11H3

52-001

GE Nuclear Energy

ABWR

Date 5/3/92

To Vic McCree 11H3

Fax No. —

This page plus 65 page(s)

From Jack Fox/Monty Ross

Mail Code 782
175 Curtner Avenue
San Jose, CA 95125

Phone (408) 925-4824

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Subject HFE ITAAC/DACs

Message GE comments on HFE ITAAC/DAC. Please pass a copy to Clare Goodman.

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GE Nuclear Energy

ABWR

Date 5/3/92

To Vic McCree -(301) 504-2260 Fax No. —

This page plus 65 page(s)

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Please pass a copy to
Clare Goodman.

THE ATTACHED PACKAGE INCLUDES:

1) REVISED BNL "ELEMENT A" PRESENTED IN THREE COLUMN FORMAT. DELETIONS INDICATED BY LINE THROUGH THE TEXT AND ADDITIONS SHOWN BY UNDERLINE. (19 PAGES)

2) REVISED (TIER 2) H.F.E DESIGN TEAM COMPOSITION CRITERIA (6 PAGES)

3) DRAFT (TIER 2) DEFINITION OF DESIGN IMPLEMENTATION TECHNOLOGIES AND ASSOCIATED EVALUATION CRITERIA (3 PAGES)

4) BNL "ELEMENT B" DELETED IN ITS ENTIRETY. (4 PAGES)

5) BNL "ELEMENT C" REVISED. (9 PAGES)

6) BNL "ELEMENT D" REVISED WITH FIRST PAGE TYPED AND THE REMAINDER HANDWRITTEN. (4 PAGES)

7) BNL "ELEMENT E" REVISED WITH FIRST PAGE TYPED AND THE REMAINDER HANDWRITTEN (6 PAGES)

8) BNL "ELEMENT A" UPDATED TO INCORPORATE THE DELETIONS AND ADDITIONS PRESENTED IN ITEM # 1, ABOVE.

PLEASE REVIEW IN PREPARATION FOR THE GE/[illegible] TECHNICAL STAFF MEETINGS PLANNED FOR WEDNESDAY (5/6/92) STARTING AT APPROXIMATELY 3:00.

Regards,

5/3/92

Element A - Human Factors Engineering Program Management

DESIGN COMMITMENT:

Human system interfaces (HSI) shall be ~~provided for the operation, maintenance, test, and inspection of the ABWR that reflect "state of the art human factors principles" (10 CFR 50.34(f)(2)(iii)) as required by 10 CFR 52.47(a)(1)(ii). All aspects of HSI shall be~~ developed, designed, and evaluated based upon a structured top-down system analysis using accepted human factors engineering (HFE) principles ~~based upon current HFE practices.~~ The HSI ~~is used here in the broad sense and~~ shall include all operations, maintenance, test, and inspection interfaces, procedures, and training needs of the main control room and remote shutdown system functions and equipment.

~~State of the art human factors principles is defined as those principles currently accepted by human factors practitioners.~~

INSPECTION/TEST/ANALYSIS:

To assure the integration of HFE into system development: (1) a HFE Design Team shall be established; ~~(2) a procedure to document and track HFE related problems/concerns/issues and their solutions throughout the HFE program shall be developed;~~ and (2) ~~(3)~~ a HFE Program Plan shall be established to assure the proper development, execution, oversight, and documentation of the human factors engineering program.

DESIGN ACCEPTANCE CRITERIA:

~~General Criteria~~ (Move this section to HFE Program Plan)

1. The primary objective goal of the HFE Program shall be to developing an HSI which makes possible safe, efficient, and reliable operator performance ~~and which satisfy all regulatory requirements as stated in 10 CFR as identified in Table Y.~~

2. The goals ~~general objectives~~ of this program shall be stated in "operator-centered" terms which, ~~as the HFE program develops, shall be objectively defined and~~ shall serve as criteria for test and evaluation activities. These Generic "operator-centered" HFE design goals shall include:

a. The operating team can accomplish all assigned tasks within system defined time and performance criteria.

~~"Current" is defined with reference to the time at which a program management or implementation plan is prepared.~~
~~"Accepted" is defined as a practice, method, or guide which is (1) documented~~

~~in the human factors literature within a standard or guidance document that has undergone a peer-review process and/or (2) can be justified through scientific/industry research/practices literature that has undergone a peer review process.~~

b.- The system and allocation of functions will provide acceptable workload levels and facilitate operator ~~to assure~~ vigilance. ~~and to assure no operator overload~~.

c.- The system will support a high degree of operating crew "situation awareness."

d.- Signal detection and event recognition requirements will be kept within the operators' information processing limits and will minimize the need for operators to mentally transform data in order to be usable.

e.- The system will minimize operator memory load.

~~e~~ operator interfaces ~~to~~ minimize the potential for operator error. ~~and will provide for error detection and recovery capability.~~

~~2. The HFE Program shall be based upon state-of-the-art HFE practices at the time of its development (as defined above) including those documents under Element A in Table X.~~

HFE Design Team

~~1. An HFE Design Team shall have the responsibility, authority and placement within the organization (as defined below) to ensure that the design commitment is achieved.~~

2. (Duplication - Move to HFE Program Plan) The HFE Design Team shall be responsible for (1) the development of all HFE plans and procedures; (2) the oversight and review of all HFE design, development, test, and

evaluation activities; (3) the initiation, recommendation, and provision of solutions through designated channels for problems identified in the implementation of the HFE activities; (4) verification of implementation of team recommendations, (5) assurance that all HFE activities comply to the HFE plans and procedures, and (7) scheduling of activities and milestones.

3. (Duplication - Move to HFE Program Plan) The scope of the Team's responsibility for the main control room and remote shutdown system shall include:

~~- Control and instrumentation equipment~~

a. all operations, maintenance, test, and inspection interfaces and ~~facilities both within and outside the control room~~,

b. procedures

c. training requirements development.

4. (Duplication - Move to HFE Program Plan) The HFE Design Team shall have the authority and organizational freedom to ensure that all its areas of responsibility are accomplished and to identify problems in the implementation of the HSU design. The team shall have the authority to determine where its input is required, access work areas, design documentation. The Team shall have the authority to control further processing, delivery, installation or use of HFE/HSI products until the disposition of a non-conformance, deficiency or unsatisfactory condition has been achieved.

5. (Duplication - Move to HFE Program Plan) The HFE Design Team shall be ~~placed at the level in the COL organization required to execute its responsibilities and authorities. The team shall~~ report to a level of management such that required authority and organizational freedom are provided, including sufficient independence from cost and schedule considerations.

1 ~~6~~. The HFE design team shall include the following expertise:

a. - Technical Project Management

b. - Systems Engineering

c. - Nuclear Engineering

d. - Control and Instrumentation

e. - Engineering

~~- Architect-Engineering~~

f. - Human Factors

g. - Plant Operations

h. - Computer Systems Engineering

i. - Plant Procedure Development

j. - Personnel Training

~~- Safety Engineering~~

~~- Reliability/Availability/Maintainability/Inspectability (RAMI) Engineering~~

2. (Tier 2 criteria only)

Criteria regarding the composition of the HFE Design Team are as presented in Attachment I to the HFE ITAAC/DAC

~~HFE Issue Tracking System~~ (Move this Section to HFE Program Plan)

1. The HFE issue tracking system shall ~~address~~ monitor the identification and closure of human factors issues that are ~~(1) known to the industry (such as TMI related HF issues and other NRC, industry and generic human factors issues), (2) identified in the operating experience review (see Element B), and (3) those~~ identified throughout the development and evaluations ~~life cycle~~ of the main control room and remote shutdown system ~~ABWR system~~ design implementations. ~~development and evaluation.~~

2. The HFE Issue Tracking System ~~method~~ shall document and track human factors engineering issues and concerns, from identification until elimination or reduction to a level acceptable to the review team.

4. (Duplication - Move to HFE Program Plan) The HFE Design Team shall have the authority and organizational freedom to ensure that all its areas of responsibility are accomplished and to identify problems in the implementation of the HSU design. The team shall have the authority to determine where its input is required, access work areas, design documentation. The Team shall have the authority to control further processing, delivery, installation or use of HFE/HSI products until the disposition of a non-conformance, deficiency or unsatisfactory condition has been achieved.

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d. - Control and Instrumentation

e. - Engineering

~~- Architect-Engineering~~

f. - Human Factors

g. - Plant Operations

h. - Computer Systems Engineering

i. - Plant Procedure Development

j. - Personnel Training

~~- Safety Engineering~~

~~-~~

~~Reliability/Availability/Maintainability/Inspectability (RAMI) Engineering~~

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2. The HFE Issue Tracking System ~~method~~ shall document and track human factors engineering issues and concerns, from identification until elimination or reduction to a level acceptable to the review team.

3. (Tier 2 criteria only) Each issue/concern that meets or exceeds the threshold effects established by the HFE Design review Team shall be entered on the log when first identified, and each action taken to eliminate or reduce the issue/concern should be thoroughly documented. The final resolution of the issue/concern, as accepted by the HFE Design review Team, shall be documented in detail, along with information regarding HFE Design review Team acceptance (eg., person accepting, date, etc.)

4. (Tier 2 criteria only)The HFE issues tracking system procedure shall specify the carefully spell out individual responsibilities of the HFE Design Team members when an issue/concern is identified, inclusing definition of identify who should log it the item, who is responsible for tracking the resolution efforts, who is responsible for acceptance of a resolution, and who should shall enter the necessary closeout data.

~~HFE Program and Management Plan~~

1. An HFE Program ~~Management~~ plan shall be developed to describe how the human factors program shall be accomplished, i.e., the plan shall describe the HFE Design Team's organization and composition, define the scope of the work ~~and which lays out the effort~~ to be undertaken by the HFE Design Team and provides a the technical approach, schedule, and management control structure and technical interfaces required to achieve the HFE program objectives. ~~The plan is the single document which describes the designer's entire HFE program, identifies its elements, and explains how the elements will be managed.~~ The HFE Program Plan ~~Generally,~~ it shall address: establish:

- (Duplication - Delete) ~~The scope of the HFE Design Team's authority within the broader scope of the organization responsible for plant construction. Included within this scope shall be the authority to suspend from delivery, installation, or operation any equipment which is determined by the Team to be deficient in regard to established human factors design practices and evaluation criteria~~

a. The process through which the HFE Design Team will executes its responsibilities.

b. The processes through which findings of the HFE Design Team are resolved and including how equipment design changes that may be necessary for resolution of HFE issues are incorporated, ~~into the actual equipment ultimately used in the plant~~

c.- The members and qualification of the team members

d.- The process through which the HFE Design Team activities will be assigned to individual team members, the responsibilities of each team member and the procedures that will govern the internal management of the team

e. The Design Control procedures through which the results of the iterative design development activities are documented and processed to maintain integration of design activities and assure that the design, design analyses and documentation are consistent and appropriately reflect the details of design implementation decisions.

f.- The procedures and documentation requirements of the HFE Issues Tracking System

2. (Tier 2 criteria only)The HFE Program Management Plan shall include ~~provide the following; information:~~

a.~~1.~~ Purpose and organization of the plan;

~~2. Literature and current practices review~~

b.~~3.~~ Overall HFE program goals and objectives

c.~~4.~~ The relationship between the HFE program and the overall plant equipment procurement and construction program ~~design program~~ (organization and schedule).

d.~~5.~~ HFE Design Team

~~- Organization within the HFE program~~

(i)~~-~~ Description of ~~Identify and describe the primary~~ HFE Design Team organization ~~or~~ function within the broader scope ~~organization~~ of the plant equipment procurement and construction ~~total~~ program, including charts to show organizational and functional

relationships, reporting relationships, and lines of communication

~~- Functions and internal structure of the HFE Organization~~

(ii) ~~Describe~~ Description of the responsibility, authority and accountability of the HFE Design Team organization

~~- Identify the organizational unit responsible for each HFE task.~~ (?)

(iii) ~~Describe~~ Description of the process through which management decisions will be made regarding HFE

(iv) ~~Describe~~ Description of the process through which ~~design~~ technical decisions will be

made ~~regarding~~ by the HFE Design Team

~~(v) Describe all~~ Description of the tools and techniques (e.g., review forms, documentation) to be utilized by the Team in ~~to ensure they~~ fulfilling their responsibilities

~~• Staffing~~

~~(vi) Describe~~ Description of ~~the staffing of~~ the HFE Design Team Staffing

~~(vii) Provide~~ Job descriptions of ~~personnel of~~ the HFE Design Team

~~Indicate the assignment of key personnel and provide their~~ personal qualifications, ~~with regard to the areas of expertise indicated above~~

6. HFE Issue Tracking System

(i) Individual HFE Design Team member responsibilities regarding HFE

~~- Literature and current practices review~~

~~- Responsibilities~~

~~- Responsibilities on~~ Issue identification,

~~- Responsibilities for~~ Issue Logging,

~~- Responsibilities for~~ Issue Resolution, and

~~- Responsibilities for~~ Issue Closeout,

(ii) - Procedures and documentation requirements regarding ~~H~~FE

Issue identification. These shall include

description of the HFE issue,

effects of the issue if no design change action is taken and an assessment of the

criticality and

likelihood of the identified HFE issue manifesting itself into unacceptable HSI performance.

(iii) Procedures and documentation requirements regarding HFE

- Issue resolution. These shall include evaluation and documentation of proposed solutions, implemented solutions, evaluated residual effects of the implemented solution and the evaluated ~~Resultant~~ Criticality and Likelihood of the implemented resolution of the HFE issue manifesting itself into unacceptable HSI performance.

~~- Documentation~~

~~- Audit of the issue identification and tracking system~~

~~7.~~ f. HFE requirements

(i) ~~Identify~~ Identification and description of ~~describe~~ the HFE requirements imposed on the design implementation which shall include the defined design implementation technologies and associated applicable codes and standards as presented in Attachment 2 to the HFE ITAAC/DAC

process

(ii) ~~List~~ Identification of the standards and specifications which are the sources of the HFE requirements identified

g. ~~8.~~ HFE program

Identification ~~Identify~~ and description of ~~describe~~ the following ~~development of~~ implementation plans, which are to be developed; ~~analyses, and evaluation/verification of:~~

~~- Operating Experience Review~~

(i) ~~-~~ System Functional Requirements Development

(ii) ~~-~~ Allocation of Function

(iii) ~~-~~ Task Analysis

(iv) ~~-~~ Human-system Interface Design

(v) ~~-~~ Plant and Emergency Operating Procedure Development

(vi) HF Verification and Validation

h. 9. HFE program milestones

(i) Identify Identification of HFE milestones, so that at which evaluations of the effectiveness of the HFE effort ar to can be made at critical check points and show the relationship to the integrated plant construction sequence of events

(ii) Provide A program schedule of HFE tasks which addresses the showing:

– relationships between HFE elements and activities, the development of HFE

– reports and the conduct of HFE

– reviews

(iii) Identify integrated design Identification of other plant equipment procurement and construction activities which are related applicable to the HFE Design Team activities program but outside the scope of the team (e.g., C&I equipment manufacture specified in other areas

(i) ~~10.~~ HFE documentation

~~- Identify and briefly describe each required HFE documented item~~

(i)~~- Identify~~ Identification of procedures for ~~accessibility and retention~~, and retrieval.

~~- Describe the supporting documentation and its audit trail maintained for NRC audits~~

(i) ~~11.~~ Communication of HFE ~~in subcontractor efforts~~ program requirements

~~- Provide a copy of the HFE requirements proposed for inclusion in each subcontract~~

(i)~~- Describe~~ Description of the manner in which HFE Program requirements will be communicated to all applicable personnel and organizations, including those which may be subcontracted, who are responsible for the performance of work associated with the main control room and remote shutdown system design implementation ~~the designer proposes to monitor the subcontractor's compliance with HFE requirements~~

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ATTACHMENT 1 TO HFE ITAAC/DAC
(TIER 2 CRITERIA ONLY)

~~II~~ HFE DESIGN TEAM COMPOSITION

(1) The composition of the Human Factor Engineering (HFE) ~~Man-Machine Interface Systems (MMIS)~~ Design Team shall include, as a minimum, the technical skills presented in Article (4), below.

(2) The education and related professional experience of the HFE ~~MMIS~~ Design Team personnel shall satisfy the minimum personal qualification requirements specified in Article (4), below, for each of the areas of required skills. In those skill areas where related professional experience is specified, qualifying experience of the individual HFE ~~MMIS~~ Design Team personnel shall include experience in the technologies and techniques, of the particular skill area, utilized in the ABWR ,main control room and remote shutdown system Human System Interface (HSI) ~~MMIS~~ designs and design implementation activities. The required professional experience presented in those personal qualifications of Article (4) are to be satisfied by the HFE ~~MMIS~~ Design Team as a collective whole. Therefore, satisfaction of the professional experience requirements associated with a particular skill area may be realized through the combination of the professional experience of two or more members of the HFE ~~MMIS~~ Design Team who each, individually, satisfy the other defined credentials of the particular skill area but who do not possess all of the specified professional experience. Similarly, an individual member of the HFE ~~MMIS~~ Design Team may possess all of the credentials sufficient to satisfy the HFE ~~MMIS~~ Design Team qualification requirements for two or more of the defined skill areas.

(3) Alternative personal credentials may be accepted as the basis for satisfying the minimum personal qualification requirements specified in Article (4), below. Acceptance of such alternative personal credentials shall be evaluated on a case-by-case basis and approved, documented and retained in auditable plant construction files by the COL Applicant. The following factors are examples of alternative credentials which are considered acceptable.

(A) A Professional Engineer's license in the required skill area may be substituted for the required Bachelor's degree.

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TABLE 18.E.2.1 MMIS DESIGN TEAM (Cont'd)

(B) Successful completion of all technical portions of an engineering, technology or related science college degree program may be substituted for the Bachelor's degree. The courses shall be in appropriate technical subjects relevant to the required skill areas of the HFE ~~MMIS~~ Design Team for which the individual will be responsible.

(C) Related experience may substitute for education at the rate of six semester credit hours for each year of experience up to a maximum of 60 hours credit.

(D) Where course work is related to job assignments, post secondary education may be substituted for experience at the rate of two years of education for one year experience. Total credit for post secondary education shall not exceed two years experience credit.

(4)	Required Skill Area	Personal Qualification
	(A) Technical Project Management	(A) - Bachelor's degree, and - five years experience in nuclear power plant design or operations, and - three years management experience
	(B) Systems Engineering	(B) - Bachelor's of Science degree, and - four years cumulative experience in at least three of the following areas of systems engineering; design, development, integration, operation, and test and evaluation

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TABLE 18.E.2.1 MMIS DESIGN TEAM (Cont'd)

(C) Nuclear Engineering	(C) - Bachelor's of Science degree, and - four years nuclear design, development, test or operations experience
(D) Control and Instrumentation (C&I) Engineering	(D) - Bachelor's of Science degree, and - four years experience in design of process control systems, and - experience in at least one of the following areas of C&I engineering; development, power plant operations, and test and evaluation
~~E) Architect Engineering~~	~~E) Bachelor's of Science degree, and four years power plant control room design experience~~

TABLE 18.E.2.1 MMIS DESIGN TEAM (Cont'd)

(F) Human Factors	(F) - Bachelor's degree in human factors engineering, engineering psychology or related science, and - four years cumulative experience related to the human factors aspects of human-computer interfaces. Qualifying experience shall include experience in at lease two of the following human factors related activities; design, development, and test and evaluation, and - four years cumulative experience related to the human factors field of ergonomics. Again, qualifying experience shall include experience in at least two of the following areas of human factors activities; design, development, and test and evaluation

TABLE 18.E.2.1 MMIS DESIGN TEAM (Cont'd)

(F) Human Factors	(F) - Bachelor's degree in human factors engineering, engineering psychology or related science, and - four years cumulative experience related to the human factors aspects of human-computer interfaces. Qualifying experience shall include experience in at lease two of the following human factors related activities; design, development, and test and evaluation, and - four years cumulative experience related to the human factors field of ergonomics. Again, qualifying experience shall include experience in at least two of the following areas of human factors activities; design, development, and test and evaluation

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TABLE 18.E.2.1 MMIS DESIGN TEAM (Cont'd)

(G) Plant Operations	(G) - Have or have held a Senior Reactor Operator license, and - two years experience in BWR nuclear power plant operations
(H) Computer System Engineering	(H) - Bachelor's degree in Electrical Engineering or Computer Science, or graduate degree in other engineering discipline (e.g., Mechanical Engineering or Chemical Engineering), and - four years experience in the design of digital computer systems and real time systems applications
I) Plant Procedure Development	(I) - Bachelor's degree, and - four years experience in developing nuclear power plant operating procedures
(J) Personnel Training	(J) - Bachelor's degree, and - four years experience in the development of personnel training programs for power plants, and - experience in the application of systematic training development methods

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TABLE 18.E.2.1 MMIS DESIGN TEAM (Cont'd)

(K) Maintainability Engineering	(K) Bachelor's of Science degree, and four years cumulative experience in at least two of the following areas of power plant maintainability engineering activity; design, development, integration and test and evaluation, and experience in analyzing and resolving plant system and/or equipment related maintenance problems
(L) Safety Engineering	(L) Bachelor's of Science degree in Safety Engineering, and four years experience in Safety Engineering
(M) Reliability Engineering	(M) Bachelor's degree, and four years cumulative experience in at least two of the following areas of power plant reliability engineering activity; design, development, integration, and test and evaluation, and knowledge of computer based human interface systems

ATTACHMENT 2
TO HFE ITAAC/DAC
(TIER 2 CRITERIA ONLY)

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Item	Description	Applicable Codes/Standards
f.	Rocker switch, momentary or retained	NUREG-0700, Sect. 6.4.5.4
g.	Two or more position toggle switch, momentary or retained	NUREG-0700, Sect. 6.4.5.3
h.	Soft switch, the functions of which may be changed through the execution of software functions	NUREG-0700, Sect. 6.4.3.1-3
i.	Pull-to-lock switch	NUREG-0700, Sections 6.4.1, 6.4.2
2.	Continuous adjustment controls	
a.	Rotary control	NUREG-0700, Section 6.4.4.4
b.	Thumbwheel	NUREG-0700, Section 6.4.4.4
3.	Visual Display Units with full color screens	
a.	Large reverse projection screen	NUREG-0700, Section 6.7.2.1, 6.7.2.2
b.	Cathode ray tube	NUREG-0700, Section 6.7.2.1, 6.7.2.2
c.	Flat panel display screens (e.g., liquid crystal, electroluminescent or plasma technology, etc.)	NUREG-0700, Section 6.7.2.1, 6.7.2.2
d.	On-screen control utilized with 2.b and 2.c, above.	NUREG-0700, Section 6.7.2.1, 6.7.2.2
4.	VDU screen format types	
a.	Menus (e.g. lists of related displays to facilitate selection by the user)	ESD-TR-83-122, Section 4
b.	Text or pictorial displays of alarm information	NUREG-0700, Section 6.7.2 ESD-TR-83-122, Section 2

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Item	Description	Applicable Codes/Standards
c.	Trend Plot displays which present plant parameters vs. time. Scales can be changed by the user.	NUREG-0700, Section 6.7.2 ESD-TR-83-122, Section 2
d.	Two-Dimensional displays which present trends in relationship between two plant parameters	NUREG-0700, Section 6.7.2 ESD-TR-83-122, Section 2
e.	Status displays which present summary evaluation of selected equipment or data status in tabular form..	NUREG-0700, Section 6.7.2 ESD-TR-83-122, Section 2
f.	Diagram displays which schematically illustrate a systems configuration and the status of its major components.	NUREG-0700, Section 6.7.2 ESD-TR-83-122, Section 2
g.	Pictorial displays which utilize text, color, labels, highlighting and graphs to present historical, present status and future status prediction information on plant components, systems and processes.	NUREG-0700, Section 6.7.2 ESD-TR-83-122, Section 2
h.	Text/graphical displays which provide summary of plant procedures and guidance.	NUREG-0700, Section 6.7.1.3
5.	Analog Meters which employ a hardware medium to pictorially or graphically present quantitative and qualitative information concerning plant process parameters. This includes analog meters using digitally controlled LEDs and digital readouts.	NUREG-0700, Section 6.5.2 ESD-TR-83-122, Section 2
6.	Fixed-Position Digital Displays which present alphanumeric information in a hardware medium. These can be back-lit.	NUREG-0700, Sections 6.5.1.3, 6.5.5.1, 6.5.5.2 ESD-TR-83-122, Section 2

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Item	Description	Applicable Codes/Standards
7.	Fixed-position hardware mimic displays which schematically represent plant systems and components and their relationships utilizing pictorial elements, labels and indicator lights.	NUREG-0700, Sections 6.6, 6.7.1.7, 6.7.2.3, 6.7.2.4, 6.7.2.5, 6.7.2.7, 6.8
8.	Fixed-Position alarm tiles which use light to indicate the alarm state.	NUREG-0700, Section 6.3.3
9.	Light Emitting Diodes (LEDs) which are multicolor and are incorporated in both text and graphic display elements.	NUREG-0700, Sections 6.5.1, 6.3.3, 6.3.4
10.	An Audio Signal system which is coordinated to the alarm tiles in #8, above, and utilizes prioritization and alarm reduction logic and pre-defined set points to alert operators to plant status changes.	NUREG-0700, Section 6.3.1, 6.3.2
11.	Keyboards which are composed of alphanumeric and/or assignable function keys and function as computer input devices.	NUREG-0700, Section 6.7.1.4 ESD-TR-83-122, Section 1
12.	Printers and Printer/Plotters used to provide hard copy output in the form of plots, logs and text.	NUREG-0700, Section 6.7.3

List of Codes and Standards

1. NUREG-0700, "Guidelines For Control Room Design Reviews", USNRC, September, 1981

2. ESD-TR-83-122, "Design Guidelines For Computer-Based Information Systems", United States Air Force, March , 1983

Element B - Operating Experience Review

DESIGN COMMITMENT:

The accident at Three Mile Island in 1979 and other reactor incidents have illustrated significant problems in the actual design and the design philosophy of NPP HSIs. There have been many studies as a result of these accidents/incidents. Utilities have implemented both NRC mandated changes and additional improvements on their own initiative. However, the changes were formed based on the constraints associated with backfits to existing CRs using early 1980s technology which limited the scope of corrective actions that might have been considered, i.e., more effective fixes could be used in the case of a designing a new CR with the modern technology typical of advanced CRs.

Problems and issues encountered in similar systems of previous designs shall be identified and analyzed so that they are

avoided in the development of the current system or, in the case of positive features, to ensure their retention.

INSPECTION/TEST/ANALYSIS:

- A Predecessor System Review Implementation Plan shall be developed to assure that the analysis is conducted according to accepted HFE principles.

- An analysis of predecessor systems shall be conducted in accordance with the plan and the findings will be documented in an Analysis Results Report.

- The analyses shall be reviewed by the HFE Design Team and shall be documented in an Evaluation Report.

DESIGN ACCEPTANCE CRITERIA:

General Criteria

1. The analysis shall meet all 10CFR regulatory requirements as specified under Element B in Table Y.

2. The activity shall be based upon state of the art HFE principles at the time of its development (as defined in Element A) including those documents under Element B in Table X.

3. Problems and issues encountered in similar systems of previous designs shall be identified and analyzed:

- Human performance issues, problems and sources of human error shall be identified.
- Design elements which support and enhance human performance shall be identified.

4. The review shall include both a review of literature pertaining the human factors issues related to similar systems and operator

interviews.

5. The following sources both industry wide and plant or subsystem relevant should be investigated at a minimum:

- Government and Industry Studies of Similar Systems
- Licensee Event Reports
- Outage Analysis Reports
- Final Safety Analysis Reports and Safety Evaluation Reports
- Human Engineering Deficiencies identified in DCRDRs
- Modifications of the Technical Specifications for Operation
- Internal Memoranda/Reports as Available

6. The following topics should be included in interviews as a minimum:

- Screen Design Issues
- Data Presentation Formats
- Data Entry Requirements
- Situational Awareness

- Communications
- Procedures
- Staffing and Job Design
- Training

Implementation Plan

The plan shall describe the designer's approach to Predecessor System Review. The plan shall address the following:

- Literature and current practices review
- Describe the technical basis for the plan
- Documentation review and analysis
- User survey methodology (for conducting interviews) and analysis plans
- Method of documenting lessons learned
- Integration of lessons learned into the design process

Analysis Results Report

At a minimum, the report shall address the following:

- Objectives
- Description of the Methods

- Identification of any deviations from the implementation plan
- Results and Discussion

- Conclusions
- Recommendations/Implications for HSI Design

HFE Design Team Evaluation Report

At a minimum, the report shall address the following:

- The review methodology and procedures
- Compliance with Implementation Plan Procedures
- Review findings

ITAAC/DAC
Element C - System Functional Requirements Analysis

DESIGN COMMITMENT:

System requirements shall be analyzed to identify those functions which must be performed to satisfy the objectives of each functional area. System function analysis shall: (1) determine the objective, performance requirements, and constraints of the design; and (2) establish the functions which must be accomplished to meet the objectives and required performance.

INSPECTION/TEST/ANALYSIS:

- A System Functional Requirements Analysis Implementation Plan shall be developed to assure that the analysis is conducted according to accepted HFE principles.

- An analysis of system functional requirements shall be conducted in accordance with the System Functional Requirements Analysis Implementation Plan and the findings will be documented in System Functional Requirements an Analysis Results Report.

- The analyses of the system functional requirements shall be reviewed by the HFE Design Team and shall be documented in System Functional Requirements Analysis an Evaluation Report.

DESIGN ACCEPTANCE CRITERIA:

General Criteria

1. The analysis shall meet all 10CFR regulatory requirements as specified under Element C in Table Y.

2. The activity shall be based upon state of the art HFE practices at the time of its development (as defined in Element A) including those documents under Element C in Table X.

1. The system functional requirements analysis implementation plan shall establish that:

a.3. System requirements shall define the determine system functions and those system the functions shall provide the basis for determining the a. iated human and system performance necessary to carry out the function. requirements.

b.4. Critical functions shall be defined (i.e., those functions required to achieve major system performance requirements; or those functions which, if failed, could degrade system or equipment perfor.nance or pose a safety hazard to plant personnel or to the general public).

c.5. Safety functions shall be identified and any functional interrelationship with non-safety systems shall also be identified.

d.6. Functions shall be defined as the most general, yet differentiable means whereby the system requirements are met, discharged, or satisfied. Functions shall be arranged in a logical sequence so that any specified operational usage of the system can be traced in an end-to-end path.

e7. Functions shall be described initially in graphic form. [redacted]n diagramming shall be done at severa[redacted], starting at a "top level" where a ~~very gross picture of~~ major functions ~~is~~ are described, and continuing to decompose major functions to ~~several~~ lower levels until a specific critical end-item requirement ~~will emerge~~s, e.g., a piece of equipment, software, or an operator.

f.8. Detailed narrative descriptions shall be developed for each of the identified functions and for the overall system configuration design itself. Each function shall be identified and described in terms of inputs (observable parameters which will indicate system

status), functional processing (control process and performance measures required to achieve the function), functional operations (including detecting signals, measuring information, comparing one measurement with another, processing information, and acting upon decisions to produce a desired condition or result such as a system or component operation actuation or trip) outputs, feedback (how to determine correct discharge of function), and interface requirements from the top down so that subfunctions are recognized as part of larger functional areas. elements.

~~9. Functional operations or activities shall include:~~

~~- detecting signals~~

~~- measuring information~~

~~- comparing one measurement with another~~

~~- processing information~~

~~- acting upon decisions to produce a desired condition or result on the system or environment (e.g., system and component operation, actuation, and trips)~~

~~10. The function analysis shall be kept current over the life cycle of design development.~~

~~11. Verification~~ (Covered by 10CFR50 App. B)

~~• All the functions necessary for the achievement of operational and safety goals are identified.~~

~~• All requirements of each function are identified.~~

~~Implementation Plan Tier 2~~

~~Criteria~~

~~a. Describe the designer's~~

~~system Functional Requirements~~

~~Analysis~~

2. The System Functional Requirements Analysis Implementation Plan shall include; ~~address:~~

~~- Literature and current practices review~~

~~- Describe the technical basis for the plan.~~

a. ~~-~~ The methods for identification of ~~List~~ required system level functions – based on upon system performance requirements

b. ~~-~~ The methods for graphic function descriptions – (e.g., Functional Flow Block Diagrams and Time Line Diagrams)

c. ~~-~~ The method for developing detailed function descriptive descriptions addressing: which encompass observable parameters that ~~which will~~ indicate system status, Control process and measure/data required to achieve the function and how to determine proper discharge of function.

~~- Analysis~~

d. – Analysis methods which define an the integration of ~~subfunctions that are~~ closely related subfunctions so that they can be treated as a unit

e. – Analysis methods which divide identified subfunctions into two groups according to whether:

(i) – Common achievement of the subfunction is an essential condition for the accomplishment of a higher level function, or

(i.) – The subfunction is an alternative supporting functions to a higher level function or the subfunction's whose accomplishment is not necessarily a requisite for a higher level function.

f. Requirements to identify for each integrated subfunction:

(i) – The basis for ~~Logical requirements for accomplishment (~~ why accomplishment of the subfunction is required).

(ii) – The control actions necessary for accomplishment of the subfunctions.

(iii) – The parameters necessary for the subfunction control actions.

(iv) – The criteria for

evaluating the result of the subfunction control actions.

(v) – The parameters necessary for ~~the~~ evaluation of the subfunction

(vi) – The evaluation criteria to be used to evaluate the subfunction, and

(vii) – The criteria for ~~choosing~~ selecting alternatives assignments if the evaluation criteria is not satisfied.

~~– Identify characteristic measurement and define for each measurement important factors such as Load, Accuracy, Time factors, Complexity of action logic, Types and complexities of decision making, Impacts resulting from the loss of function and associated time factors~~
(Repeat of evaluation criteria?)

~~• Verification~~

~~Describe system function verification methodology~~ (Covered by 10CFR50 App. B)

Analysis Results Report (Tier 2 criteria only)

3 The results of the System Functional Requirements Analyses shall be documented in a report ~~shall address~~ that includes the following:

a - Objectives of the System Functional Requirements Analyses

b - Description of the methods employed in the conduct of System Functional Requirements Analyses

c - Identification of any deviations from the System Functional Requirements Analysis Implementation Plan

d - Presentation and discussion of the results ~~and Discussion~~ of the System Functional Requirements Analysis including discussion of any design change recommendations derived from these analyses and/or negative implications that the current design may have on safe plant operations.

e - Conclusions regarding the conduct of the analyses and the analysis results

~~- Recommendations/Implications for HSI Design~~

HFE Design Team Evaluation Report (Tier 2 criteria only)

4. The results of the HFE Design Team's evaluation of the conduct and results of the system functional requirements analyses shall be documented in a report that includes ~~report shall address~~ the following:

a. ~~-~~ The methods ~~review methodology~~ and procedures used by the HFE Design Team in their review of the System Functional Requirements Analyses.

b. ~~-~~ The HFE Design Team's evaluation of the completed System Functional Requirements Analyses including evaluation of the compliance with the System Functional Requirements Analysis Implementation Plan ~~Procedures~~ and

c. ~~-~~ Presentation and discussion of the HFE Design Team's Review findings.

5. The System Functional Requirements Analyses shall be conducted in accordance with the requirements of the Human Factors Engineering Program Plan and the System Functional Requirements Analysis Implementation Plan.

DESIGN COMMITMENT:

The allocation of functions to the human shall capitalize upon areas take advantage of human strengths and avoids areas of allocating functions which would be impacted by human limitations. To assure that The allocation of function shall be is conducted in accordance according to with accepted HFE principles, through a structured and well-documented methodology of allocating functions to personnel, system elements, and personnel-system combinations, shall be developed.

INSPECTION/TEST/ANALYSIS:

- An Allocation of Function Implementation Plan shall be developed to assure that the analysis is conducted according to accepted HFE principles.

- An analysis of the allocation of function shall be conducted in accordance with the Allocation of Function Implementation Plan and the findings will be documented in an Analysis of Function Analysis Results Report.

- The analyses of the allocation of function shall be reviewed by the HFE Design Team and the results of that review shall be documented in an Allocation of Function Evaluation Report.

DESIGN ACCEPTANCE CRITERIA:

General Criteria

1. The analysis shall meet all 10CFR regulatory requirements as specified under Element D in Table Y.

2. The activity shall be based upon state-of-the-art HFE practices at the time of its development (as defined in Element A) including those documents under Element D in Table X.

1. The Allocation of Function Implementation Plan shall establish that:

a. 3. All aspects of system and functions definition shall must be analyzed in terms of resulting human performance requirements based on the expected user population.

b. 4. The allocation of functions to personnel, system elements, and personnel-system combinations shall be made reflect (1) sensitivity, precision, time, and safety requirements, (2) required reliability of system performance, and (3) the number and level of skills of personnel required to operate and maintain the system.

configurations of personnel and systems performed functions. Analyses shall confirm that the personnel elements can correctly perform tasks allocated to them while maintaining operator situation awareness, acceptable workload, and vigilance. Proposed function assignment shall take the maximum advantage of the capabilities of human and machine without imposing unfavorable requirements on either.

5. Functions shall be re-allocated in an iterative manner, in response to developing design specifics and the outcomes of on-going analyses and trade studies.

8. Function assignment shall be evaluated.

Implementation Plan (Tier 2 criteria only)

The plan shall describe the designer's approach to Allocation of Function. The

2 4. Allocation of Function Implementation Plan shall address:

- Literature and current practices

a. Establishment of a structured basis for function allocation

b. Alternative systems analyses

c. Specification of criteria for selection of conducting function allocation analysis

(i) ~~(...)~~ → ~~Define~~ objectives and requirements

(ii) → ~~Identify~~ alternatives

(iii) → ~~Formulate selection~~ criteria

(iv) → ~~Weight~~ criteria

~~Prepare utility functions~~

(v) → ~~Evaluate~~ alternatives

(vi) → ~~Perform~~ Sensitivity ~~Check~~

(vii) → ~~Select Preferred~~ ~~Alternatives~~

~~Evaluation of function assignment~~

~~The plan shall describe the tests and analyses that will be performed to evaluate the function allocation~~

Analysis Results Report (TIER 2 CRITERIA ONLY)

3.8. The report ~~shall address~~ the following:

a. – Objectives

b. – Description of the Methods

c. – Identification of any deviations from the Implementation Plan

d. – Results ~~and Discussion~~

e. – Conclusions

~~– Recom~~ ~~nendations/Implications for HSI Design~~

HFE Design Team Evaluation Report (TIER 2 CRITERIA ONLY)

4.7. The ~~report shall address~~ the following:

a. – The ~~review methodology~~ and PROCEDURES USED BY THE HFE DESIGN TEAM IN THEIR REVIEW OF THE FUNCTION ALLOCATION ANALYSES.

OF THE FUNCTION ALLOCATION ANALYSES INCLUDING DISCUSSION OF ANY DESIGN CHANGE RECOMMENDATIONS DERIVED FROM THESE ANALYSES AND/OR ANY NEGATIVE IMPLICATIONS THAT THE CURRENT DESIGN MAY HAVE ON SAFE PLANT OPERATIONS.

RESULTS OF THE HFE DESIGN TEAM'S EVALUATION OF THE CONDUCT AND RESULTS OF THE FUNCTION ALLOCATION ANALYSES SHALL BE DOCUMENTED IN A REPORT THAT INCLUDES

b. THE HFE [illegible] COMPLETED FUNCTION ALLOCATION ANALYSES INCLUDING AN EVALUATION OF THE COMPLIANCE WITH THE ALLOCATION OF FUNCTION IMPLEMENTATION Plan. ~~Procedures~~

c. → Review findings.

PRESENTATION AND DISCUSSION OF THE HFE DESIGN TEAM'S

5 THE FUNCTION ALLOCATION ANALYSES SHALL BE CONDUCTED IN ACCORDANCE WITH THE REQUIREMENTS OF THE HUMAN FACTORS ENGINEERING PROGRAM PLAN AND THE ALLOCATION OF FUNCTIONS IMPLEMENTATION PLAN.

ITAAC/DAC

Element E - Task Analysis

DESIGN COMMITMENT:	INSPECTION/TEST/ANALYSIS:	DESIGN ACCEPTANCE CRITERIA:
Task analysis shall be conducted and used to identify the behavioral requirements of the tasks the personnel subsystem is required to perform in order to achieve the functions allocated to them. A task shall be a group of activities that have a common purpose, often occurring in temporal proximity, and which utilize the same displays and controls. The task analysis shall: a. provide one of the bases for making design decisions, (e.g., determining before hardware fabrication equipment manufacture to the extent practicable, whether system performance requirements can be met by combinations of anticipated equipment, software, and personnel), b. assure that be used to maintain human performance requirements within do not exceed human capabilities, c. be used as an input basic information for developing personnel manning, skill, personnel training, and system communication requirements of the system, and as an input to the evaluation of established plant operations control room staffing levels, and d. form the basis for specifying the	A Task Analysis Implementation Plan shall be developed to assure that the analysis is conducted according to accepted HFE principles. • An analysis of tasks shall be conducted in accordance with the Task Analysis Implementation Plan and the findings will be documented in an a Task Analysis Results Report. • The task analyses shall be reviewed by the HFE Design Team and the results of that review shall be documented in an a Task Analysis Evaluation Report.	General Criteria 1. The analysis shall meet all 10CFR regulatory requirements as specified under Element E in Table Y. 2. The activity shall be based upon state-of-the-art HFE practices at the time of its development (as defined in Element A) including those documents under Element E in Table X. 1. The Task Analysis Implementation Plan shall establish that: a. 3. The scope of the task analysis shall include all operations, maintenance, test and inspection tasks. The analyses shall be directed to the full range of plant operating modes, including startup, normal operations, abnormal operations, transient conditions, low power and shutdown conditions. The analyses shall include tasks performed at in the operator interface in the main control room as well as outside of the control room and at the remote shutdown system. b. 4. The analysis shall link the identified and described tasks in operational sequence diagrams. A review of the descriptions and operational sequence diagrams shall identify which tasks can be considered "critical" in

are found to affect plant risk in PRA sensitivity analyses shall also be considered "critical." Where critical functions are automated, the analyses shall consider ~~all~~ ASSOCIATED human tasks, ~~including~~ SUCH AS THE monitoring of ~~all~~ OPERATION THE EXECUTION OF automated safety system, and back-up actions, if ~~it~~ THE AUTOMATED FUNCTION fails. BY THE OPERATOR

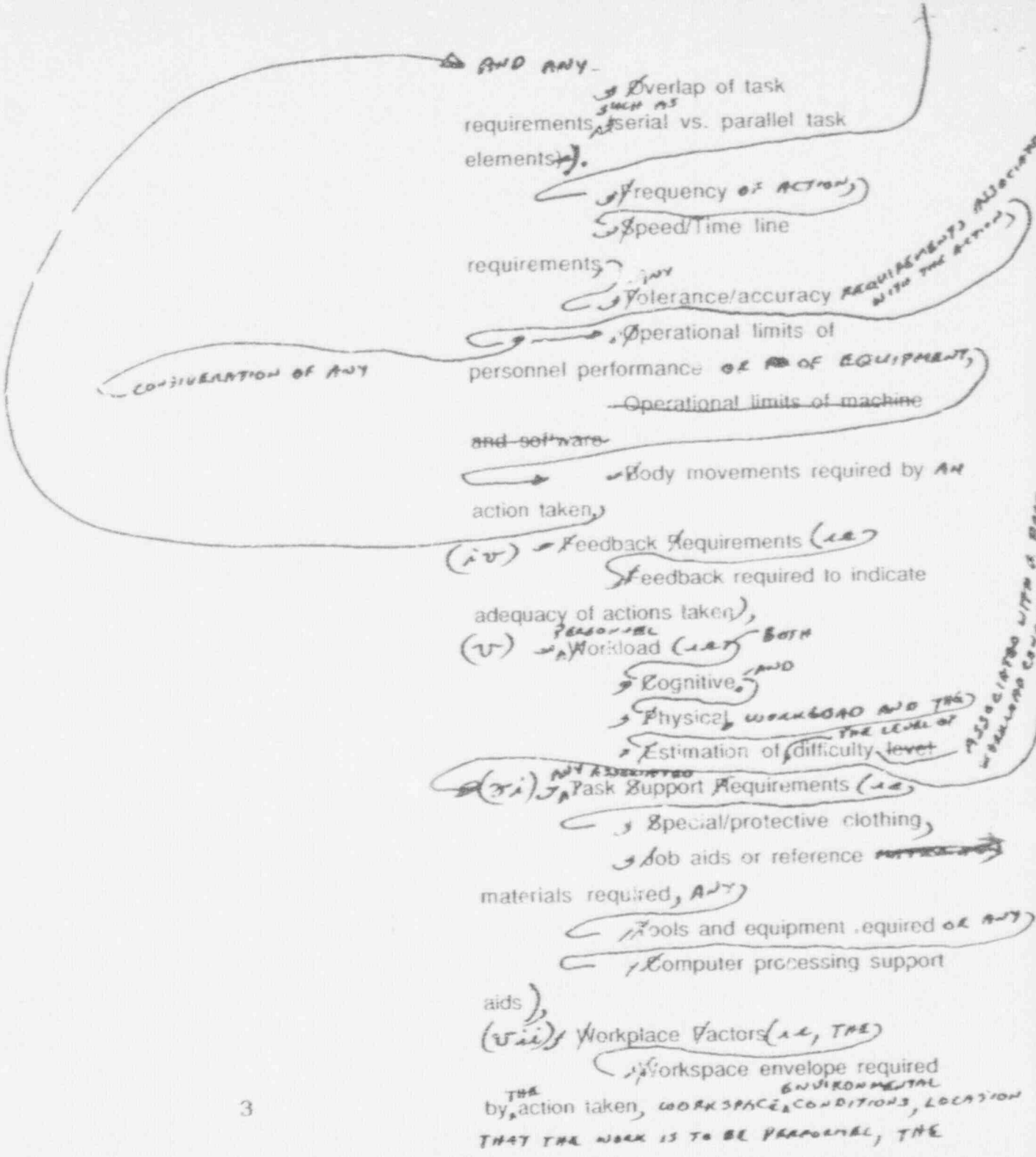
C ~~5.~~ Task analysis shall begin ~~on a gross level and involve~~ WITH the development of detailed narrative descriptions of ~~what~~ DESCRIBES personnel ACTIONS REQUIRED FOR SUCCESSFUL COMPLETION OF THE TASK ~~must do~~. Task analyses shall define the ~~nature of the~~ input, process, and output ~~of~~ THE METHODS FOR RELEVANCE required by and of personnel. Detailed task descriptions ~~shall~~ THAT address ~~(as appropriate)~~:

(i) ~~a~~ Information Requirements (~~a~~ ii)
- Information required, including cues for task initiation, AND
- Information available),

(ii) ~~a~~ Decision-Making Requirements (~~a~~ iii)
- Description of the decisions to be made (relative, absolute, probabilistic)
- NOTED Evaluations to be performed),
- Decisions that are probable based on the evaluation ~~(opportunities for cognitive errors, such as capture error, will be identified and carefully analyzed)~~

(~~iii~~) – Response Requirements (~~a~~ iv)
- Action to be taken,

(MOVE THE REST OF THIS DISCUSSION OF THE DETAILED TASK ANALYSIS DESCRIPTIONS TO THE TIER 2 IMPLEMENTATION PLAN SECTION)


AND ANY
Overlap of task
requirements such as serial vs. parallel task
elements).
Frequency of action,
Speed/Time line
requirements,
Tolerance/accuracy requirements associated with the action,
Operational limits of
personnel performance or of equipment,
Operational limits of machine
and software
Body movements required by an
action taken,
(iv) Feedback Requirements (i.e.
Feedback required to indicate
adequacy of actions taken),
(v) Personnel Workload (i.e. both
Cognitive, and
Physical, workload and the
Estimation of difficulty level
(vi) Any associated Task Support Requirements (i.e.
Special/protective clothing,
Job aids or reference
materials required, any
Tools and equipment required or any
Computer processing support
aids),
(vii) Workplace Factors (i.e. the
Workspace envelope required
by the action taken, workspace environmental conditions, location
that the work is to be personnel, the
configuration of any

PHYSICAL/MENTAL ATTRIBUTES OF THE WORK)

~~Environment~~

(viii) Staffing and Communication Requirements (i.e. THE number of personnel, their technical specialty, and specific skills, THE FORM AND CONTENT OF Communications ~~required, AND OTHER including type~~ Personnel interaction REQUIRED when more than one person is involved), AND

~~(ix)~~ ~~Hazard Identification~~

(ix) THE identification of ANY Hazards involved IN EXECUTION OF THE TASK.

d. ~~6. The task analysis shall be iterative and become progressively more detailed over the design cycle.~~ The task analysis shall be detailed enough to identify information and control requirements to enable specification of detailed requirements for alarms, displays, data processing, and controls for human task accomplishment.

e ~~7.~~ The task analysis results shall provide input to the personnel training programs.

2. (TIER 2 CRITERIA ONLY)

Implementation Plan

~~The plan shall describe the designer's approach to task analysis.~~ The Task ANALYSIS IMPLEMENTATION PLAN SHALL INCLUDE:

~~Literature and Current Practices~~

~~review~~ The

a. ~~General~~ methods and data sources to be used in the conduct of the task analyses.

b. ~~Cross~~ task analysis—including: The methods for conducting the initial (high level)

(i) ~~Convert~~ Functions to Tasks,

(ii) ~~Develop~~ Narrative Task Descriptions,

(iii) ~~General~~ statement of the task functions,

~~(iv) Detailed task descriptions (enter criteria on detailed task descriptions for original article 5)~~

(iv) ~~Breakdown~~ of tasks to individual activities, and

(v) ~~Develop~~ Operational Sequence Diagrams.

c. (Enter criteria on detailed task descriptions from the original article 5)

d. ~~Critical task analysis~~ The methods for identification of Critical Tasks

~~Detailed Task Descriptions~~

e. ~~Information~~ The methods for establishing information and control requirements

f. ~~Initial~~ The methods for conducting alarm, display, processing, and control requirements analysis

~~Develop a task-based I&C inventory~~

g. The methods through which the ~~Application of~~ task analysis results are assembled and documented to provide input to the ~~to training~~ development of personnel training programs

~~Evaluation of task analysis~~

h. ~~The plan shall describe~~ the methods ~~that will~~ to be used to evaluate the results of the task analysis.

RESULTS OF THE TASK ANALYSES SHALL BE DOCUMENTED IN A

Analysis Results Report (Tier 2 criteria only) THAT INCLUDES

3. The report ~~shall address~~ the following:

a. – Objectives OF THE TASK ANALYSES,

b. – Description of the Methods EMPLOYED IN THE CONDUCT OF THE TASK ANALYSES,

c. – Identification of any deviations from the Implementation Plan TASK ANALYSIS

~~d. – Results and Discussion~~

– PRESENTATION AND DISCUSSION OF THE RESULTS OF THE TASK ANALYSES, INCLUDING DISCUSSION OF ANY DESIGN CHANGE RECOMMENDATIONS DERIVED FROM THESE ANALYSES AND/OR ANY NEGATIVE IMPLICATIONS THAT THE CURRENT DESIGN MAY HAVE ON SAFE PLANT OPERATIONS.

– Conclusions REGARDING THE CONDUCT OF THE ANALYSES AND THE ANALYSES RESULTS.

– ~~Recommendations/Implications for~~

~~ISI Design~~

HFE Design Team Evaluation Report (TIER 2 CRITERIA ONLY)

4. The ~~report shall address~~ the following:

a. – The ~~review methodology~~ METHODS and procedures

b. – Compliance with THE TASK ANALYSIS Implementation Plan ~~Procedures~~, AND

c. – Review findings.

RESULTS OF THE HFE DESIGN TEAM'S EVALUATION OF THE CONDUCT AND RESULTS OF THE TASK ANALYSES SHALL BE DOCUMENTED IN A REPORT THAT INCLUDES

PRESENTATION AND DISCUSSION OF THE HFE DESIGN TEAM'S

USED BY THE HFE DESIGN TEAM IN THEIR REVIEW OF THE COMPLETED TASK ANALYSES, &

THE HFE DESIGN TEAM'S EVALUATION OF THE COMPLETED TASK ANALYSES INCLUDING [redacted] AN EVALUATION OF THE

Element A - Human Factors Engineering Program Management

DESIGN COMMITMENT:

Human-system interfaces (HSI) shall be developed, designed, and evaluated based upon a structured top-down system analysis using accepted human factors engineering (HFE) principles. The HSI shall include all operations, maintenance, test, and inspection interfaces, procedures, and training needs of the main control room and remote shutdown system functions and equipment.

INSPECTION/TEST/ANALYSIS:

To assure the integration of HFE into system development: (1) a HFE Design Team shall be established; and (2) a HFE Program Plan shall be established to assure the proper development, execution, oversight, and documentation of the human factors engineering program.

DESIGN ACCEPTANCE CRITERIA:

(Move this section to HFE Program Plan)

1. The primary objective of the HFE Program shall be to develop an HSI which makes possible safe, efficient, and reliable operator performance .

2. The goals of this program shall be stated in "operator-centered" terms which shall serve as criteria for test and evaluation activities. These "operator-centered" HFE design goals shall include:

   a. The operating team can accomplish all assigned tasks within system defined time and performance criteria.

   b. The system and allocation of functions will provide acceptable workload levels and facilitate operator vigilance.

   c. The system will support a high degree of operating crew "situation awareness."

   d. Signal detection and event

recognition requirements will be kept within the operators' information processing limits and will minimize the need for operators to mentally transform data in order to be usable.

e.The system will minimize operator memory load.

f. The operator interfaces will minimize the potential for operator error.

HFE Design Team

(Duplication - Move to HFE Program Plan) The HFE Design Team shall be responsible for (1) the development of all HFE plans and procedures; (2) the oversight and review of all HFE design, development, test, and evaluation

activities; (3) the initiation, recommendation, and provision of solutions through designated channels for problems identified in the implementation of the HFE activities; (4) verification of implementation of team recommendations, (5) assurance that all HFE activities comply to the HFE plans and procedures, and (7) scheduling of activities and milestones.

(Duplication - Move to HFE Program Plan) The scope of the Team's responsibility for the main control room and remote shutdown system shall include:

a. all operations, maintenance, test, and inspection interfaces

b. procedures

c. training requirements development.

(Duplication - Move to HFE Program Plan) The HFE Design Team shall have the authority and organizational freedom to ensure that all its areas of responsibility are accomplished and to identify problems in the implementation of the HSU design.

The team shall have the authority to determine where its input is required, access work areas, design documentation. The Team shall have the authority to control further processing, delivery, installation or use of HFE/HSI products until the disposition of a non-conformance, deficiency or unsatisfactory condition has been achieved.

(Duplication - Move to HFE Program Plan) The HFE Design Team shall report to a level of management such that required authority and organizational freedom are provided, including sufficient independence from cost and schedule considerations.

1. The HFE design team shall include the following expertise:

a. Technical Project Management
b. Systems Engineering
c. Nuclear Engineering
d. Control and Instrumentation
e. Engineering

f.Human Factors

g.Plant Operations

h.Computer Systems Engineering

i.Plant Procedure Development

j.Personnel Training

2. (Tier 2 criteria only)
Criteria regarding the composition of the HFE Design Team are as presented in Attachment I to the HFE ITAAC/DAC

(Move this Section to HFE Program Plan)

1. The HFE issue tracking system shall monitor the identification and closure of human factors issues that are identified throughout the development and evaluations of the main control room and remote shutdown system design implementations.

The HFE Issue Tracking System shall document and track human factors engineering issues and concerns, from identification until elimination or reduction to a level acceptable to the review team.

(Tier 2 criteria only) Each issue/-concern that meets or exceeds the threshold effects established by the HFE Design Team shall be entered on the log when first identified, and each action taken to eliminate or reduce the issue/concern should be documented. The final resolution of the issue/concern, as accepted by the HFE Design Team, shall be documented in detail, along with information regarding HFE Design Team acceptance (eg., person accepting, date, etc.)

(Tier 2 criteria only)The HFE issues tracking system procedures shall specify the individual responsibilities of the HFE Design Team members when an issue/concern is identified, including definition of who should log the item, who is responsible for tracking the resolution efforts, who is responsible for acceptance of a resolution, and who shall enter the necessary closeout data.

HFE Program Plan

1. An HFE Program plan shall be developed to describe how the human factors program shall be accomplished, i.e., the plan shall describe the HFE Design Team's organization and composition, define the scope of the work to be undertaken by the HFE Design Team and provides a the technical approach, schedule, and management control structure and technical interfaces required to achieve the HFE program objectives. The HFE Program Plan Generally, it shall establish:

• (Duplication - Delete)

a. The process through which the HFE Design Team executes its responsibilities.

b.The processes through which findings of the HFE Design Team are resolved including how equipment design changes that may be necessary for resolution of HFE issues are incorporated.

c.The members and qualification of the team members

d. The process through which the HFE Design Team activities will be assigned to individual team members, the responsibilities of each team member and the procedures that will govern the internal management of the team

e. The Design Control procedures through which the results of the iterative design development activities are documented and processed to maintain integration of design activities and assure that the design, design analyses and documentation are consistent and appropriately reflect the details of design implementation decisions.

f. The procedures and documentation requirements of the HFE Issues Tracking System.

2. (Tier 2 criteria only)The HFE Program Management Plan shall include the following:

a. Purpose and organization of the plan

b. Overall HFE program goals and

objectives

c. The relationship between the HFE program and the overall plant equipment procurement and construction program (organization and schedule).

d HFE Design Team

(i)- Description of the HFE Design Team function within the broader scope of the plant equipment procurement and construction program, including charts to show organizational and functional relationships, reporting relationships, and lines of communication

(ii)- Description of the responsibility, authority and accountability of the HFE Design Team organization

(?)

(iii) - Description of the process through which management decisions will be made regarding HFE

(iv) - Description of the process through which technical decisions will be made by the HFE Design Team

(v)- Description of the tools and techniques (e.g., review forms, documentation) to be utilized by the Team in fulfilling their responsibilities

(vi)- Description of the the HFE Design Team Staffing

(vii)- Job descriptions of the HFE Design Team personnel and their personal qualifications.

e. HFE Issue Tracking System

(i) Individual HFE Design Team member responsibilities regarding HFE Issue Identification, Logging, Issue Resolution, and Issue Closeout.

(ii) Procedures and documentation requirements regarding HFE

-Issue identification. These shall include description of the HFE issue, effects of the issue if no design change action is taken and an assessment of the criticality and likelihood of the

identified HFE issue manifesting itself into unacceptable HSI performance.

(iii) Procedures and documentation requirements regarding HFE

- Issue resolution. These shall include evaluation and documentation of proposed solutions,implemented solutions, evaluated residual effects of the implemented solution and the evaluated Criticality and Likelihood of the implemented resolution of the HFE issue manifesting itself into unacceptable HSI performance.

f. HFE requirements

(i) Identification and description of the HFE requirements imposed on the design implementation process which shall include the defined design implementation technologies and associated applicable codes and standards as presented in Attachment 2 to the HFE ITAAC/DAC.

(ii) Identification of the standards and specifications which are the sources of the HFE requirements identified

g. HFE program

Identification and description of the following implementation plans, which are to be developed;

(i) System Functional Requirements Development

(ii) Allocation of Function

(iii)Task Analysis

(iv) Human-system Interface Design

(v) Plant and Emergency Operating Procedure Development

(vi) HF Verification and Validation

h. HFE program milestones

(i) Identification of HFE milestones at which evaluations of the effectiveness of the HFE effort are to can be made and the relationship to the integrated plant construction sequence of events

(ii) A program schedule of HFE tasks which addresses the relationships between HFE elements and activities, the development of HFE reports and the conduct of HFE reviews

(iii) Identification of other plant equipment procurement and construction activities which are related to HFE Design Team activities but outside the scope of the team (e.g., C&I equipment manufacture

i. HFE documentation

(i) Identification of procedures fo retention and retneval.

j. Communication of HFE program requiremer'.s

(i) Description of the manner in which HFE Program requirements will b communicated to all applicable personnel and organizations, including those which may be subcontracted, who are responsible for the performance of work associated with the main control room an remote shutdown system design implementation.