ST. LUCIE UNITS 1 & 2
TURKEY POINT UNITS 3 & 4
DETAILED CONTROL ROOM
DESIGN REVIEWS

PROGRAM PLAN

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1.0 REVIEW PLAN

1.1 Introduction

This Program Plan Report has been prepared in response to NUREG-0700 and details the program for a detailed control room design review to be conducted for the St. Lucie Units 1 & 2 and the Turkey Point Units 3 & 4 (Dockets 50-250, 251, 335 and 389). The outline of this report conforms to paragraph 5.1 of NUREG-0700 published September, 1981.

1. Review Plan
2. Management and Staffing
3. Documentation and Document Control
4. Technical Approach (Review Procedures)
5. Assessment and Implementation.

Implementation of this program plan meets all the objectives of NUREG-0700, and closely follows the guidance of that document.

1.2 Task Phasing

The review is conducted as delineated in four phases, as follows:

Phase 1 - Project Planning. This document.

Phase 2 - Control Room Review. This represents the period in which data collection, reduction and analysis is conducted, resulting in Human Engineering Discrepancy (HED) reports.

Phase 3 - Enhancement & Design Solutions. Discrepancies are collated, alternate enhancements and design solutions are generated and the results are considered in trade-offs.

Phase 4 - Reporting. Results of detailed control room design review with plans for modifications are published.

Figure 1 shows, in general, the phases and task flow for conducting the detailed control room design review. A brief discussion of the activities conducted in each phase of the review follows this figure. For detailed descriptions of the objectives, approach, data reduction and results of specific evaluation methods, refer to Section 4.0 Technical Approach of this review plan.

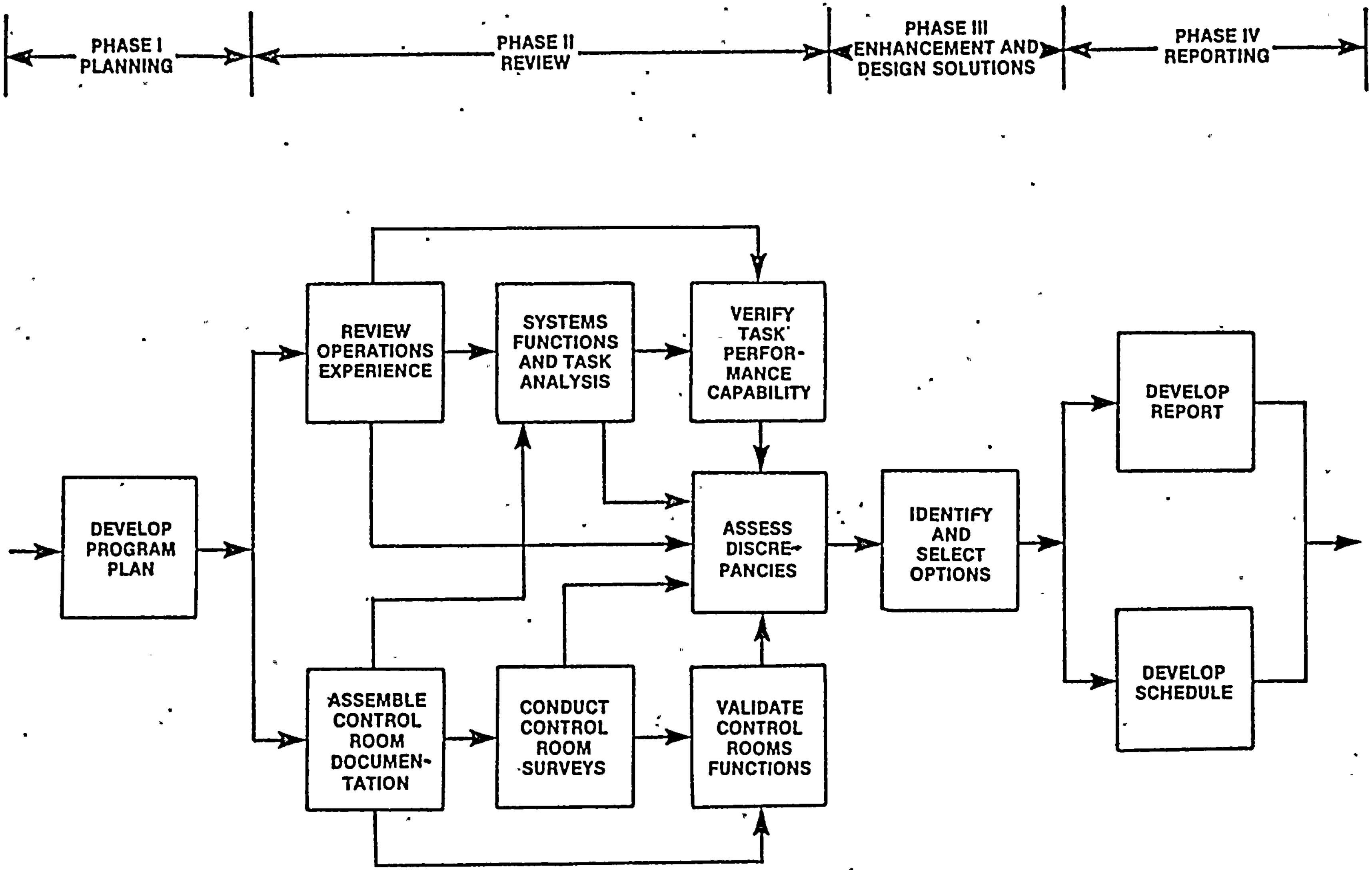


FIGURE 1 The four phases and the task flow/relationships of the Control Room review.

1.2.1 Phase 1 — Project Planning

This document delineates the project planning. NUREG-0700 and its guidelines form the basis of this document.

1.2.2 Phase 2 — Control Room Review

The Control Room review phase is divided into seven tasks as follows:

1. Review of operating experience
2. Assemble Control Room documentation
3. Review of system functions and task analysis
4. Control Room surveys
5. Verify task performance capability
6. Validate Control Room functions
7. Assess discrepancies

1.2.2.1 Review of Operating Experience — This task is composed of two subtasks: 1) conduct operator interviews, and 2) review of plant operational experience through Licensing Event Reports, technical specification modifications, etc. This review task is conducted in accordance with the guidelines of NUREG-0700.

1.2.2.2 Assemble Control Room Documentation — In this task, a Control Room data base is established to support the subsequent evaluation. A library is established with Control Room related documentation (Technical Specifications, drawings, etc.), Control Room components are photo-documented, and a 1/3 scale photo-mosaic is constructed. The library and photo-documentation are centrally located to support the effort. In addition to the library and photographic documentations, a Control Room inventory of components is developed, identifying for each component, its location, system relationships, functions, and characteristics. Inventory data is filed for subsequent use.

1.2.2.3 Review of System Functions and Task Analysis — System functions and tasks are identified and evaluated in this task. A four step procedure is employed:

- Identification of systems and subsystems by review of plant documentation
- Identification of event sequences to undergo task analysis, these are identified by:
  - NUREGs-0737, 0660, 0700
  - results of operating experience review
- Identification of system/subsystem functions through document review and operator interviews

- o Identification and analysis of Control Room operational tasks

Task analysis data is an input for the verification of task performance capability and the validation of Control Room functions (see paragraphs 1.2.2.5 and 1.2.2.6). The results/products of this task are:

1. Response selection diagrams
2. Task analysis of functional sequences
3. Task analysis of event sequences
4. Spatial-operational sequence diagrams of task sequences
5. Traffic pattern diagrams.

1.2.2.4 Conduct Control Room Surveys — Fourteen surveys will be performed to develop the detailed assessment of the Control Room. Surveys require the collection of data using preconstructed checklists, interview forms, and direct measurements of Control Room parameters such as noise levels, light levels etc. The guidance for the survey criteria is found in NUREG-0700. For each survey, a draft report (summarizing HEDs) is prepared for subsequent inclusion into a final report. The surveys to be conducted are:

- o Noise — direct measurements of noise levels are taken and compared to individual checklists items.
- o Lighting — measurements are taken under various ambient conditions (e.g., emergency lighting) and compared to individual checklist items.
- o Control Room Environment — assessments are made by direct measurement of the parameters listed below and comparison of the data to the NUREG-0700 guidelines
  - Temperature
  - Humidity
  - Ventilation
  - Workspace arrangement
  - Document organization, use and storage
  - Control Room access
- o Design conventions — evaluations of survey for the conventions listed below. Data to be compared to NUREG-0700 guidelines
  - Coding methods (color, shape, pattern, etc.)
  - Standardization of abbreviations and acronyms
  - Consistency of control use
  - Consistency of display movement or indication
- o Controls — checklist evaluation of controls
- o Displays — checklist evaluation of displays

- Computers — checklist evaluation of computer systems.
- Emergency Garments — data to be collected by walk-throughs, use of emergency garments, speech intelligibility analysis, and checklist application.
- Labeling — checklist evaluation of labels.
- Annunciators — checklist evaluation of annunciator systems.
- Anthropometrics — analysis of reach and visual access to Control Room components given physical configuration of boards, panels, work space layout, etc. Data to be compared to checklist item requirements.
- Force/Torque — when indicated by operator observation, force/torque information for control types are collected for comparison to checklist items.
- Communications — checklist evaluation of communications systems. Speech intelligibility analysis of communications modes.
- Maintainability — checklist and questionnaire data concerning operator-maintained components (trend recorders, bulbs, etc.).

1.2.2.5 Verify Task Performance Capability — This evaluation task involves two subtasks: verification of instrument/control availability, and verification of Human Engineering suitability. The first, verification of availabiilty, is conducted using the task analysis and Control Room inventory. In general, tasks associated with Control Room functions are examined in terms of appropriate instrumentation in the Control Room (i.e., task equipment demands vs. actual equipment presence in the Control Room). Once this is accomplished, estimates of the frequency-of-use for all instrumentation are generated for:

- Startup
- Shutdown
- Change of reactor power.

Estimations of non-procedurally bound operations (e.g., boration, etc.) are generated via operator interviews. Also, task sequences required in selected event sequences are estimated as to frequency of occurrence in the event sequences. Comparing both frequency and requirements data to the inventory, identification is made of: 1) the absence (in the Control Room) of task required information or control, 2) the estimated frequency with which the information or control is required, and 3) the conditions (events, procedures, etc.) under which the information or control is required. Based on the above, HEDs are identified and documented.

The second subtask, verification of suitability, involves using spatial-operational sequence diagrams, traffic pattern diagrams, identified functional groups, and checklists to evaluate human engineering suitability in terms of sequence of component use, control/display proximity,etc. The NUREG-0700 guidelines serve as the source document for evaluation criteria.

1.2.2.6 Validate Control Room Functions — This involves analysis of workload and distribution of workload for operators for specific task and event sequences, and overall Control Room traffic. The means of the analysis are: 1) task timelines, 2) traffic analysis, and 3) walk- and talk-through simulation of task sequences. Checklists will be used to aid in the validation of Control Room functions.

1.2.2.7 Assess Discrepancies — Assessment is discussed in Section 5.0 of this plan. In general, the process is similar to that discussed in NUREG-0801 (draft, published in October, 1981), and is as follows:

1. Assess extent of deviation from NUREG-0700 guidelines
2. Estimate increase in human error for the discrepancy
3. Determine if discrepant component(s) perform safety functions
4. Determine if errors in using discrepant component(s) could lead to violation of tech specs or lead to unsafe operation
5. Assignment of category and priority, based on the above.

1.2.3 Phase 3 — Enhancement and Design Solutions

The logic path to be employed in identifying and selecting enhancements and design solutions is based on NUREG-0700, Exhibit 4-2, as shown in Figure 2.

1. Analysis of correction by enhancement
2. Analysis of correction by design alternatives
3. Assess extent of correction.

1.2.3.1 Analysis of Correction by Enhancement — Discrepancies are first examined for possible correction by enhancement (labeling, demarcation, procedure aids, etc.). Each HED is considered and where such correction is possible, the discrepancy is reassessed for its effect on operator performance. As appropriate, HEDs are reevaluated via checklisting and task analysis until Human Engineering suitability is verified. Where it is determined that correction by enhancement is not possible, the discrepancy is analyzed for correction by design alternatives.

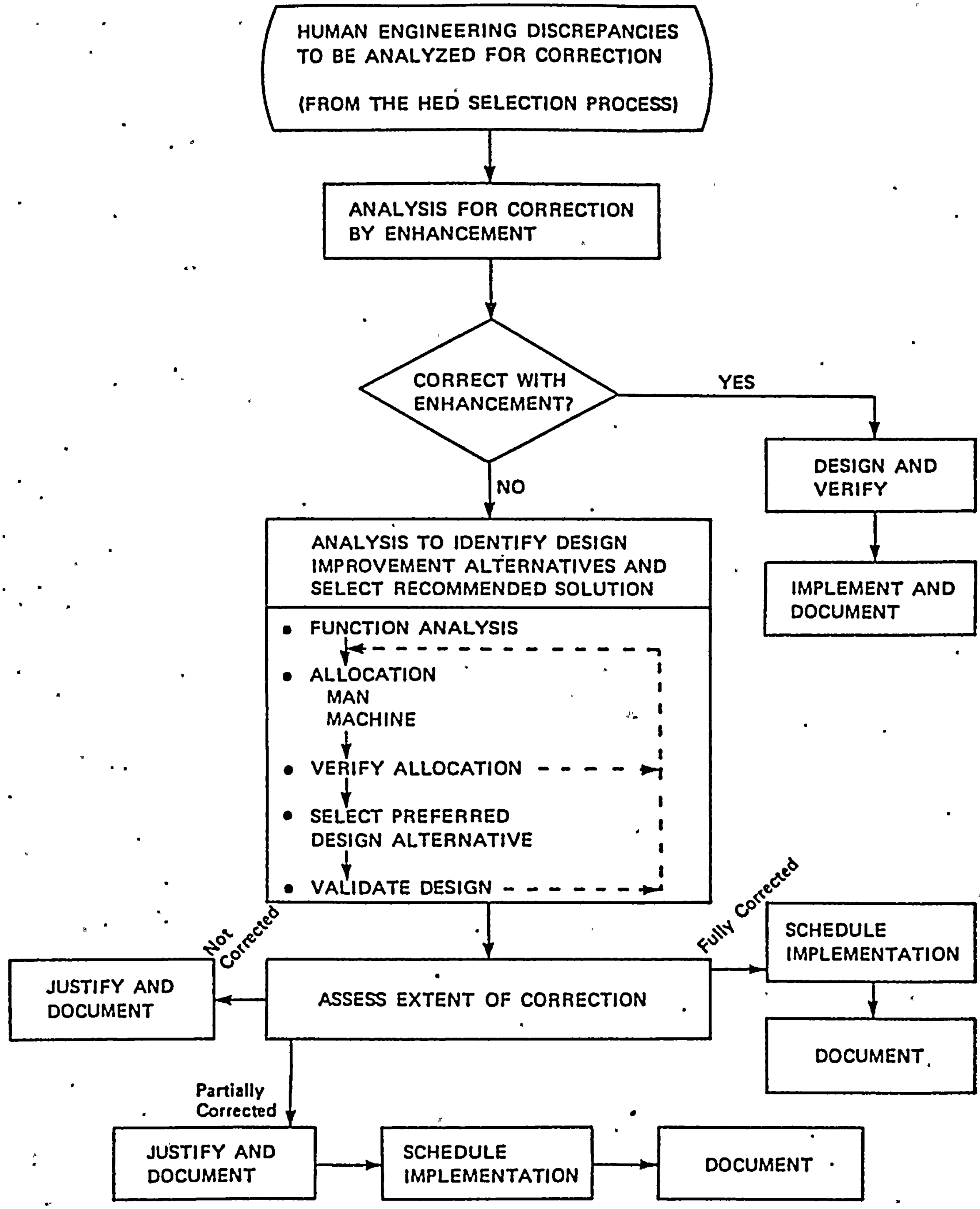


FIGURE 2
ASSESSMENT: SELECTION OF DESIGN IMPROVEMENTS
(FROM NUREG 0700)

1.2.3.2 Analysis of Correction by Design Alternative — Identification of design alternatives will be achieved by the examination of the HED, reference to task analysis data, and identification of potential constraints (e.g., availability of equipment, Reg. Guide 1.75, etc.). The acceptability of design alternatives will be verified by further evaluation using the following:

- o Functional analysis
- o Task analysis
- o Reapplication of survey guidelines.

1.2.3.3 Assess Extent of Correction — During the Human Engineering meetings, enhancement and/or redesign corrections will be selected, assessed, and noted in Section G "Disposition" of the HED report shown in Figure 5.

1.2.4 Phase 4 — Reporting

Two requirements of this phase are 1) preparation of schedules for implementation of selected backfits, and 2) preparation and submittal of the final report.

1.2.4.1 Develop Backfit Schedules — Backfit schedules will be proposed as HEDs are identified, documented, and assessed. Scheduling of HED backfits will be a function of:

- o HED category and priority
- o Engineering and procurement lead time requirements and constraints
- o Overall plant outage schedules.

Schedules will be reviewed and updated as part of the implementation program.

1.2.4.2 Develop Final Report — The detailed control room design review report will closely follow the outline recommended in Section 5.2 of NUREG-0700. Specifically, the final report will address:

- o The detailed control room design review phases
- o The technical activities
  - Review of operating experience
  - Assembly of Control Room documentation
  - System/function/task analysis
  - Conduct of Control Room surveys
  - Verification of task performance capability
  - Validation of Control Room functions
- o Method of assessment of discrepancies
- o Method of identification and selection of enhancement and design solutions
- o Review results of HEDs, HED assessment, and the selected enhancement and design solutions will be organized into the following groups:

- Survey findings (annunciator, communications, etc.)
- Task analysis findings (panel/workspace)
- Human engineering suitability and validation of functions findings (Control Room traffic, workload distribution, man/machine functional allocations)

o Improvements to be made
  - Enhancements/justification/extent of correction
  - Design alternative/justification/extent of correction

o Schedule of implementation.

2.0 MANAGEMENT & STAFFING

2.1 Introduction

This section details the 1) management responsibility of the detailed control room design review and 2) HED review team structure and management.

Figure 3 shows the detailed control room design review and HED review organizations for the St. Lucie 1 and 2 and Turkey Point 3 & 4 Nuclear Power Plants. Responsibilities and team member qualifications are discussed below.

2.2 Management Responsibility

2.2.1 The Human Engineering Program Manager is the Florida Power and Light Company designated representative who has the overall responsibility for the administration of the Detailed Control Room Design Review program. His responsibilities include but are not limited to:

A. The overall administration of the Detailed Control Room Design Review of FP&L's Nuclear Generating Units located at the St. Lucie and Turkey Point sites.

B. Administering vendor contracts associated with the performance of the Detailed Control Room Design Review.

C. Integrating and coordinating other human factors programs as described in other NRC publications; for example:

1. NRC Task Action Plan NUREG-0660 and NUREG-0737
2. Aspects of the TMI-related requirements for new operating Licenses, NUREG-0694
3. Functional Criteria for Emergency Response Facilities, NUREG-0696
4. Implementation of Regulatory Guide 1.97
5. Human Factors Acceptance Criteria for the Safety Parameter Display System, Draft NUREG-0835.

D. Coordinate and develop the necessary adminstrative controls to support the organization controls of an implementation program.

The Human Engineering program manager will have a bachelor's degree in an engineering discipline or equivalent experience and a minimum of 3 years experience in a managerial role. Also a minimum of 5 years of applied design or operating experience in power plants and/or process control application in complex commercial, industrial or military facilities and systems is desirable.

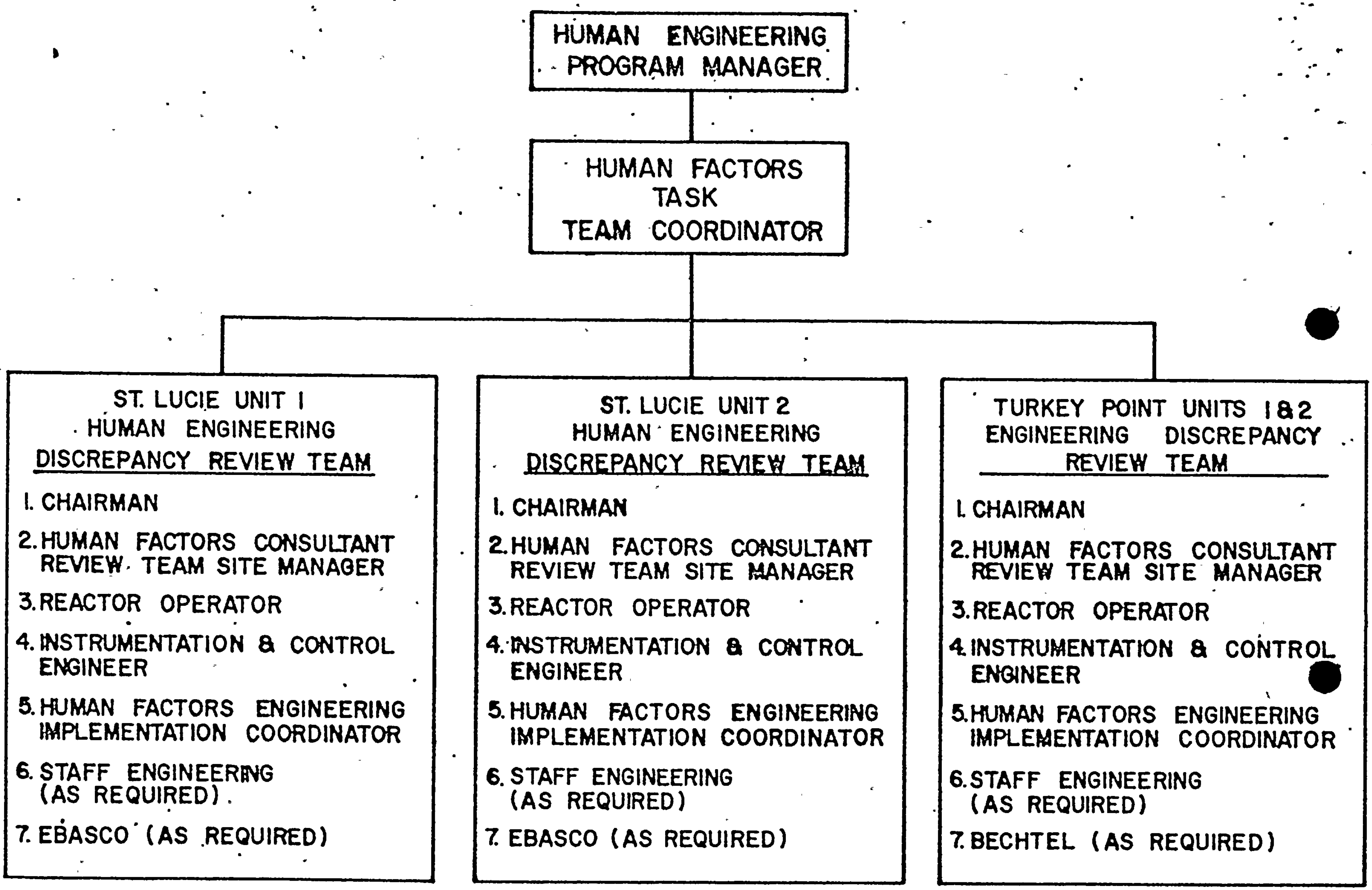


FIGURE 3

DETAILED CONTROL ROOM DETAILED REVIEW PROGRAM ORGANIZATION

2.2.2 The Human Factors Task Team Coordinator reports directly to the Human Engineering Program Manager. The Human Factors Task Team Coordinator is responsible for directing and coordinating the necessary personnel, task teams and review groups required to support the Detailed Control Room Design Review effort. The human factors task team coordinator also presides over the HED review team. This arrangement of administrative responsibility allows the Detailed Control Room Design Review Management Team to quickly evaluate project priorities, assignment of specialized key personnel based on the overall project schedule, as well as consistency of program philosophy between sister units. The assessment and disposition of HED's will be addressed in Section 2.2.3.

The Human Factors Task Team Coordinator will have a bachelor's degree in an engineering discipline or equivalent experience. Also a minimum of 5 years of applied design or operating experience in power plants and/or process control applications in complex commercial, industrial or military facilities and systems is desirable.

2.2.3 HED Review Team Structure and Management

The HED review team is comprised of a minimum of four members, as follows:

2.2.3.1 Chairman — The HED review team chairman is responsible for coordinating the HED review team effort. The chairman interfaces with the designated site operations representatives to arrange for review team access to:. plant information (records, documents, plans, procedures, drawings, etc.), required facilities (control room computers, word processing, cameras/VTR, etc.) and personnel with useful or necessary information (reactor operators, equipment designers or planners, or utility management).

The HED review team chairman presides over the HED review team meetings and coordinates the necessary personnel and resources required to support the assessment, disposition and recommended backfits for HED's submitted to the team for review by the contracted Human Factors consultant. The HED review team Chairman is responsible for signing the disposition block and signifying HED review team concurrence or dissenting opinion. The HED's are then reviewed for engineering scope, material requirements and implementation schedule. The proposed implementation schedule will then be incorporated into the detailed control room design review findings section of the final report.

The HED review team chairman will have a bachelor's degree in an engineering discipline or equivalent experience. A minimum of 5 years of applied design or operating experience in power plants and/or process control applications in complex commercial, industrial or military facilities and systems is desirable.

2.2.3.2 Human Factors Consultant Review Team Site Manager— The Human Factors Consultant Review Team Site Manager is responsible for directing the Detailed Control Room Design Review effort on site in accordance with the agreed upon contractual scope between Florida Power and Light Company and Essex Corporation (the Human Factors consulting company hired to perform the Control Room Review). The Human Factors Consultant Review Team Site Manager reports directly to the Human Factors Task Team Coordinator and is also a member of the HED Review Team. The Human Factors Consultant Review Team Site Manager is responsible for directing and managing the on-site Essex Corporation review effort as well as providing input to help formulate assessment, disposition and recommended backfits for HED's addressed during the HED Review Team meetings. The Human Factors Consultant Review Team Site Manager also provides assistance in overall project planning and technical leadership.

The Human Factors Consultant Review Team Site Manager will have five years of applied human factors engineering experience relative to system design, including two years in Nuclear Power Plant control room human factors engineering, testing and evaluation. In addition, academic and professional experience in the following areas will apply:

- o Human Factors Engineering/Ergonomics
- o Sensory/Perceptual Processes
- o Experimental design and statistical analysis
- o Anthropometrics
- o Survey analysis and other data collection methods
- o Human performance theory.

2.2.3.3 Reactor Operator — At least one Reactor Operator will be a member of the HED Review Team. The Reactor Operator will provide operational input to help formulate assessments, dispositions and recommended backfits for HED's addressed during the HED Review Team meetings. A Reactor Operator will also be available to assist the Human Factors Consultant Review Team during their DCRDR effort.

The reactor operators assigned to support the HED Review Team effort will have a minimum of two years operating experience in a control room similar to the one being reviewed.

2.2.3.4 Instrumentation and Control Engineer — An Instrumentation and Control (I&C) Engineer will be a member of the HED Review Team as the need arises. The I&C

Engineer will provide input to the team with regard to regulations, standards and design constraints that have an impact on nuclear power plant control room design as well as help formulate assessments, dispositions and recommended backfits for HEDs addressed during the HED Review Team meetings.

The I&C engineer will have a bachelor's degree in engineering or equivalent along with a minimum of five years of applied experience. Most of this experience should have been gained in the nuclear field; however, previous experience in power plants or other process control applications involving complex commercial, industrial, or military facilities and systems will be considered acceptable.

2.2.3.5 Other Discipline Representatives — As the need arises other discipline representatives from various organizations such as the Architect Engineer, Nuclear Steam Supplier and/or utility may be required to support the HED Review team effort.

These individuals should have a bachelor's degree or equivalent in a course of study relevant to the specific discipline and a minimum of three years of applied design of operating technical experience. Previous experience in power plants or other process control applications in complex commercial, industrial, or military facilities and systems will be considered acceptable.

3.0 DOCUMENTATION AND DOCUMENT CONTROL

3.1 Introduction

Three types of documentation will be addressed; 1) reference documentation, 2) process and HED documentation, and, 3) Detailed Control Room Design Review output findings and reports.

3.2 Reference Documentation

A program library will be established with reference documents to support the Detailed Control Room Design Review tasks. This will contain:

- o Liscensee Event Reports
- o Outage Analysis Reports
- o FSAR
- o Technical Specifications and system descriptions
- o Piping and instrumentation drawings
- o Floor plans
- o Panel drawings and photographs
- o Software descriptions
- o Procedures
- o Samples of computer printouts
- o Various NRC and industry documents bearing on Control Room design (NUREG-0660, NUREG-0770, IEEE standards, human factor texts, etc.)

As needed, these will be referenced to support specific tasks within the Control Room evaluations.

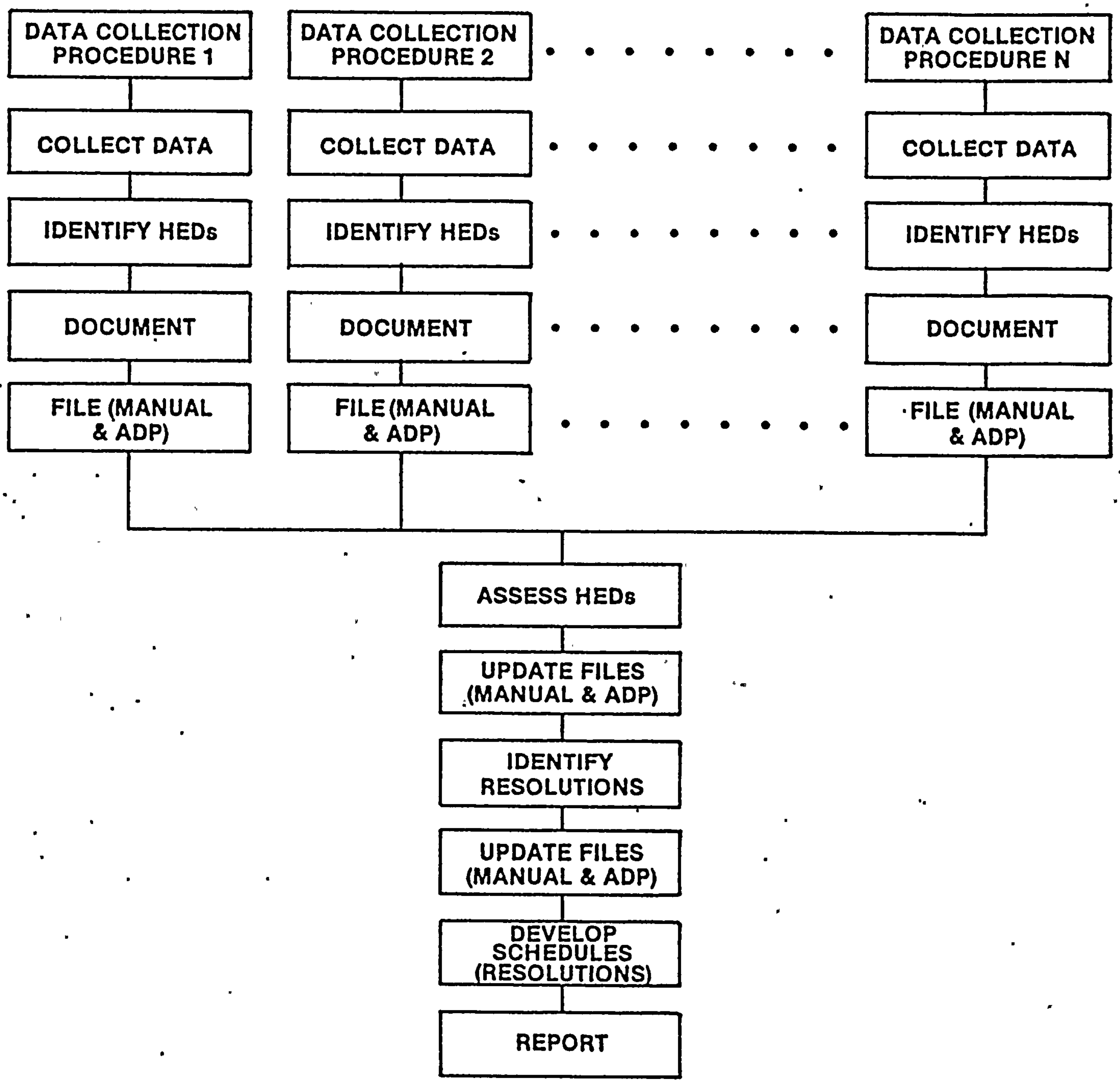
3.3 Process & HED Documentation

3.3.1 Process

The means by which data collection and reduction takes place will be documented for reporting purposes. The general flow of information management is presented in Figure 4. The individual task plans presented in Section 4.0 Technical Approach, will serve as the basic process documentation. Where deviations from the guidance in these tasks plans occur in the conduct of evaluations, task plans will be modified to reflect accurate data collection procedure.

FIGURE 4

INFORMATION MANAGEMENT



3.3.2 Guideline HED

Data files for each task will be generated. For each task requiring a report, file space will be reserved for that report. HED information will be stored in a computer file which will contain the following information:

- Guideline number which also serves as the HED number
- HED description
- HED assessment
- HED locations (item types which are discrepant from the survey guidelines)
- Action to be taken on the HED.

The Human Engineering Descrepancy Report to be used is presented in Figure 5.

3.3.3 Component HED Reports

A manually maintained file will be established which documents, for each component, all HEDs cited for that component. In addition, the heading for each component HED contains the following Control Room inventory information:

- Panel/Workstation
- Unique location code
- System relationship
- Component function and use
- Component type and characteristics.

The HEDs noted against a component where appropriate, are listed on the bottom of the form, by HED number (which corresponds to NUREG-0700 guideline number). The Component Level form used is presented in Figure 6.

3.3.4 Task Reports

For each plan in Section 4.0, a separate report section will be generated, detailing:

- Objectives of the task plan
- The actual data collection and analysis methods employed
- The criteria (guidelines) implemented
- Summary of findings.

In short, the process followed for each survey or evaluation from inception to writing of HEDs, will be included in task reports.

FIGURE 5
HUMAN ENGINEERING DISCREPANCY REPORT

NO:____________ PLANT-UNIT:____________________ DATE:________

REVIEWER NAME:____________________________

a) HED TITLE:____

____

____

b) ITEMS INVOLVED:

ITEM TYPE	NOMENCLATURE	LOCATION	PHOTO NO.

c) PROBLEM DESCRIPTION (GUIDELINES VIOLATED):

d) SPECIFIC OPERATOR ERROR(S) THAT COULD RESULT FROM HED:

FIGURE 5 (continued)

e) SUGGESTIONS FOR POTENTIAL BACKFITS

f) ESSEX REVIEW

DATA COLLECTOR ______________________ DATE ______________

DATA COLLECTION MGR ______________________ DATE ______________

PROGRAM MGR ______________________ DATE ______________

g) DISPOSITION

☐ FURTHER REVIEW BY ______________________ DATE ______________

☐ TO BE CORRECTED BY ______________________ DATE ______________

☐ REFER TO OPERATIONS

☐ NO ACTION

☐ OTHER ____

____

____

____

EVALUATION COMPLETED
FPL PROJECT DIRECTOR ______________________ DATE ______________

FIGURE 6
COMPONENT REPORT
HUMAN ENGINEERING DISCREPANCY REPORT

COMPONENT(s) LABEL	ASSOCIATED EQUIPMENT	DESIGNATION #
LINE 1 ______	______	PANEL ______
LINE 2 ______	______	LOC CODE / TYPE
LINE 3 ______	______	

SUBSYSTEM: ______ CONTROL MODES/DISPLAY RANGE: ______

USE: ______

HED NUMBER	CAT

HED NUMBER	CAT

3.4 Detailed Control Room Design Review Report

This report is prepared at the conclusion of the Detailed Control Room Design Review and consists primarily of the process and HED reports previously prepared. The following format will be used:

- 1.0 Methodology
  - 1.1 Overview — Review Plan
  - 1.2 Management and Staffing
  - 1.3 Documentation
  - 1.4 Review procedures employed
    - a) Operating experience review and results summary
    - b) Systems, functions, and task analysis
    - c) Surveys of Control Room equipment
      - o Controls
      - o Displays
      - o Validation of Control Room Functions
  - 1.5 Assessment procedures
- 2.0 Findings
  - 2.1 Survey finding
  - 2.2 System functions task analysis findings
- 3.0 Implementation
  - 3.1 Completed improvements
  - 3.2 Proposed improvements

4.0 TECHNICAL APPROACH

4.1 Introduction

The technical approach (review procedures) to be employed is discussed in this section. Task plans are provided which describe the activities for the following tasks:

- o Review of operating experience
- o Assembly of Control Room documentation
- o Review of system functions and task analysis
- o Surveys (one task plan for each)
  - noise
  - lighting
  - Control Room environment
  - design conventions
  - controls
  - displays
  - computers
  - emergency garments
  - labeling
  - annunciators
  - anthropometrics
  - force/torque
  - communications
  - maintainability
- o Verification of task performance capability
- o Validation of Control Room functions
- o Assessment of discrepancies.

4.2 Task Plan Content

Each task plan addresses:

Task Objectives — The type of data to be collected or human performance variables under analysis.

Review Team — The personnel required to conduct the task.

Criteria — Generally the survey guidelines appropriate to the task at hand.

Task Definition — Steps or procedures to be followed to conduct the task.

Equipment Requirements — List of any equipment required to conduct the task.

Input and Data Forms — The data collection forms required by the tasks.

Outputs and Results — Task results. Often these are HEDs, but may be data which is drawn upon by subsequent tasks (e.g., task analysis).

5.0 ASSESSMENT AND IMPLEMENTATION

5.1 Assessment

When a HED has been identified, it is assessed for error inducing potential and system consequences of induced errors. The assessment determines the scheduling of backfits as a function of the potential consquences of the HED. The HED's will be corrected by enhancement (color coding, labeling, etc.) or design alternatives. The HED correction may affect the originial backfit schedule depending on the availability of materials and extent of engineering redesign. The proposed corrections are assessed to ensure that HED'a have been adequately addresses.

The basic assessment process is divided into four steps as follows:

- Assess extent of deviation from survey guidelines
- Assess HED inpact in error occurrence
- Assess potential consequences of error occurrence
- Assign HED scheduling priority.

A diagram for assessment is presented in Figure 7.

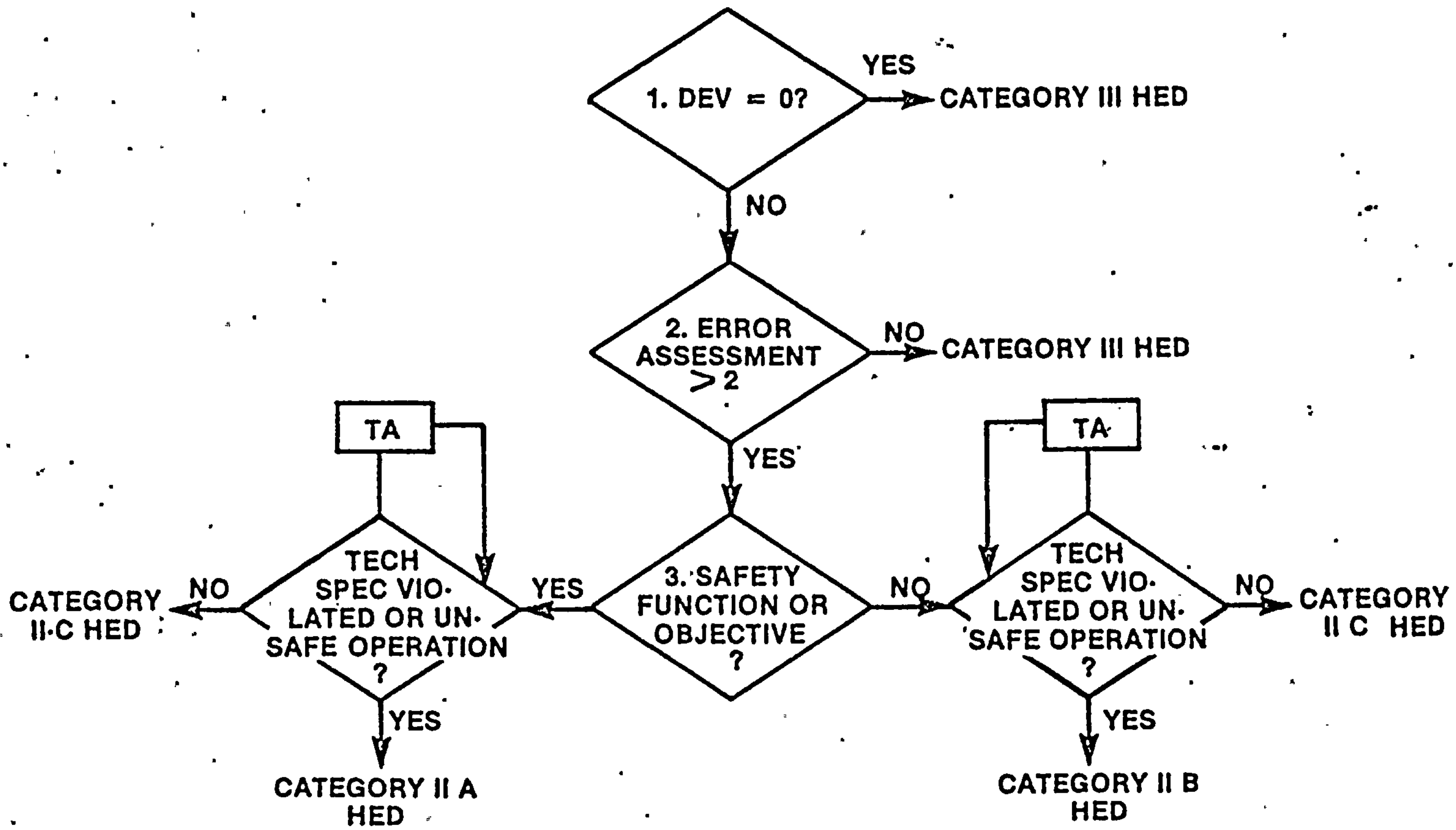
5.1.1 Assess Extent of Deviation from Survey Guidelines

The step requires that a more or less subjective assessment of the extent of discrepancy from survey guidelines be made with regard to the Control Room. For example, symbol/background contrast might be 40%, rather than 50%, or, only small amounts of parallax may exist in a display. A judgement is made based on the content of the guideline being applied and the Control Room component under assessment. Extent of deviation is then subjectively scaled from 1 (some deviation) to 5 (complete deviation). There is also a catagory N/A (not applicable) for HEDs which are not a part of NUREG-0700 (discrepancies from other documents such as military standards, HFE Texts, etc). Extent of deviation judgements are not directly used to assess priority or scheduling of backfits, but relate to assessment of increase operational error potentials. It is possible

FIGURE 7
HED PRIORITY

HED#	

1. EXTENT OF DEVIATION FROM 0700 GUIDELINES	N/A	SOME			COMPLETE	
		1	2	3	4	5
		LOW				HIGH
2. ERROR ASSESSMENT		1	2	3	4	5
3. SAFETY FUNCTION ?	YES					NO
4. NON SAFETY RELATED, REQUIRED TO MITIGATE CONSEQUENCES OF AN ACCIDENT	YES					NO
5. CONSEQUENCES OF ERROR OCCURENCE						
A. UNSAFE OPERATION	YES					NO
B. VIOLATION OF TECH. SPECS.	YES					NO



to have little deviation from the survey guidelines and high error assessments, and vise versa, but the two will probably be positively correlated. Extent of deviation will not be used to assess errors induced by HEDs.

5.1.2 Assess HED Impact on Error Occurrence

Given that no control system can be designed to be operationally error-free, assessment here is to estimate HED impact on hypothetical (unknown) baseline error rates of control room components; e.g., will additional errors be induced by discrepancies from the guidelines? Estimates of HED impact on error occurrence are qualitatively arrived at by consideration of the following:

- o Body physiology
  - Fatigue/physical stress
  - Discomfort
  - Injury
  - Anthropometry
- o Sensory/perceptual performance
  - Vision
  - Audition
  - Propioception
  - Touch
- o Information processing
  - Overload
  - Confusion
  - Recall
  - Pattern matching/recognition
  - Data manipulation (comparing, extrapolating, etc.)
- o Learning
  - Inhibition
  - Habituation
  - Response predominance
  - Transfer
  - Response competition
  - Response latency
- o Task Demands
  - Frequency
  - Duration
  - Competition
  - Sequence
  - Speed
  - Communication
  - Precision
  - Information

5.1.3 Assess Potential Consequences of Error Occurrence

Review Team technical staff and operations representatives evaluate system consequences of hypothesized operational errors. Four determinations are required:

1. Does the HED relate to plant safety functions?
2. Does the HED relate to plant functions required to mitigate the consequences of an accident?
3. Could an error lead to unsafe operations or plant conditions?
4. Could an error lead to violations of Technical Specifications?

Each of these require a yes/no type response. The logic diagram on Figure 7 (HED Priority) shows how these data are integrated to assign categories and priorities to HEDs. Table 1 shows the breakdown of category and priority as a function of error assessment and consequences of error.

Note that Category I HEDs are those which have been noted from documented operational errors. All Category I HEDs are deemed to increase error potential, but consequences must still be assigned to determine ultimate scheduling priority.

Assessment of error occurrence is estimated for the following:

1. Overall operator performance is/is not degraded by HED impact on body physiology?
2. HED does/does not degrade sensory performance?
3. Information processing capability is/is not exceeded via the HED?
4. The HED does/does not induce direct error due to principles of learning?
5. Task difficulty and reliability is/is not affected by the HED?

Based on the above, a subjective error assessment is generated on a 5- point scale, a one meaning a low probability of induced errors is expected as a result of the HED, a five indicating a high probability level of additional errors being induced.

5.1.4 Assign HED Priority Scheduling

Priority for scheduling of backfit purposes is per the following:

Priority A - Prompt — First outage, given availability of materials and engineering load time.

Priority B - Near Term — Second refueling outage given availability of parts and engineering lead time.

Priority C - Long Term — At any time.

TABLE 1
ASSESMENT OF CATEGORY AND PRIORITY
AS A FUNCTION OF ERROR ASSESSMENT
AND CONSEQUENCES OF ERROR

Documented Errors?	Deviation from 0700	Error Assessment	Safety Function		Req'd Mitigate Accident	Lead to Unsafe Operation		Lead to Tech. Spec Violation	Catagory	Priority
Yes	>1	>2	Yes	or	Yes	Yes	or	Yes	I	A
Yes	>1	>2	No		No	Yes	or	Yes	I	B
Yes	>1	>2	Yes/No		Yes/No	No		No	I	C
No	>1	>2	Yes	or	Yes	Yes	or	Yes	II	A
No	>1	>2	No		No	Yes	or	Yes	II	B
No	>1	<2	Yes/No		Yes/No	No		No	II	C
No	N/A	<3	Yes/No		Yes/No	Yes/No		Yes/No	III	N/A

5.2 Implementation

Implementation is discussed in three parts, as follows:

- o Analysis for Correction by Enhancement/assess correction
- o Analysis of Design Alternatives/assess correction
- o Scheduling and Implementation

each of these is discussed, in turn, below.

5.2.1 Analysis for Correction by Enhancement

In this task each HED is considered for correction by enhancement. Many, e.g., labeling HEDs, are immediately and fully corrected. For other HEDs, enhancement solutions may only partially ameliorate the discrepancy. Figure 8, shows the process for identifying HEDs to be corrected by enhancement (color coding, labeling, demarcation, etc.)

5.2.2 Analysis for Correction by Design Alternatives

This task requires that each HED selected for analysis of design alternatives undergo Task and Functions analysis review. The basic procedure employed is shown in Figure 9. Note that where design alternatives do not exist, HEDs are again considered for correction by enhancement, since some mitigation of the error inducement may be achievable.

5.2.3 Scheduling and Implementation

HEDs selected for correction by enhancement will undergo implementation scheduling. Longer term corrections will be scheduled and the schedule reported to the NRC for review and approval.

Figure 10 shows the form which will document the results of the HED reassessment of alternative enhancements and/or design solutions. Reassessments will be performed where original corrections could not be implemented due to conflicts in required operational function, availability of qualified equipment, and/or space requirements.

FIGURE 8   FLOW FOR CORRECTION OF HEDs BY ENHANCEMENT

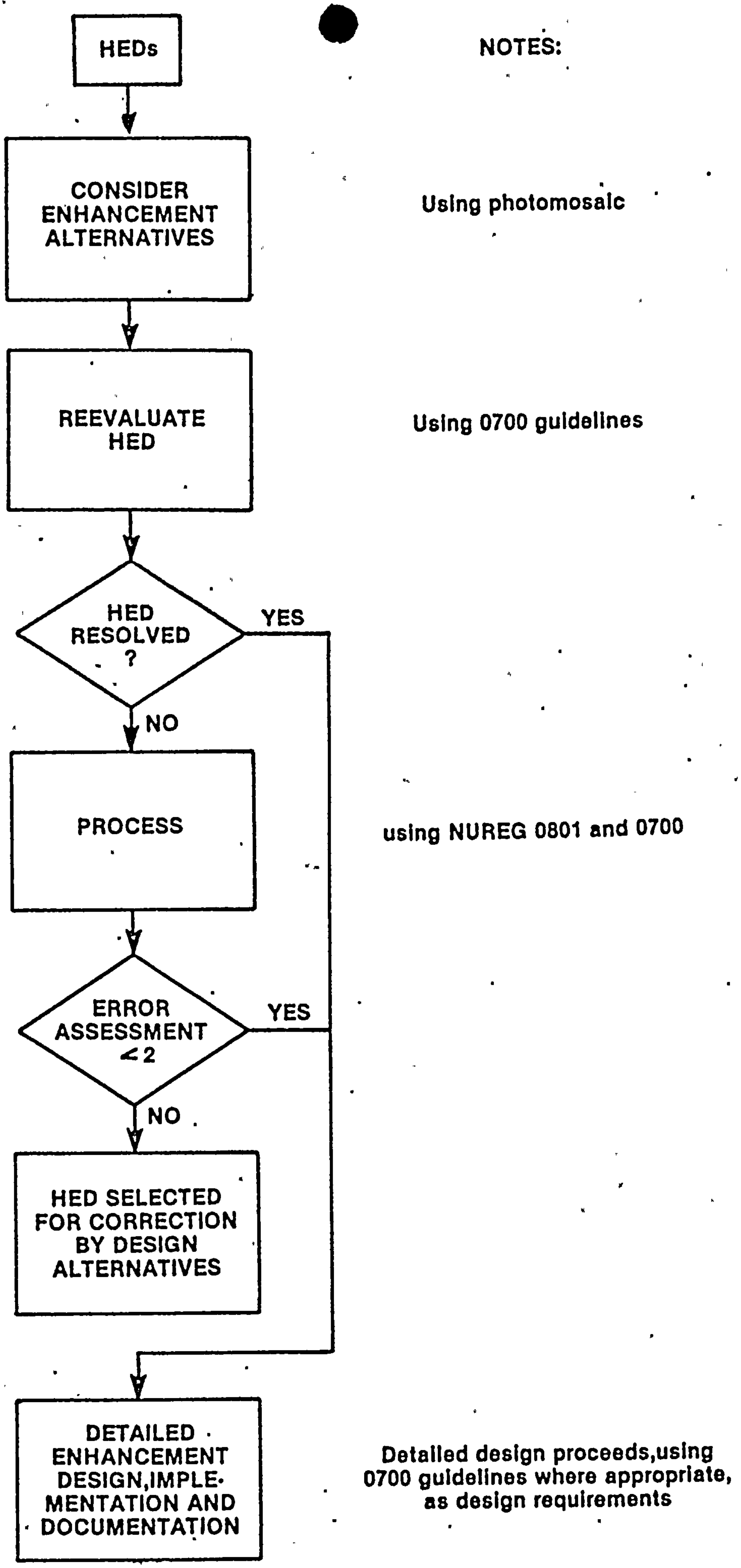


FIGURE 9

PROCESS FOR ANALYZING HED DESIGN ALTERNATIVES

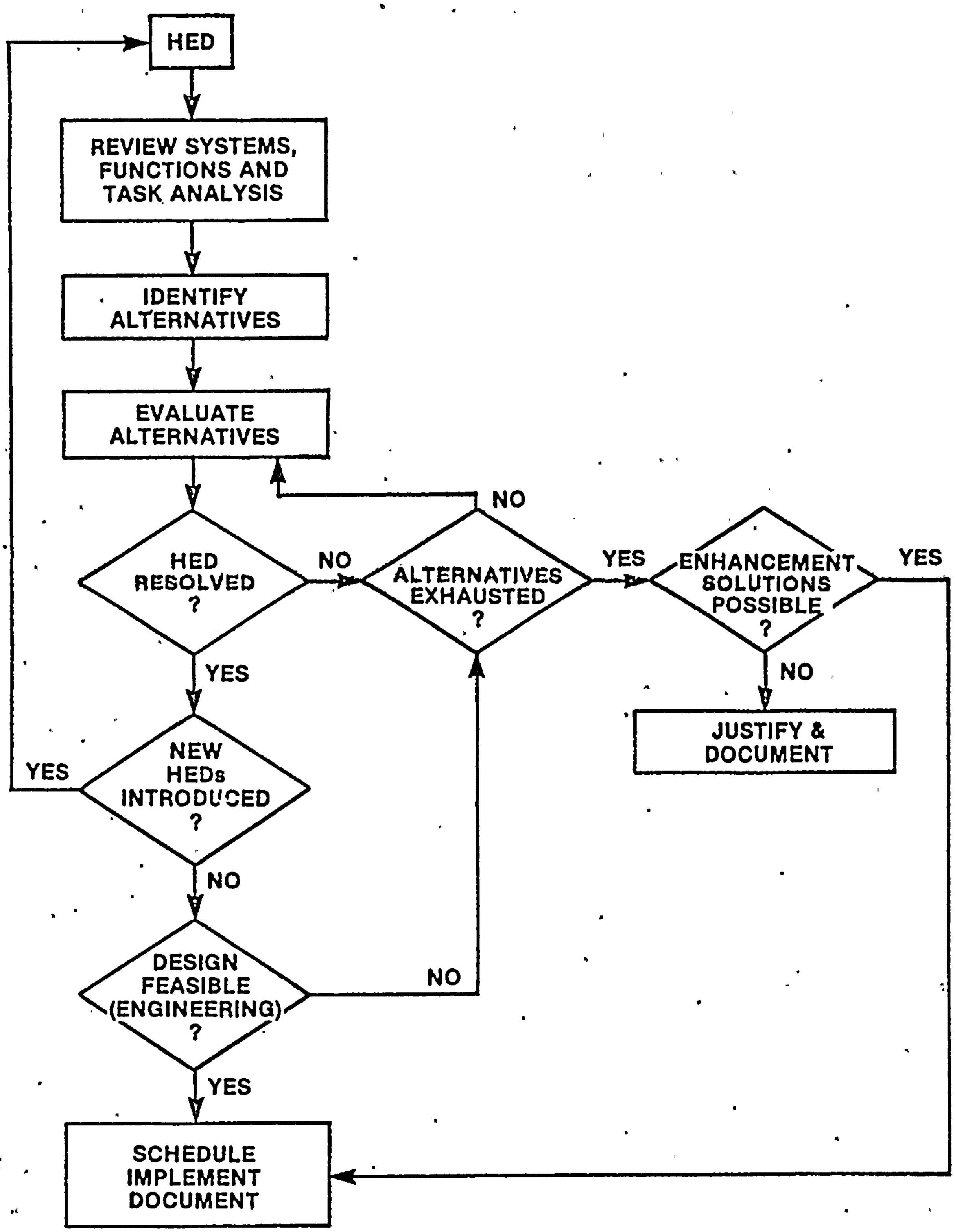


FIGURE 10

HED NO. ______________________ HED BACKFIT ASSESSMENT

		PROPOSED BACKFIT	IMPLEMENTED BACKFIT
I ENHANCEMENT			
a) LABELING	a)		
b) DEMARCATION	b)		
c) CODING	c)		
d) PROCEDURES	d)		
e) TRAINING	e)		
II DESIGN ALTERNATIVES			
a) RELOCATION	a)		
b) REPLACEMENT	b)		
c) CONFORMANCE TO PROCESS CONVENTION	c)		
d) RELOCTION OF FUNCTION	d)		

REASSESSMENT OF PROBABLE ERROR AND DEVIATION

	N/A	SOME				COMPLETE
1. EXTENT OF DEVIATION FROM 0700 GUIDELINES		1	2	3	4	5

	LOW				HIGH
2. ERROR ASSESSMENT	1	2	3	4	5

SIGNOFF: HEPM ______________________

DATE: ______________________