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FROM: Chet Poslusny

SUBJECT: Human Factors Engineering Submittal

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Enclosed is (are) a document submitted to the NRC related to the ABWR design review. Please place it (them) on the docket and in the NRC Public Document Room. To the best of my knowledge it (they) does not contain GE proprietary information.

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18.1 INTRODUCTION

This chapter describes the goals, design bases, design and implementation process and acceptance criteria for the ABWR standard plant operator interfaces. Human factors engineering principles are incorporated into all phases of the design of these interfaces. Design goals and design bases for the instrumentation and control systems and operator interfaces in the main control room and in remote locations are established in Section 18.2. The overall design and implementation program plan is described in Section 18.3. The standard operator interface design features are described in Section 18.4. Section 18.5 discusses the design implementation process and presents criteria for the design implementation verification and validation activities of the overall design implementation process. The ABWR Emergency Procedure Guidelines, which provide the basis for human factors evaluation of emergency operations, are contained in Appendix 18A. Appendix 18B discusses the differences between the ABWR emergency procedure guidelines and the U.S. BWROG Emergency Procedure Guidelines, Revision 4. Appendix 18C presents a characterization of an operator interface equipment implementation that incorporates the ABWR standard design features discussed in Section 18.4. The input data and results of calculations performed during the preparation of the ABWR Emergency Procedure Guidelines are contained in Appendix 18D. A general description of the design and implementation process for the ABWR operator interface and supporting plant systems is presented in Appendix 18E. Appendix 18F contains the results of an analysis of information and control needs of the main control room operators during emergency operations.

18.2 DESIGN GOALS AND DESIGN BASES

The primary goal for operator interface designs is to facilitate safe, efficient and reliable operator performance during all phases of normal plant operation, abnormal events and accident conditions. To achieve this goal, information displays, controls and other interface devices in the control room and other plant areas are designed and shall be implemented in a manner consistent with good human factors engineering practices. Further, the following specific design bases are adopted:

(1) During all phases of normal plant operation, abnormal events and emergency conditions, the ABWR shall be operable by two reactor operators. In addition, the operating crew will include one assistant control room shift supervisor, one control room shift supervisor, and two or more auxiliary equipment operators. During accidents, assistance is available to the operating crew from personnel in the Technical Support Center. Four licensed operators shall be on shift at all times, consistent with the staffing requirements of 10CFR50.54m,

(2) Promote efficient and reliable operation through expanded application of automated operation capabilities,

(3) The operator interface design shall utilize only proven technology,

(4) Safety-related systems monitoring displays and control capability shall be provided in full compliance with pertinent regulations regarding divisional separation and independence,

(5) The operator interface design shall be highly reliable and provide functional redundancy such that sufficient displays and control will be available in the main control room and remote locations to conduct an orderly reactor shutdown and to cool the reactor to cold shutdown conditions, even during design basis equipment failures,

(6) The principle functions of the Safety Parameter Display System (SPDS) as required by Supplement 1 to NUREG-0737, will be integrated into the operator interface design,

(7) Accepted human factors engineering principles shall be utilized for the operator interface design in meeting the relevant requirements of General Design Criterion 19, and

(8) The design bases for the Remote Shutdown System shall be as specified in Section 7.4.

18.3 SYSTEMS ANALYSIS, DESIGN APPROACH, AND APPLICATION OF HUMAN FACTORS ENGINEERING

A program plan has been developed and implemented to incorporate human factors engineering principles and to achieve an integrated design for the control and instrumentation systems of the ABWR, including the design of operator interfaces. This section describes this program plan.

The program plan presents formal decision analysis procedures to facilitate selection of design features which satisfy top level requirements and goals of individual systems and the overall plant. The plan also embodies a comprehensive, synergistic design approach which includes consideration for task analysis and human factors evaluation. The program plan provides for the following:

(1) Identification of specific design components and the associated documentation requirements,

(2) Definition of the scope and responsibilities of each design component, including the interrelationships to other design activities,

(3) Integration of task analysis, human factors engineering and evaluation, verification and validation, and operation and maintenance considerations as part of the design activities,

(4) User (i. e., customer) review of functional and performance requirements, installation procedures, operating and maintenance procedures, and personnel requirements,

(5) Standardization of operating interfaces,

(6) Traceable, auditable design trail through formal documentation requirements,

(7) Diversity and independence of the development activities and design of hardware and software, and

(8) A focus for the review of new technology applications through evaluation of design alternatives.

The structured methods which integrate the design tasks and formalize the user inputs, review and testing requirements are characterized in Figure 18.3-1. The design components which define the key design development activities include:

(1) Development of System Functional and Performance Requirements,

(2) Analysis of Tasks and Allocation of Functions,

(3) Evaluation of Human Factors and Man-Machine Interfaces,

(4) Development and Design and System Hardware and Software,

(5) Verification and Validation of System Hardware and Software, and

(6) Guidance for System Operation and Maintenance and Personnel Training Requirements.

The development of comprehensive system functional requirements provides top level performance, functional, interface, regulatory and end user requirements to be used in the design. Assumptions and constraints, as well as unique review and documentation guidelines for the design, are also established. The functional systems operations procedures, integrated plant operating procedures for plant startup and shutdown, and symptom-based emergency operating procedures will assure a thoroughly integrated operator interface design.

The detailed analysis of tasks and the allocation of functions provide specific information to be used to specify software, hardware and operator interface requirements in greater detail. Guidelines for the evaluation of design alternatives and incorporation of diversity features are also developed. This component of the design process, as is also the case for the other components, can provide important feedback for the system functional requirements.

The evaluation of human factors integrates the design with elements of human engineering fundamentals. Human factors are appropriately engineered into the design to assure that the information provided at the operator interface is easily comprehended and useful and to assure that the command and control actions from the operator are effective.

This design component also reinforces the standardization of operator and technician interfaces, within each ABWR plant application.

The hardware/software design component guides the control and instrumentation product implementation. Hardware and software modularity is incorporated to make upgrades easier throughout the plant lifetime. A structured, engineered approach to the development of both hardware and software is implemented to assure that the design proceeds along the lines of the requirement specification and has traceable documentation.

The verification and validation (V&V) design component assures that the system functional requirements are correctly implemented into the hardware and software and that an audit trail to satisfy regulatory requirements is established. V&V includes the establishment of test and evaluation criteria, the development of test and evaluation procedures, the testing of the integrated hardware and software, the installation of the hardware and software in the field and subsequent validation testing. Display- control integration validation includes the testing of normal, abnormal, and emergency operation sequences on a simulator or mock-up.

Guidance for system operation and maintenance are developed in parallel with the design of the system to ensure that the system will be operated efficiently. This includes personnel and training guidelines to aid the customer in making preparations to use the system.

Table 18.3-1 lists the types of documentation which typically will be produced for each design component activity shown in Figure 18.3-1.

Information from individual system human factors evaluations, as well as from other sources such as plant integrated operating procedures and symptom-based emergency operating procedures, will be integrated to establish the monitoring and operational control requirements for operator interfaces. Control and display panel arrangements, and control-display integration will be established based on human factors engineering studies and the functional and tasks analysis performed of normal, abnormal, and emergency operations. Human factors criteria for control room work space, work space environment, annunciator warning systems, auditory signal systems, process computers, and panel layout will be utilized to develop and validate the implementation details of the operator interface design.

TABLE 18.3-1

DOCUMENTATION FOR CONTROL AND INSTRUMENTATION SYSTEM DESIGN

Functional Requirements (Component A):

- System Level Documents
  - System Design Specification
  - Logic Diagram or Interface Block Diagram
  - Input/Output List (as applicable)
  - Hardware/Software System Specification
  - Master Parts List

Task Analysis (Component B):

- Task Analysis Reports
- Report on Evaluation of Design Alternatives (see also Component C

Human Factors Evaluation (Component C):

- Man-Machine Interface Requirements
  - Display Forms, Touch Screen Functions, etc., as required
- Report on Evaluation of Design Alternatives (see also Component B)

Hardware/Software Design (Component D):

- Hardware Design Specification
- Panel, Panel Wiring Diagram, Panel Interconnection Diagram
- Software Requirements Specification
- Software Design Specification
- Source Listing
- System Qualification and Unit Testing Report
- System Reliability Evaluation
- Component Master Parts List

Verification and Validation (Component E):

- System Pre-operational and Startup Test Procedure
  - Verification and Validation Test and Evaluation Criteria
- System Pre-operation and Startup Test Reports
  - Integrated Hardware/Software Test Report
  - Field Installation and Validation Test Report

Operations and Maintenance (Component F):

- System Maintenance Manuals
- System Operation Procedures
- Integrated Plant Operating Procedures
- Symptom-based Emergency Operating Procedures

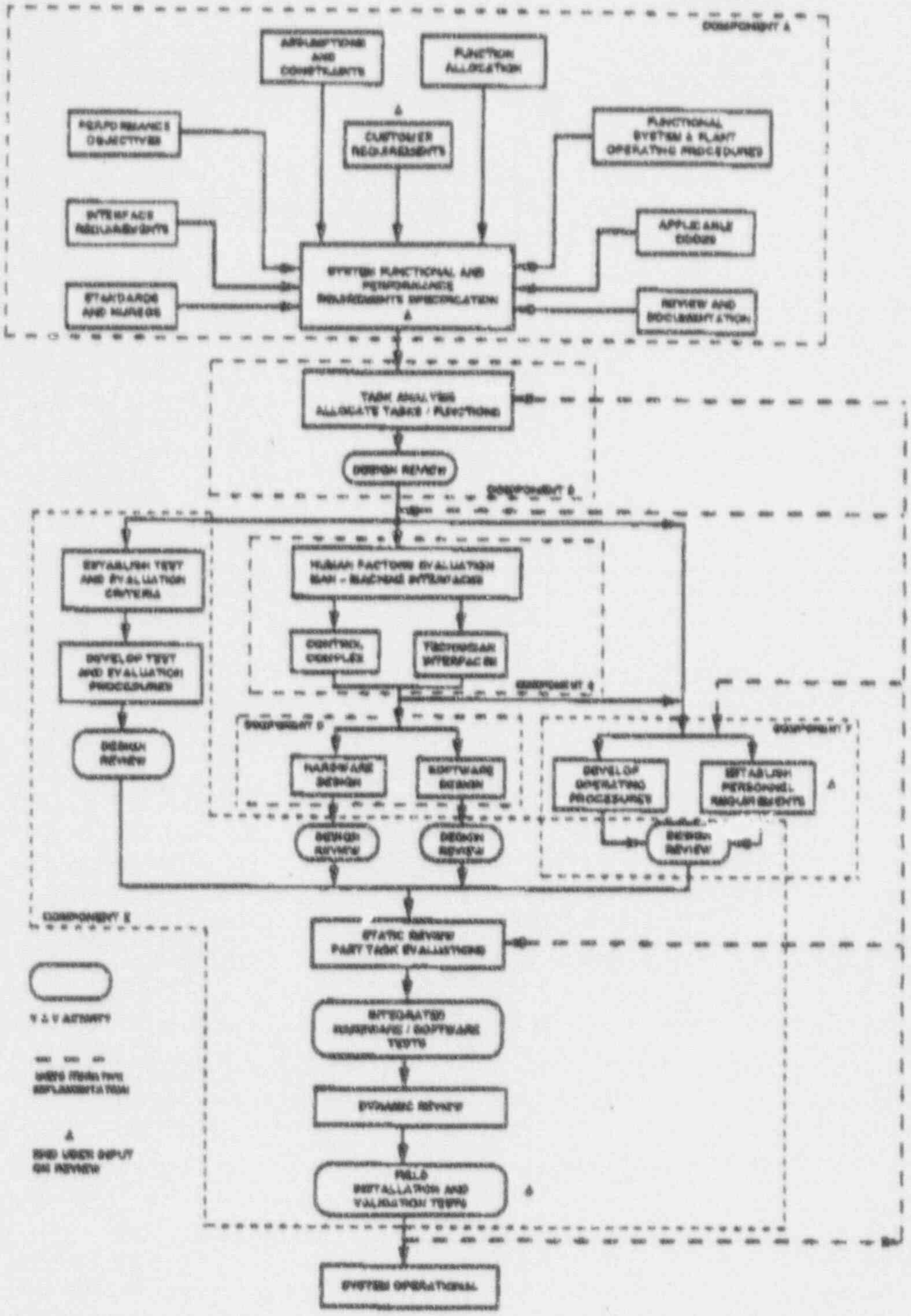

FIGURE 18.3 – 1 STRUCTURE FOR CONTROL & INSTRUMENTATION SYSTEM DESIGN

SECTION 18.4

TABLE OF CONTENTS

18.4 OPERATOR INTERFACE DESIGN REQUIREMENTS

This section presents the standard design features of the operator interface in the control room and for the remote shutdown system. These design features are based upon proven technologies and have been demonstrated, through broad scope control room dynamic simulation tests and evaluation, to achieve the ABWR operator interface design goals and design bases as given in Section 18.2. Appendix 18C presents an example of a control room operator interface design implementation which incorporates these design features.

18.4.1 Control Room Standard Design Features

18.4.1.1 General

The ABWR control room operator interface design incorporates the following standard features:

(a) A single, integrated control console staffed by two operators; the console has a low profile such that the operators can see over the console from a seated position.

(b) The use of plant process computer system driven on-screen control video display units (VDUs) for safety system monitoring and non-safety system control and monitoring.

(c) The use of a separate set of on-screen control VDUs for safety system control and monitoring and separate on-screen control VDUs for non-safety system control and monitoring; the operation of these two sets of VDUs is entirely independent of the process computer system. Further, the first set of VDUs and all equipment associated with their functions of safety system control and monitoring are divisionally separate and qualified to Class 1-E standards.

(d) The use of dedicated function switches on the control console.

(e) Operator selectable automation of pre-defined plant operation sequences.

SECTION 18.4

TABLE OF CONTENTS

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(d) The use of dedicated function switches on the control console.

(e) Operator selectable automation of pre-defined plant operation sequences.

(f) The incorporation of an operator selectable semi-automated mode of plant operations, which provide procedural guidance on the control console VDUs.

(g) The capability to conduct these pre-defined plant operation sequences in an operator manual mode.

(h) The incorporation of a large display panel which presents information for use by the entire control room operating staff.

(i) The inclusion on the large display panel of fixed-position displays of key plant parameters and major equipment status.

(j) The separation of the fixed-position displays into safety-related displays which present required critical plant parameters and post-accident monitoring (PAM) variables and non-safety-related displays which typically present plant power generation cycle information.

(k) The independence of the fixed-position displays from the plant process computer.

(l) The inclusion within the large display panel of a large video display unit which is driven by the plant process computer system.

(m) The incorporation of a "monitoring only" supervisor's console which includes VDUs on which display formats available to the operators on the main control console are also available to the supervisors.

(n) The incorporation of the safety parameter display system (SPDS) function as part of the plant status summary information which is continuously displayed on the fixed-position displays on the large display panel.

(o) The use of fixed-position alarm tiles on the large display panel.

(m) The application of alarm processing logic to prioritize alarm indications and to filter unnecessary alarms.

(n) A spatial arrangement between the large display panel, the main control console and the shift supervisors' console which allows the control room operating crew to view the information presented on the large display panel from the seated position at their respective consoles.

(o) The use of VDUs to provide alarm information in addition to the alarm information provided via the fixed-position alarm tiles on the large display panel.

The remainder of this subsection provides further descriptions of these standard design features.

18.4.1.2 Main Control Console

The main control console comprises the work stations for the two control room plant operators. It is configured such that each operator is provided with controls and monitoring information necessary to perform their assigned tasks and allows the operators to view all of the displays on the large display panel (see Subsection 18.4.1.7) from a seated position.

The main control console, in concert with the large display panel, provides the controls and displays required to operate the plant during normal plant operations, abnormal events and emergencies. These main control console controls and displays include the following:

(1) On-screen control VDUs for safety system monitoring and non-safety system control and monitoring which are driven by the plant process computer system (see Subsection 18.4.1.3).

(2) A separate set of on-screen control VDUs for safety system control and monitoring and separate on-screen control VDUs for non-safety system control and monitoring; the operation of these two sets of VDUs is entirely independent of the process computer system. Further, the first set of VDUs and all equipment associated with their functions of safety system control and monitoring are divisionally separate and qualified to Class 1-E standards (see Subsection 18.4.1.4).

(3) Dedicated function switches (see Subsection 18.4.1.5).

The main control console is also equipped with a limited set of dedicated displays for selected functions (e.g., the standby liquid control system and the synchronization of the main generator to the electrical grid).

In addition to the above equipment, the main control console is equipped with both intra-plant and external communications equipment and a laydown space is provided for hard copies of procedures and other documents required by the operators during the performance of their duties.

18.4.1.3 Process Computer Driven VDUs

A set of on-screen control VDUs is incorporated into the main control console design to support the following activities:

(1) monitoring of plant systems, both safety and non-safety related,

(2) control of non-safety system components,

(3) presentation of system and equipment alarm information,

This set of VDUs is driven by the plant process computer system. Thus, data collected by the process computer is available for monitoring on these VDUs. All available display formats can be displayed on any of these VDUs.

18.4.1.4 Process Computer Independent VDUs

A set of VDUs which are independent of the process computer are also installed on the main control console. These VDUs are each driven by independent processors. They are divided into two subsets:

The first subset consists of those VDUs which are dedicated, divisionally separated devices. The VDUs in this group can only be used for monitoring and control of equipment within a given safety division. The VDUs are qualified, along with their supporting display processing equipment, to Class 1E standards.

The second subset of process computer independent VDUs are used for monitoring and control of non-safety plant systems. The VDUs in this subset are not qualified to Class 1-E equipment standards.

18.4.1.5 Dedicated Function Switches

Dedicated function switches are installed on the main control console. These devices provide faster access and feedback compared to that obtainable with soft controls. These dedicated switches are implemented in hardware, so that they are located in a fixed-position and are dedicated in the sense that each individual switch is used only for a single function, or two very closely related functions (e.g., valve open/close).

The dedicated function switches on the main control console are used to support such functions as initiation of automated sequences of safety and non-safety system operations, manual scram and reactor operating mode changes.

18.4.1.6 Automation Design

The ABWR incorporates selected automation of the operations required during a normal plant startup/shutdown and during normal power range maneuvers. Subsection 7.7.1.5 describes the power generation control system (PGCS) which is the primary ABWR system for providing the automation features for normal ABWR plant operations.

18.4.1.6.1 Automatic Operation: When placed in automatic mode, the PGCS performs sequences of automated plant operations by sending mode change commands and setpoint changes to lower-level, non-safety related plant system controllers. The PGCS cannot directly change the status of a safety-related system. When a change in the status of a safety-related system is required to complete the selected operation sequence, the PGCS provides prompts to guide the operator in manually performing the change using the appropriate safety-related operator interface controls provided on the main control console.

The operator can stop an automatic operation at any time. The PGCS logic also monitors plant status, and will automatically revert to manual operating mode when a major change in plant status occurs (e.g., reactor scram or turbine trip). When such abnormal plant conditions occur, PGCS automatic operation is suspended and the logic in the individual plant systems and equipment directs the automatic response to the plant conditions. Similarly, in the event that the operational status of the PGCS or interfacing systems changes (e.g., equipment failures), operation reverts to manual operating mode. When conditions permit, the operator may manually re-initiate PGCS automatic operation.

18.4.1.6.2 Semi-Automated Operation

The PGCS also includes a semi-automatic operational mode which provides automatic operator guidance for accomplishing the desired normal changes in plant status; however, in this mode, the PGCS performs no control actions. The operator must activate all necessary system and equipment controls for the semi-automatic sequence to proceed. The PGCS monitors the plant status during the semi-automatic mode in order to check the progression of the semi-automatic sequence and to determine the appropriate operator guidance to be activated.

18.4.1.6.3 Manual Operation

The manual mode of operation in the ABWR corresponds to the manual operations of conventional BWR designs in which the operator determines and executes the appropriate plant control actions without the benefit of computer-based operator aids. The manual mode provides a default operating mode in the event of an abnormal condition in the plant. The operator can completely stop an automated operation at any time by simply selecting the manual operating mode. The PGCS logic will also automatically revert to manual mode when abnormal conditions occur.

18.4.1.7 Large Display Panel

The large display panel provides information on overall plant status with real-time data during all phases of plant operation. The information on the large display panel can be viewed from the main control consol and the supervisors' console. The large display panel includes fixed-position displays (see Subsection 18.4.1.8), a variable display (see Subsection 18.4.1.9) and spatially dedicated alarm windows (see Subsection 18.4.1.12).

18.4.1.8 Fixed-Position Display

The fixed-position portion of the large display panel provides key plant information for viewing by the entire control room staff. The dynamic display elements of the fixed-position displays are driven by dedicated microprocessor-based controllers which are independent of the plant process computer system.

Those portions of the large display panel which present safety-related information are qualified to Class 1E standards.

The information presented in the fixed-position displays includes the critical plant parameter information, as defined by the SPDS requirements of NUREG-0737, Supplement 1, and the Type A post-accident monitoring (PAM) instrumentation required by Regulation Guide 1.97, Revision 3 (refer to Section 18.4.1.11 for a discussion of the SPDS and to Section 7.5 for a discussion of the PAM variables).

18.4.1.9 Large Variable Display

The large variable display which is included on the large display panel is a VDU which is driven by the plant process computer system. Any screen format resident in the process computer system can be shown on this large variable display.

18.4.1.10 Supervisors' Console

A console is provided for the control room supervisors which is equipped with VDUs on which any screen format resident in the process computer system and available to the operators at the main control console is also available to the shift supervisor. The location of this console in the control room is discussed in Subsection 18.4.1.15.

18.4.1.11 SPDS

NUREG-0737 provided guidance for implementing Three Mile Island (TMI) action items. NUREG-0737, Supplement 1, clarifies the TMI action items related to emergency response capability, including item I.D.2, "Safety Parameter Display System" (SPDS). The principal purpose of the the SPDS is to aid control room personnel during abnormal and emergency conditions in determining the safety status of the plant and in assessing whether abnormal conditions warrant corrective action by operators to prevent core damage. During emergencies, the SPDS serves as an aid in evaluating the current safety status of the plant, in executing symptom-based emergency operating procedures, and in monitoring the impact of engineered safeguards or mitigation activities. The SPDS also operates during normal operation, continuously displaying information from which the plant safety status can be readily and reliably assessed. The ABWR does not provide a separate SPDS, but rather, the principal functions of the SPDS (as required by NUREG-0737, Supplement 1) are integrated into the overall control room display capabilities. Displays of critical plant variables sufficient to provide information to plant operators about the following critical safety functions are provided on the large display panel as an integral part of the fixed-position displays:

(1) Reactivity control,
(2) Reactor core cooling and heat removal from the primary system,
(3) Reactor coolant system integrity,
(4) Radioactivity control, and
(5) Containment conditions.

Displays to assist the plant operator in execution of symptom-based emergency operating procedures are available at the main control console VDUs. Examples of these VDU displays are trend plots and operator guidance. Information regarding entry conditions to the symptomatic emergency procedures is provided through the fixed-position display of the critical plant parameters on the large display panel. The critical plant parameters on the large display panel are also viewable from the control room supervisors' monitoring station. The supplemental SPDS displays on the VDUs on the main control console are also accessible at the control room supervisors' monitoring station and may be provided in the technical support center (TSC) and, optionally, in the emergency operations facility (EOF), which are the responsibility of the applicant referencing the ABWR design to provide.

Entry conditions to the symptomatic EOPs are annunciated on the dedicated hardware alarm windows on the large display panel. The large display panel also displays the containment isolation status, safety systems status, and the following critical parameters:

(1) RPV pressure,
(2) RPV water level,
(3) Core neutron flux (startup range and power range instruments),
(4) Suppression pool temperature,
(5) Suppression pool water level,
(6) Drywell temperature,
(7) Drywell pressure,
(8) Drywell water level,
(9) Control rod scram status,
(10) Primary containment oxygen concentration,
(11) Primary containment hydrogen concentration (when monitors are in operation),
(12) Containment radiation levels,
(13) Secondary containment differential pressure,
(14) Secondary containment area temperatures,
(15) Secondary containment HVAC cooler differential temperature,
(16) Secondary containment HVAC exhaust radiation level,
(17) Secondary containment area radiation levels, and
(18) Secondary containment floor drain sump water level.

The oxygen monitoring instrumentation system is normally in continuous operation and hence the large display panel also includes continuous fixed-position display of wetwell and drywell oxygen concentrations. The hydrogen monitoring instrumentation is automatically started on a LOCA signal and hence continuous display is not required. Additional post accident monitoring parameters, such as effluent stack radioactiactivy release (Refer to Section 7.5 for a list of post accident monitoring parameters), may be displayed at the large variable display or at the main control console VDUs on demand by the operator.

The ABWR control room design will be implemented to incorporate accepted human factors principles so that the displayed information can be readily perceived and comprehended by the control room operating crew (Refer to Subsection 18.5 for a discussion of the design implementation process.)

The fixed-position displays listed in Table 18F-12 include the continuously displayed information necessary to satisfy the requirements for the SPDS, as defined in NUREG-0737, Supplement 1.

18.4.1.12 Fixed-Position Alarms

Fixed-position alarm tiles on the large display panel annunciate the key, plant-level alarm conditions that potentially affect plant availability or plant safety, or indicate the need of immediate operator action.

18.4.1.13 Alarm Processing Logic

Alarm prioritizing and filtering logic is employed in the ABWR design to enhance the presentation of meaningful alarm information to the operator and reduce the amount of information which the operators must absorb and process during abnormal events. Operators may activate or deactivate the alarm suppression logic at any time. Alarm suppression in the ABWR is based upon the following concepts:

(1) Suppression based on the operating mode. The plant operating mode is defined on the basis of the hardware or process status, and alarms which are not relevant to the

current operating mode are suppressed. For example, alarms which are needed in the "RUN" mode but are unnecessary in the "SHUTDOWN" mode are suppressed.

(2) Suppression of subsidiary alarms. Alarms are suppressed if they are logically consequent to the state of operation of the hardware or to the process status. For example, scram initiation (a plant-level alarm condition announced with a fixed-position alarm tile on the large display panel) will logically lead to an FMCRD hydraulic control unit scram accumulator low pressure (also an alarm condition). Such subsidiary alarms are suppressed if they simply signify logical consequences of the systems operation.

(3) Suppression of redundant alarms. When there are overlapping alarms, such as "high" and "high-high" or "low" and "low-low", only the more severe of the conditions is alarmed and the others are suppressed.

18.4.1.14 Equipment Alarms

Alarms which are not indicated by fixed-position alarm tiles on the large display panel (i.e., those alarms of nominally lower level importance such as those related to specific equipment status) are displayed to the control room operating staff via the main control console VDUs. The supplemental alarm indications and supporting information regarding the plant-level alarms which are presented on the large display panel are also presented on the VDUs.

18.4.1.15 Control Room Arrangement

In the ABWR main control room arrangement, the main control console is located directly in front of the large display panel for optimum viewing efficiency by the plant operators seated at the main console. The shift supervisor's console is also placed in front of the large display panel, but at a somewhat greater distance than the main control console. The shift supervisor is, thus, in a position behind the control console operators. This arrangement allows all control room personnel to view the contents of the large panel displays.

18.4.2 Remote Shutdown System

The remote shutdown system (RSS) provides a means to safely shutdown the plant from outside the main control room. It provides control of the plant systems needed to bring the plant to hot shutdown, with the subsequent capability to attain cold shutdown, in the event that the control room becomes uninhabitable.

The RSS system design is described in Subsections 7.4.1.4 and 7.4.2.4. All of the controls and instrumentation required for RSS operation are identified in Subsection 7.4.1.4.4 and in Figure 7.4-2.

The RSS uses conventional, hardwired controls and indicators to maintain diversity from the main control room. These dedicated devices are arranged in a mimic of the interfacing systems process loops.

18.4.3 Systems Integration

18.4.3.1 Safety Systems

The operator interfaces with the safety-related systems through dedicated hardware switches for system initiation and logic reset; hardware switches for system mode changes; safety related VDUs for individual safety equipment control, status display and monitoring; non-safety VDUs for additional safety system monitoring and the large fixed-position display for plant overview information. Instrumentation and control aspects of the microprocessor-based safety systems and logic control (SSLC) are described in Appendix 7A.

Divisional separation for control, alarm and display equipment is maintained. The SSLC processors provide alarms signals to their respective divisional alarm windows on the large display panel and provide display information to the divisionally dedicated VDUs. The SSLC microprocessors communicate with their respective divisional VDU controllers through the essential multiplexing system (EMUX). The divisional VDUs have on-screen control capability.

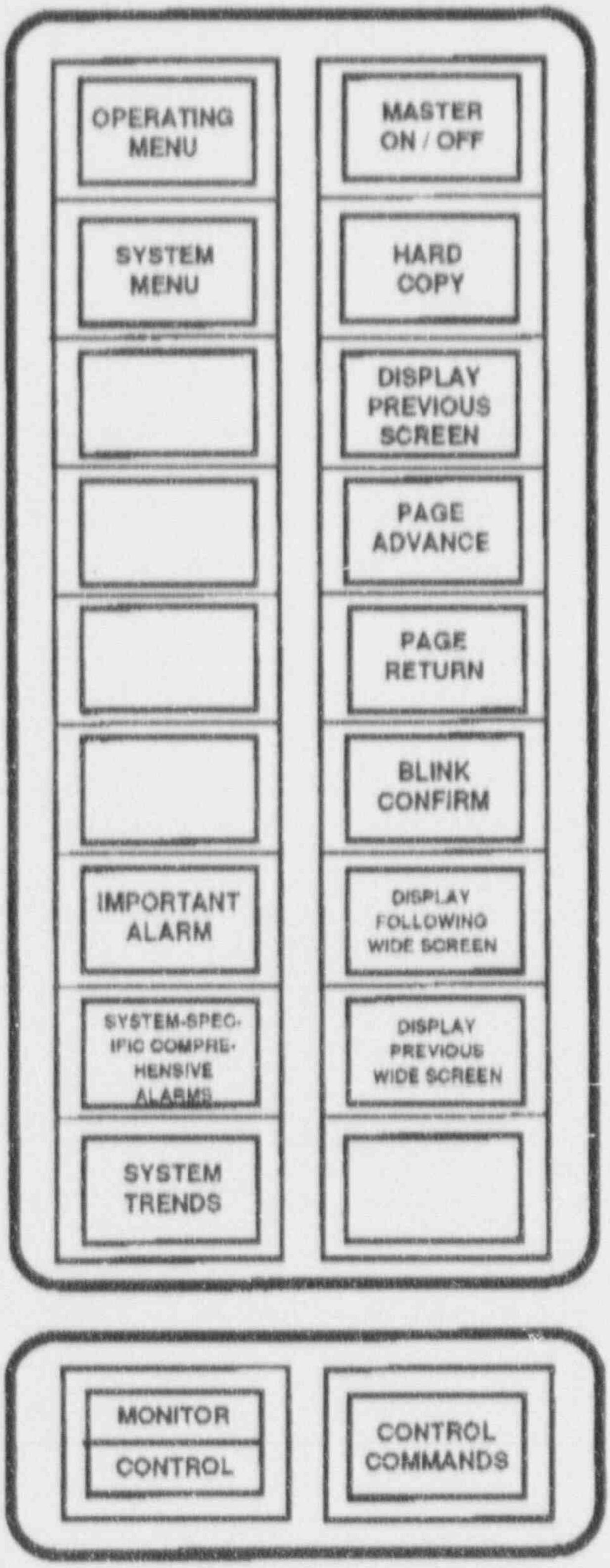

Figure 18C.6-4
CRT Display System Dedicated Hardware Switches

Figure 18C.8-1
Appearance of Plant-Level Fixed-Position Alarm Display

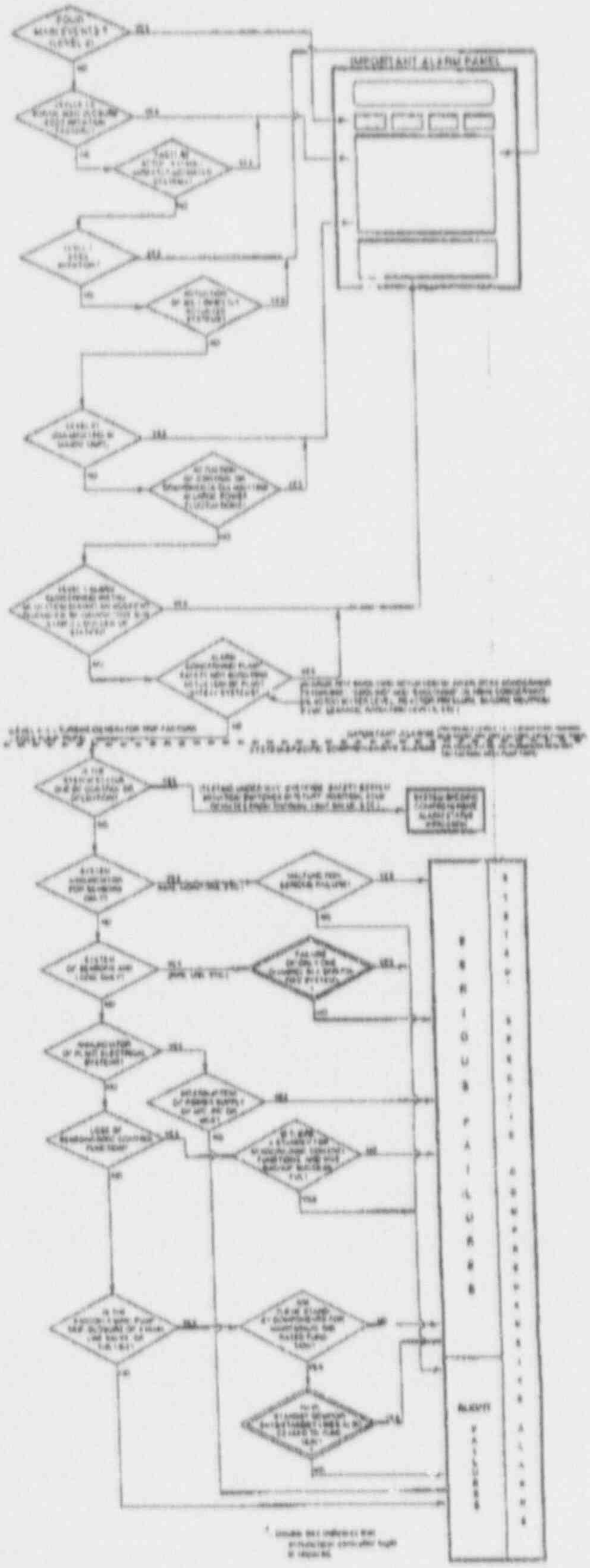

Figure 18C.8-2
Classification Logic for Plant-Level and System-Specific Alarms

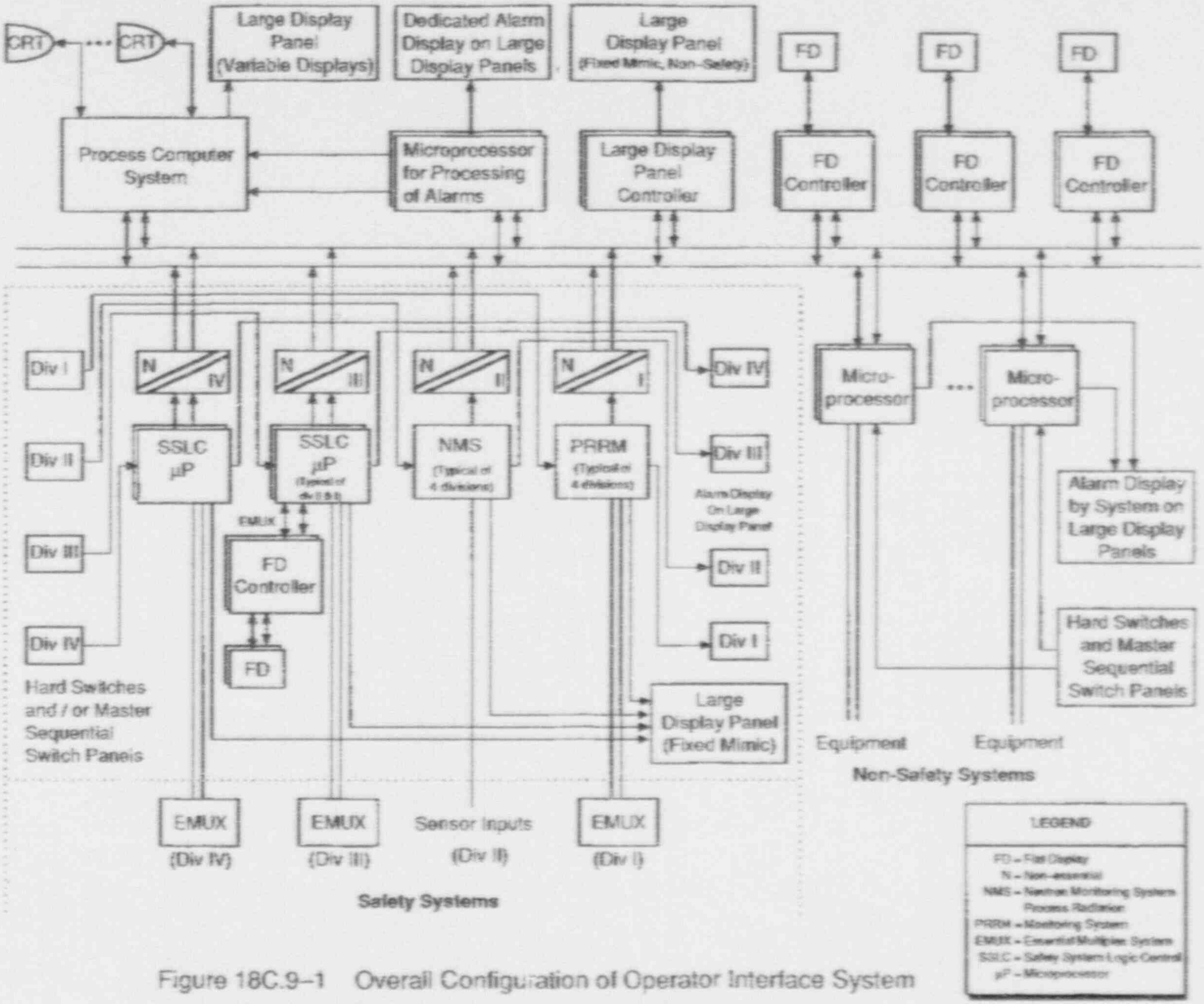

Figure 18C.9–1 Overall Configuration of Operator Interface System