summary of the results will be prepared and submitted to the NRC. The final report will describe the results of the DCRDR and will be submitted by December 31, 1985. This report will summarize the human factors activities to date, state the review process as described in this Program Plan, provide descriptions of the identified HEDs, detail proposed corrective actions and present implementation schedules for each action. Details of the DCRDR, along with complete documentation, will be available for NRC evaluation and review.

The final report will indicate any modifications or revisions made to the Program Plan submitted to the NRC.

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 DCRDR will provide a summary of processes involved in the system function review and task analysis and will contain:

- Charts or lists for major systems and subsystems, and their major components
- Task descriptors, organized by system
- System instrumentation and control requirements as identified in the task analysis

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

Samples of control room inventory forms and 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 DCRDR will be organized according to chapter headings suggested in NUREG-0700. Each chapter heading will describe identified discrepancies, potential safety consequences and identify the proposed corrective action. Details of the assessment procedure used in this process will be summarized and supporting documentation provided. Changes which 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.

The summary report will address review findings at the individual control room system level based on the control room survey or task analyses. Further discussion will be directed to review findings and solutions identified during the operating experience review, task peformance 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 appendices.

Proposed control board design, training or procedure changes, and implementation schedules will be described.

7.0 BIBLIOGRAPHY

The following is a list of regulations, reports and studies which have, in part, provided guidance in the preparation of this document. Other documents included in the list may be used during the conduct of the Control Room Review; these are valuable reference sources for the successful completion of the tasks described in this document.

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APPENDIX A

DCRDR DATA COLLECTION FORMS

HISTORICAL REPORT REVIEW ERROR ANALYSIS
PROBLEM ANALYSIS REPORT

Name(s) of Investigator(s): _____

Station: _____

Unit: _____ Index Number: _____

Report Type and Number: _____

Date of Incident: _____

Description of Incident: _____

_____

_____

Effect on Unit: Unit Derated _____ Hrs. Unit Shutdown _____ Hrs.

Unit Trip (Scram) _____ Hrs.

Documented Problem: _____

_____

_____

Corrective Action Taken or Proposed: _____

_____

_____

Probable Fundamental Cause: _____

_____

_____

Problem Identified and Corrected: Yes _____ No _____

HISTORICAL REPORT REVIEW ERROR ANALYSIS
PROBLEM ANALYSIS REPORT

Apparent Cause(s) of Problem: _____

Recommendations for Corrective Action: _____

Control Room Human Engineering Discrepancy Log/Index Number: _____

CONTROL ROOM HUMAN ENGINEERING DISCREPANCY RECORD

HFS: Date: No: Plant: _____
System: _____

Panel ID#	Equipment ID#	Equipment Name

Description of Discrepancy

Photo Log No.	Photography Instructions

Photo Caption:

C 1. Workspace
O 2. Communications
D 3. Annunciators
E 4. Controls
S 5. Displays
6. Labels & Aids
7. Computer/CRT
8. Panel layouts
9. C/D Integration
Other:

Guideline No. & Caption:

Comments:

Assessment Category/Level: I _____ II _____ III _____

Recommendation(s) Record

Reviewers: _____

Recommendation(s): _____

Accept Recommendation No.: _____ Rejection Signature

Reject Recommendation Nos.: _____ _____

Rejection Justification: _____

Implementation and Scheduling

Tentative Scheduled Completion Date _____

Approved Implementation Date _____

EWR No. _____

Task Assignment No. _____

QUESTIONNAIRE ITEM SUMMARY FORM

1. HFS Analyst: _____

2. Content Area: _____

3. Question # _____

4. Question:

Frequency/%	Type of Response/Specific Equip. Ref.	Investigation
	Omission - No Response Given	

PERSONNEL SURVEY SUMMARY FORM

1. HFS Analyst: _____
2. Station: _____

Population Demographics and Statistics

MEAN STATISTICS

Group	N	Sex M	Sex F	Height	Age	Nuclear Oper Exp.	Control Board Oper Exp.	#Yrs RO	#Yrs SRO
Non-Licensed Operator									
Licensed Operators									
Licensed Non-Operations									
Simulator Instructor									
Overall									

MEDIAN STATISTICS

Group	N	Sex M	Sex F	Height	Age	Nuclear Oper Exp.	Control Board Oper Exp.	#Yrs RO	#Yrs SRO
Non-Licensed Operator									
Licensed Operators									
Licensed Non-Operations									
Simulator Instructor									
Overall									

Page ____ of ____
Date ________
Analyst ________

Procedure Section: ________________

STEP	OPERATOR FUNCTION	OPERATOR TASK

TASK ANALYSIS INSTRUMENTATION REQUIREMENT FORM

Procedure Section _____ Same as: _____ Page ____ of ____

Step Number _____ Function/Purpose _____ Task Number _____ Date _____

Task Number _____ Task Title _____ Alt. to: _____ Task Number _____ Analyst _____

ACTION STEP	OP	VERB	OBJECT																OTHER PERFORMANCE REQUIREMENTS	EXIT OR COMMENTS
			CONTROL								INDICATOR/FEEDBACK									
			PARAMETER	EQUIPMENT	POSITION	STATUS	ID	TYPE	MODE	OTHER	PARAMETER	STATE	TYPE	ID	UNITS	RANGE	DIV	OTHER		

VERB KEY

1.1 OBSERVES	3.3 LOCK-OUT	4.1 INFORMS
2.1 COMPARES	3.4 TOUCH	4.2 REQUESTS
2.2 CALCULATES	3.5 ADJUSTS	4.3 RECEIVES
3.1 PUSH	3.6 TYPES	
3.2 TURN	3.7 PULL	

CONTROL TYPE KEY

J JTANDLE	R ROCKER SWITCH	TW TIRANDWHEEL	M MAN
JS JOYSTICK	RS ROTARY SWITCH	TS TOUCHSCREEN	A/M AUTO W/MAN OVERRIDE
K KEY OPERATOR	S SLIDE SWITCH	KB KEYBOARD	M/A MANUAL W/AUTO OVERRIDE
LP LEGEND PUSHBUTTON	T T HANDLE	C CONTROLLER	
NP NON-LEGEND PUSHBUTTON	TG TOGGLE SWITCH	A AUTO	

CONTROL MODE

D DISCRETE	
C CONTINUOUS	

CONTROL OTHER KEY

SR SPRING RETURN	
T TIROTILE	
B BACKLIT	

DISPLAY TYPE KEY

A ANNUNCIATOR	D DIGITAL DISPLAY	G GRAPHIC	
C DRUM COUNTER	CSL CONTROL STATUS LIGHT		
EC ELECTRONIC COUNTER	LL LEGEND LIGHT		
M METER	NL NON LEGEND LIGHT		
R RECORDER	CRT CATHODE RAY TUBE		

VALIDATION REVIEW WORKSHEET

Event: _____ Operator: _____

Procedure(s): _____ Human Factors Specialist: _____

Procedure Step	Yes	No	Comment	HED Index Number

AIR VELOCITY SURVEY RECORD

Plant: _____ Date: _____ Time: _____

Measurements made by: _____ Sheet # ____ of ____

Equipment/Instrument used: _____

Serial #: _____ Calibration date: _____

Location	6 ft.	4 ft.

HUMIDITY/TEMPERATURE RECORD

Plant: _____ Date: _____ Time: _____

Measurements made by: _____ Sheet # ____ of ____

Equipment/Instrument used: _____

Serial #: _____ Calibration date: _____

Time	Height	Temperature	Humidity	Remarks
	Floor			
	6 ft.			
	Floor			
	6 ft.			
	Floor			
	6 ft.			
	Floor			
	6 ft.			
	Floor			
	6 ft.			
	Floor			
	6 ft.			
	Floor			
	6 ft.			
	Floor			
	6 ft.			
	Floor			
	6 ft.			

LIGHTING SURVEY-LUMINANCE AND REFLECTANCE RECORD

Plant: _____ Date: _____ Time: _____ Sheet # _____ of _____

Measurements made by: _____ Equipment/Instrument used: _____

Serial #: _____ Calibration date: _____

Location Ref. #	Panel # and Surfaces	Record					Calculations				
		Panel		Meter/Display			Luminance Ratio of Display: Panel		Reflectance Ratio		
										Meter/Display: Pad	
		Reflect Pad	Panel Back-ground	Reflect Pad	Surface w/Glare	Surface w/o Glare	w/Glare	w/o Glare	Panel: Pad	w/Glare	w/o Glare

LIGHTING SURVEY ILLUMINANCE RECORD

Plant: _____ Date: _____ Time: _____

Measurements made by: _____ Sheet # ____ of ____

Equipment/Instrument used: _____

Serial #: _____ Calibration date: _____

Location Ref. No.	Panel I.D. No.	Full AC Ambient	Full Emergency	Other Conditions (Specify)

SOUND SURVEY RECORD

Plant: _____ Date: _____ Time: _____ Sheet # ____ of ____

Measurements made by: _____

Equipment/Instrument used: _____

Serial #: _____ Calibration date: _____

Operator Work Station	db(A)	Octave Band Center Frequency					Remarks
		250	500	1K	2K	4K	

PHOTOGRAPHIC LOG

Station: _____ Photographer: _____

Unit: _____ Date: _____

Slide Sequence Number	F Stop	Shutter Speed	HED Index Number	Location Code	Photo Caption Code	Description Caption

SYSTEM NUMBER: _____ INVENTORY PAGE ____ OF ____

EQUIPMENT ID NUMBER	** LABEL NAME	DISPLAY REQUIREMENTS						CONTROL REQUIREMENTS			
		COLOR	TYPE OF DISPLAY	WHAT MEASURED	UNITS	RANGE	DIVISIONS	TYPE OF SWITCH	VALVE CONTROL	SWITCH ACTION	NAMES OF SWITCH POSITION
9 - - -											
SUB NUMBER / SUB NAME											
EPN											
9 - - -											
SUB NUMBER / SUB NAME											
EPN											
9 - - -											
SUB NUMBER / SUB NAME											
EPN											
9 - - -											
SUB NUMBER / SUB NAME											
EPN											

INDEX OF REVIEWED REPORTS					
Index#	Problem Title	Priority*	Report Type	Report Number	Disposition***

* Priority: H = high, L = low

** Disposition: C = Problem deemed CORRECTED, (no additional investigation warranted)
UC = Problem deemed UNCORRECTED, (additional investigation warranted)

Plant: _____

Status Report # _____
Date: _____
Page: _____

HISTORICAL REPORT

PROBLEM STATUS REPORT

Index #	Problem Title	Report Type	Report #	Problem Analysis Status		
				Started	Completed	Distributed

APPENDIX B

Since there are differences in usage of terms (even among practitioners within the same field), the following definitions are provided to reduce ambiguity.

DCRDR REPORT: Final report of the results of the DCRDR as required by NUREG-0737, Supplement 1.

DETAILED CONTROL ROOM DESIGN REVIEW: The control room design review as required by NUREG-0737, Supplement 1.

EVENT: Perturbation of failure of plant equipment and the subsequent actions that follow.

ENHANCEMENTS: Surface modifications that do not involve major physical changes; for example, demarcation, labeling changes and painting.

FUNCTION: An activity performed by one or more system constituents (people, mechanisms, structures) to contribute to a goal.

FUNCTIONAL ALLOCATION: The distribution of functions among the human and automated constituents of a system.

FUNCTIONAL ALLOCATION REVIEW: The examination of system goals to determine what functions they require. Also, examination of the required functions to determine how the functions may be allocated and executed. Primarily the identification of established functions and examination of how they are allocated and executed.

HUMAN ENGINEERING DISCREPANCY (HED): A departure from some benchmark of system design suitability for the roles and capabilities of the human operator. Depending upon the circumstances, HEDs may reflect acceptable design practices and thus may not require design improvements.

HUMAN FACTORS ENGINEERING: The science of optimizing the performance of human beings, especially in industry. Also, the science of equipment design for efficient use by human beings.

OBJECTIVE (MISSION, GOAL): The end-product as a result of a coordinated group of activities.

OPERATOR (LICENSED): Any NRC certified individual in a plant who manipulates a control or directs another to manipulate a control within the plant.

PLANT SYSTEM: Group of people and/or equipment constituents linked together (e.g., CVCS, Feedwater).

SIGNIFICANT HEDs: Those HEDs which, alone or in combination with other HEDs, may increase the potential for operator error and/or may have serious impact on system performance.

SUBJECT MATTER EXPERT (SME): Technically competent individuals trained and experienced who support the investigative activities (i.e., senior reactor operators in a nuclear power plant).

SUBTASK: An activity (action, step) performed by a person (or machine) directed toward achieving a single task.

SYSTEM: An organization of interdependent constituents (people and/or equipment) that work together in a patterned manner to accomplish some objective (goal).

TASK: A group of actions performed by a system constituent(s) that contribute to the accomplishment of a function(s).

VALIDATION: The process of determining whether the physical and organizational design for operations is adequate to support effective integrated performance of the functions of the control room operating crew.

VERIFICATION: The process of determining whether instrumentaton, controls and other equipment meet the specific requirements of the tasks performed by operators.