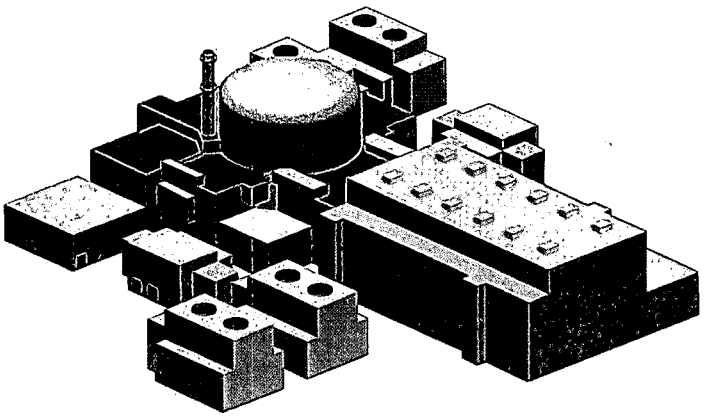
U.S. Evolutionary Power Reactor

Generic U.S. EPR Plant



EPR Human System Interface Design Style Guide

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RECORD OF REVISIONS

Safety Related? ☐ YES ☒ NO

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1.0 APPLICABILITY

This guide applies to the U.S. EPR Project, Human Factors Engineering (HFE).

2.0 OWNER

Program Manager, HFE and Control Room Design.

3.0 PURPOSE

The purpose of this guide is to establish human factors guidance and provide a consistent approach to the Human System Interface (HSI) design for the U.S. EPR which satisfies the Quality Assurance plan, the Design Control Procedures, the U.S. EPR Project Plan, and Nuclear Regulatory Commission (NRC) regulatory guidelines.

4.0 SCOPE

The scope of this guide includes the following:

- Human characteristics
- Human Factors Engineering design considerations for operation and control centers
    - The form, function, and operation of the HSIs
    - Environmental characteristics relevant to human performance.
- Design of the HSIs

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5.0 ACRONYMS AND DEFINITIONS

5.1 Acronyms

Acronym	Definition
ASD	**Alarm Sequence Display**
CBP	**Computer Based Procedures**
EPR	**Evolutionary Power Reactor**

HSI	**Human System Interface**
I&C	**Instrumentation and Control**
I&C SC	**I&C Service Center**
MCR	**Main Control Room**
NRC	**Nuclear Regulatory Commission**
NUREG	**Publications Prepared by the NRC staff**
PICS	**Process Information and Control System**
P&ID	**Piping and Instrumentation Diagram**
POP	**Plant Overview Panel**
QDS	**Qualified Display System**
RSS	**Remote Shutdown Station**
SICS	**Safety Information and Control System**
TSC	**Technical Support Center**

5.2 Definitions

Accuracy	**How well the representation or measurement of a variable represents the actual state or value of the variable.**
Border	**The black outline of a screen-based or graphic symbol or icon. (Note: this is as opposed to a "frame")**
Coding	**Attaching a meaning to some relevant feature.**
Color Blocking	**Using a closed block of different color than the standard display/panel background color as the background color behind a defined group of items to emphasize that they are to be considered as a group.**
Color Coding	**Attaching a meaning to the color used. Typically a unique color is assigned to different systems or fluids shown on a mimic display.**

Compatible	**Not matching exactly in details such as color coding or configuration, including orientation and flow direction, but using similar general rules for details that do not obviously contradict each other.**
Consistent	**Matching exactly in general configuration including coding, orientation, and flow direction.**
Demarcation	**Demarcation is used to identify groups of elements.**
Display	**The predefined format and contents of parameters, data, static graphics, and/or control devices assigned a unique ID number by the system that can be retrieved and shown by normal navigation methods.**
Dynamic	**A graphic that has features that change dependent upon system feedback signals. (As opposed to "static")**
Faceplate	**A pop-up window opened from a display by selecting a symbol. The faceplate contains the virtual buttons used to input control signals to plant equipment or controllers.**
Frame	**A colored rectangle that may appear surrounding a symbol or icon on a screen-based display to indicate some status of that item.**
Jump Button	**A button that permits one-click navigation to another pre-defined display**
Labels	**Descriptor that is distinguishable from, and helps to identify, displayed structures or components.**
Legibility	**The quality of a display that allows individual or groups of characters and symbols to be easily discriminated and recognized.**
Line Coding	**Attaching a meaning to the thickness or format (solid, dotted, or dashed, etc.) used on mimic lines on diagrams.**
Lines of Demarcation	**Lines added as a defining border used to group a set of items on a display or panel.**
Units of Measure	**The type of units a parameter value is expressed in, such as inches, ft^3, m^3/h,, seconds, gallons, ohms, volts, etc.**
Navigation	**The method used to call up individual displays.**
Precision	**The accuracy or exactness of a measurement.**

Readability	**The ease with which words, text and symbols can be read and understood. Readability specifically refers to the ability to functionally extract the intended meaning from the text or graphics.**
Static / static item	**Any graphic item, text or symbol, that does not receive any system feedback, has no control capability, and does not vary in appearance (as opposed to "dynamic")**

6.0 INTRODUCTION

According to NUREG-0711 (Reference [6]), a design-specific HFE design guidance (style guide) shall be developed in order to utilize HFE guidance in the design of the HSI features, layout, and environment. NUREG-0700 (Reference [7]), provides HFE guidelines that address the physical and functional characteristics of HSIs. These guidelines were used to create this HSI Style Guide. Use of this guide provides standardization and consistency in applying HFE principles to the design of the U.S. EPR.

This guide provides the HFE guidelines to be used on the U.S. EPR project. It will be revised as additional information becomes available during the detailed design process. The process for the design of the U.S. EPR HSI is described in the HSI Design Implementation Plan (Reference [1]).

7.0 HUMAN CHARACTERISTICS

7.1 Assumptions

All HFE guidelines outlined in this document take into account the physical characteristic requirements of control room operators which are documented in the Concept of Operations document (Reference [2]). It is assumed that all operators have

- No mobility impairments
- No perceptual deficiencies
- Strength and dexterity within normal abilities
- The ability to hear alarms and conversations at a normal voice level
- The ability to read text and assess displayed values from the directed viewing distances (wearing corrective lenses, if required).
- Adequate color discrimination abilities to read the displays and differentiate between the various colors used for status, alarm, or media mimic line coding.

7.2 Matching User Experience and Expectations

Design and layout of the HSIs shall match the experience and expectations of U.S. Pressurized Water Reactors in order to take advantage of population stereotypes. The conventions used, interface selections, and coding conventions shall align with those stereotypes.

8.0 OPERATION AND CONTROL CENTER GUIDELINES

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8.1 Use of Non-Safety HSI

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8.2 Use of Safety-Related HSI

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8.3 Operations-Related Considerations

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The workstations shall be located so that the staff can freely communicate between each other and coordinate their actions. The workstations shall be arranged to facilitate coordination and communications between the members of the staff.

The panel layout should be based on analyses of operator roles and organized based on frequency of use, importance, and sequence of use as described by the task analysis in the HSI Design Implementation Plan (Reference [1]).

8.4 Workstation Viewing and Reach Distances

Workstations shall be laid out so that all the information the operator needs to safety monitor and control the plant is available. To achieve this, the viewing and reach distances for these workstations shall be in accordance with the following requirements.

8.4.1 PICS

The PICS workstation viewing and reach distances shall be designed in accordance with the dimensions provided in NUREG-0700, Section 11.1.2 (Reference [7]).

When seated, the supervisors are not required to be able to see the operators' screens. However, when standing, the supervisors should be able to identify which displays are currently on the operator workstations and may be able to identify which faceplates are open.

8.4.2 POP

8.4.3 SICS

The SICS workstations are stand-up consoles. The viewing and reach distances of these workstations shall be designed in accordance with the dimensions provided in NUREG-0700, Section 11.1.1 (Reference [7]).

The viewing distance guide for all displays, indicators, and alarm messages shall be readable from within arms length of the panels when manned.

The text on alarm tiles shall be easily read when within arm's length distance from the associated panel. If an alarm is on a different panel than where the operator is located, the operator should be able to identify from location and coding the nature of the alarm, even if they are not able to reliably read the text.

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8.4.4 All Other System Monitors/Panels

For all other monitors/panels in the control rooms, such as those on the fire system panel, the viewing distance shall be within a normal reach distance (33 – 80 in.) to the monitor/panel.

8.5 Communications

The communication system shall provide reliable and effective communications inside buildings onsite and with external locations during normal operation, maintenance, transient, fire, accident conditions including loss of offsite power, and security related events. The design of the communication system shall take into account human factors considerations described in NUREG-0700, Section 10 (Reference [7]).

8.6 Environment

Environment considerations for the HMI design consist of characteristics such as temperature, ventilation, illumination, and noise. The environment of the operation and control centers can have an effect on operators' performance in terms of attention, awareness, memory, perceptions, and thinking (e.g., processing information). An optimum environment is an essential part in the prevention of operator mistakes and accidents. The following guidelines shall be followed for the environment of all the operations and control centers. Exceptions for specific rooms will be noted where applicable. The MCR has other requirements that must be met per Reference [10].

8.6.1 Temperature and Humidity

The temperature and humidity of the operation and control centers shall be maintained such that the operators and staff can perform their tasks effectively and comfortably.

For the MCR, the climate control system should maintain the temperature ranges provided in NUREG-0700, Section 12.1.2.1 (Reference [7]).

8.6.2 Ventilation

Each of the operation and control centers shall be provided with ventilation that introduces fresh air.

For the MCR, ventilation shall maintain MCR operability during all operating conditions, including design basis accidents. The air quantity and velocity rates provided in NUREG-0700, Section 12.1.2.2 (Reference [7]), shall be maintained.

8.7 General Lighting

Sufficient lighting shall be provided in all of the operation and control centers. Illumination levels, glare, and reflectance shall be in accordance with the guidance in NUREG-0700, Section 12.1.2.3 (Reference [7]).

8.8 Emergency Lighting

Emergency lighting shall be provided in all of the operation and control centers.

In the MCR, the guidance in NUREG-0700, Section 12.1.2.4 (Reference [7]) for emergency lighting shall be followed.

8.9 Acoustics

The acoustic design of the operation and control centers shall not inhibit verbal communication, muffle auditory signals, or provide distraction, irritation, or fatigue.

In the MCR, the auditory guidance in NUREG-0700, Section 12.1.2.5 (Reference [7]) shall be followed.

8.10 Flooring

Specific details about the flooring type and color for each of the operation and control centers will be determined at a later date.

8.11 Walls

Wall color and textures for each of the operation and control centers will be determined at a later date.

9.0 HSI DESIGN PRINCIPLES

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9.1 Prevention of Inadvertent Actions

The HSIs shall provide methods to prevent inadvertent control actions. For some tasks, this may be in the form of requiring the operator to perform two separate actions to complete that task (e.g., use of separate conformation/ covers/ execute/ release controls which will have to be used with a proper sequence in order to execute the desired command).

Specific guidelines to determine which conventional control tasks require two actions will be determined later.

For all screen based HSI, two separate actions will be required to control plant equipment; a control command and then an execute command.

9.2 Labeling

Controls, displays, and other items that must be located, identified, or manipulated shall be appropriately and clearly labeled.

9.3 Colors

Color is used to code the status of components or alarms. One color will be assigned to only one meaning or status.

Table 9-1: Color Table for HSI Displays

Table 9-2: Color for Static Display Components

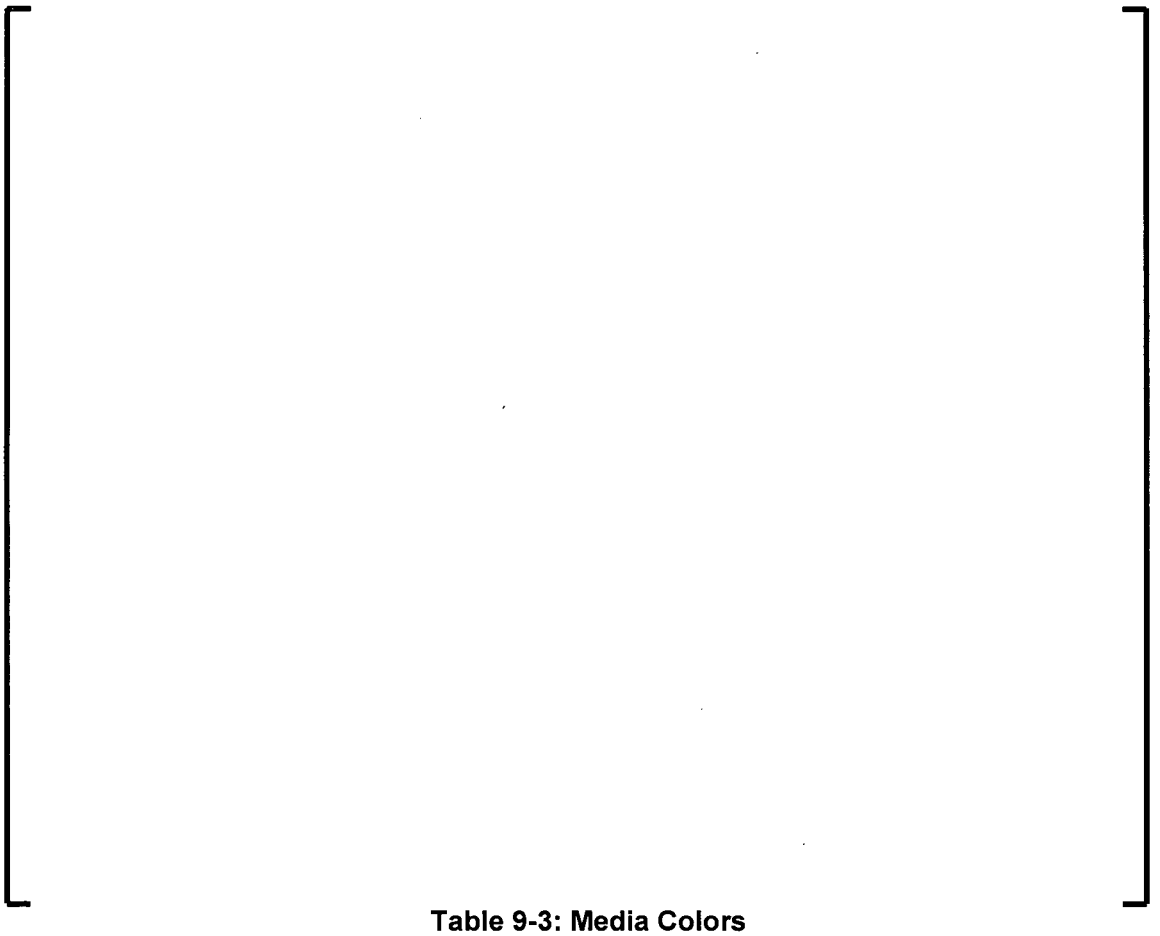

Table 9-3: Media Colors

9.4 Text Format

The following general text guidelines shall be used:

- All text (except labels) shall be presented using upper and lower case characters.
- Label and titles shall be displayed in upper case.
- Upper case shall be used when lower case letters have decreased legibility.
- Text font type shall be Courier New. This font type shall maintain a uniform dimensional ratio.

9.4.1 Display Text Size

Text size rules are based on readability considerations from NUREG-0700, section 1.3.1-4 (Reference [7]). In general, character size requirements should be based on maximum reading distances. The type of information and context in which it is presented can also be used to make size determinations.

9.4.1.1 PICS and QDS

[redacted]

9.4.1.2 POP

Special displays will be developed for the POP. Specific text size will be determined at a later date based on Section 6.3.2.9 in Reference [7].

9.4.2 Panel Text Size

[redacted]

9.5 Abbreviations and Acronyms

In general, abbreviations and acronyms should be avoided, but may be used when space is limited. Abbreviations and acronyms are defined for the U.S. EPR to ensure consistency between the design documentation and the HSI. The abbreviations should be those that are found in this style guide, the US EPR ECS Coding Standard (Reference [12]), or the Official US EPR Systems / Structures List (Reference [13]).

In the case where no abbreviation exists and a new abbreviation has to be defined, then the rules for abbreviations in NUREG-0700, Section 1.3.2 (Reference [7]) shall be applied.

9.6 Display of Parameter Values

Parameter values are the status of plant equipment or results of processes. The values can be represented digitally through a numerical display or as an analog value through a bar chart or trend curve. The following guidelines apply to the design of both the PICS and SICS (displays and panels).

9.6.1 Precision and Accuracy

Information should be displayed only to the degree of specificity and precision required for a specific operator action or decision. The precision of any numerical or analog display shall not be greater than the accuracy of the input signals. Instrument and equipment precision will be determined by the responsible system engineer.

9.6.2 Units of Measure

The units of measure for the U.S. EPR are English (U.S. customary) units. Exceptions may apply to some plant systems; therefore the units to be used for all displayed parameters shall match the units specified in the plant system documentation.

These measuring/engineering units shall be shown in the appropriate lower or upper case text as is prescribed for the particular unit.

9.6.2.1 Showing measuring units

The units of measure associated with any digital display value shall always be included with the value. In groups of similar parameters it is acceptable to have a common label identifying the units if the applicable grouping is obvious.

9.6.3 Percentages

The use of percentage scales and "%" (percent) for the measuring / engineering unit is acceptable if there is no operational need for the user to have the value in standard measuring/engineering units. The decision to use percentages is decided on a case-by-case basis.

Under the following conditions, users find it easier to use simple percentage scales rather than ones with actual values in measuring/engineering units:

- If there are no required operational setpoints or conversions/comparisons with other parameters required in the actual measuring/engineering units, and/or
- Users are not apt to remember the ranges of the value in the measuring/engineering units

9.6.3.1 Motor current percentage scales

For all major (>10 kV) motors, indication of motor current should be provided. Such indication shall use percentage scales rather than showing actual current in electrical units (e.g., amperes). The percentage scaling should be set with 100% being defined as normal full load expected current (also known as the "rated" current).

To account for in-rush current during motor start-up; the scale should indicate up to 130% of normal so that an extended reading above 100% can be identified as an abnormal condition.

9.6.4 Use of Appropriate Measuring Units

Height / distance / displacement measurements are in standard U.S. units (e.g., inches and feet). The choice of appropriate units for each measurement should be based on the normal expectations of the users and the appropriate consideration of precision and accuracy requirements as discussed in Section 9.6.1.

Detailed guidance for deciding which unit to use will be determined later.

Measured value range	Preferred units
< xx in.	in.
xx in. – xx ft.	ft.

Table 9-4: Measuring Units

9.6.5 Numerical Indicators

Numerical indicators are used to display digital readouts of parameters. Indicators can take many forms, including numerical scales, digital readouts, and lights.

9.6.5.1 Indicator Format

The following rules apply to parameter values that are displayed in a numerical format (as opposed to an analog format such as a bar chart).

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9.6.5.2 Indicator Location

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9.6.5.2.1 Associating with source

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9.6.5.3 Indicator Grouping

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9.6.5.4 Indicate Pressure and Temperature Differentials

In the case of indication of a pressure or temperature drop across a component, dotted lines shall be placed from the inlet and outlet measurement point up to opposite sides of the numerical indicator.

9.6.6 Bar Charts

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9.6.7 Tables and Lists

Tables and lists are used to present information to the operator in a manner that makes it easier for the operator to find the needed information.

The information shall be organized increasing from left to right or top to bottom. The information shall be arranged in either logical or alphabetical order.

9.6.8 Trend Group Displays

Trend group displays are used to display one or more variables with respect to another variable.

9.6.8.1 Content of Trend Groups

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9.6.8.2 Types of Trend Group Displays

Time Curve Displays

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9.6.8.3 Grouping rules

9.6.8.3.1 Filling of groups

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9.6.8.3.2 Combine based on expected use

It is more difficult to compare trends located on different trend groups. It is therefore necessary to include parameters whose correlation is apt to be of operational interest within a single trend group.

9.6.8.3.3 Duplication of parameters in multiple trend groups

Although there is a goal to minimize the total inventory of displays, it may be desirable in certain circumstances to include the same parameter in multiple trend groups when the parameter is of interest within the different groups.

For example, there are more than one trend group of generator temperatures, however it might be operationally significant to include an active power signal in each associated group in order for the operator to see how the individual signals respond to changes in power.

9.6.8.3.4 Combining all parameters from a single component

When there are multiple parameters from a single component (e.g., both bearing and motor winding temperatures, motor current, oil pressure, etc.), then an effort should be made to include all related parameters within a single trend group.

9.6.8.3.5 Comparing conditions across redundant components

When there may be need to assess conditions between components, it is desirable to combine similar parameters from each component in a single trend group.

9.6.8.3.6 Mixing of Logarithmic and Linear Scales

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9.6.8.3.7 Mixing of Ranges for the Same Parameter

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9.6.8.4 Navigation to Trend Groups

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9.6.8.4.1 Labeling of Jump Buttons to Trend Groups

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9.6.8.4.2 Trend Group Labeling Content

Each pre-defined, pre-engineered trend group display shall have a unique plant identification code and descriptor that makes the content of the trend group (i.e., general composition of the included parameters) or its operational purpose obvious.

9.6.9 Scaling

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9.6.9.1 Scaling of non-linear measurements

Parameters displayed should be processed and shown with standard linear scales. An exception will be made for those parameters traditionally indicated with logarithmic scales, such as neutron flux and radioactivity measures. These measurements should be shown with their logarithmic scale.

9.6.9.2 Trend Group Exceptions

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9.7 General Layout Guidelines

The most important HSI organization concept is that items should be easy for users to locate on a drawing, panel, or display. This is achieved when the layout matches the user's understanding and expectations.

The layout of the displays and panels should match the general format and drawing conventions for the applicable plant drawings. For fluid and air systems, those are the flow diagrams / P&IDs. In the case of electrical systems, the applicable drawings are typically the electrical single-line diagrams. For the remainder of this section the term "plant drawing" includes the flow diagrams, P&IDs, or electrical single-line diagrams where applicable, unless specifically stated otherwise.

9.7.1 Accurate Functional Flow

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ect, it is acceptable for the layout of the displays and panels to not match th

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9.7.2 Conformance with Plant Drawings

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9.7.2.1 Consistency with Plant Drawings

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9.7.2.2 Layout Simplification

When the display and panel layouts are simplified (i.e., they do not include all the components or subsections shown on the plant drawings), the flow paths should also be simplified. The flow paths should not be deliberately distorted to match orientation of the components as shown on the plant drawing due to the presence of the other shown items.

9.7.2.3 Consistency with Physical Layout

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9.7.2.4 Resolving Inconsistencies with the Plant Drawings

Consistency between the displays and panel layouts should be maintained even if inconsistencies exist between connections and relationships shown on the plant drawings. In this case, the general conventions described in the following sections should be followed.

9.7.3 General Flow Conventions

The following general guidance for direction flow is to be used when the applicable plant drawings do not provide clear-cut unambiguous guidance.

9.7.3.1 General Flow Conventions for Fluid/ Air Mechanical Systems

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9.7.3.2 General Flow Conventions for Electrical Distribution Systems

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9.7.4 Flow line guidelines

The following rules apply to lines shown to represent process, piping, and electrical flow lines.

9.7.4.1 Flow Line Characteristics

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9.7.4.2 Flow line width coding

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9.7.4.3 Flow line color coding

Color coding shall be used to indicate general system / fluid / medium involved or voltage levels. The colors of flow lines are defined in Table 9-3.

9.7.4.4 Dynamic flow line color coding

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9.7.4.5 Crossing Flow Lines

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Figure 9-1: Example of Line Crossing

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9.7.4.6 Intersecting Flow Lines

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"Intersecting" in this context refers to situations where there are physical connections at which transmitted fluid

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Figure 9-2: Example of Intersecting Flow Lines

9.7.4.7 Parallel Flow Lines

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9.7.4.8 Flow Line Termination Points

All flow path lines shall either originate or terminate at a labeled component on the display / panel. There may be instances where the flow line shown extends to components or systems on a different display or panel. In this

case, the flow path line shall identify where the line leads. Where the flow is directional, the termination shall also be shown.

9.7.4.9 Use of Directional Arrows / Arrowheads

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9.7.5 Alphanumeric Order of Redundant Component Configuration

In the absence of another guideline, redundant components or trains of components should be arranged in numerical or alphabetical order from left-to-right or top-to-bottom. (i.e., "A" to left or above "B"; "1" to left or above "2")

9.7.5.1 Exception for Reactor Coolant System

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9.7.6 Mirror Image Guidelines

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9.7.7 Demarcation

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9.7.7.1 Lines of Demarcation

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9.7.7.2 Color Blocking

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10.0 DISPLAY SPECIFIC GUIDELINES

10.1 Interface Devices

All control actions through the graphical interface system should be accomplished through the selection and actuation of virtual "buttons" on the display.

10.1.1 PICS

10.1.2 QDS

10.2 Display Inclusion Guidance

The following guidance should be followed to ensure the operator is able to efficiently use the displays.

10.2.1 Inclusion of Dynamic Items

In order to make the displays as simple as possible, generally only components that can actually be controlled using the display and the indications needed to assess those components' operation are included.

Typically manually operated valves for maintenance purposes, (e.g., maintenance isolation valves and instrument root valves) are not included on displays.

Dynamic indications for components that are not controlled but whose status is needed by operators are included as required to support operator actions.

10.2.2 Inclusion of Static Items

If required to facilitate operator recognition or comprehension, some static symbols (having neither control capability nor dynamic status feedback) may be included on a display. Static items shall be readily differentiable from those dynamic and/or controlled components shown on the display.

Examples of static items include the reactor vessel, tanks, or heat exchangers that help the operator recognize where in the system the components are located, or showing important check valves (one-way valves) to clarify possible flow paths.

10.2.3 Inclusion of Components from Other Systems

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10.2.4 Inclusion of Redundant Measures

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10.2.5 Detailed Pump and Valve Displays

The following rules apply to the lower level detailed displays that provide mostly component level details for pumps and certain major complex valves. These displays mostly contain component-level parameters (bearing temperatures, cooling flows, etc.) for the major components shown on higher level displays.

10.3 System Functioning Indication

10.4 Individual Display Identification

Each individual display shall include a unique display ID and a text description. For configuration control purposes, it shall be possible to identify the revision number of the display.

10.5 Display Area

10.6 Navigation and Hierarchy

In order for the operator to effectively monitor and control the plant, navigation methods used to call up and assign individual displays to a given monitor shall be provided. In order to navigate to displays effectively, the displays must be put into an organization, called the display hierarchy. The display hierarchy provides a means of identifying each individual display and supports the display navigation process.

10.6.1 Navigation Aids

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10.6.2 Between Monitor Functionality (PICS only)

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10.6.3 Different Monitor Display Assignment (PICS only)

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10.7 Alarm Status (PICS only)

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10.8 Faceplates

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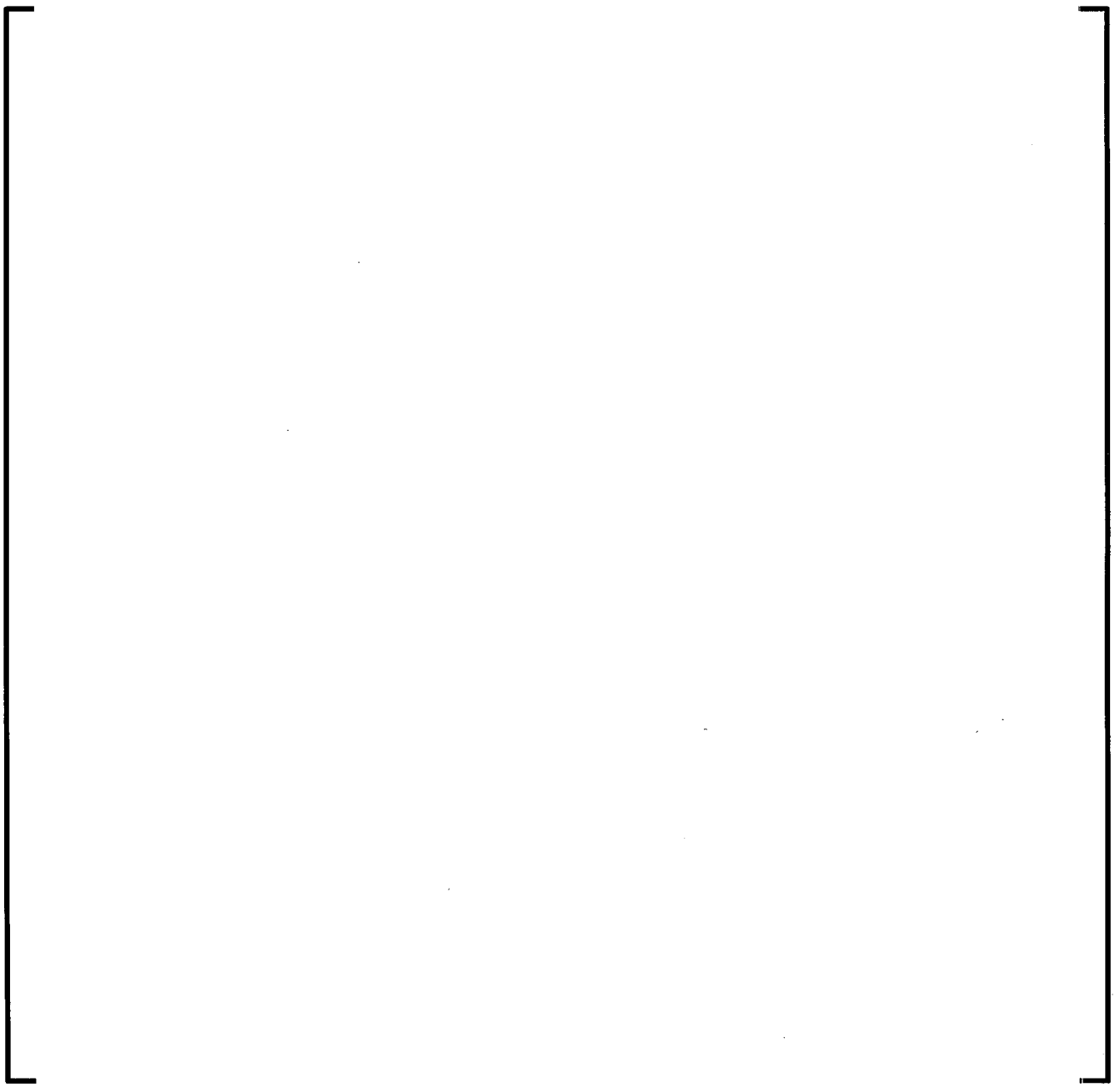

For example, for the selection symbol (e.g., a pump or valve symbol) located on the display in position # 15 (southwestern position in the southeastern quadrant), the initial opening position of the faceplate would be # 5 (the same southwestern relative position in the opposite northwestern quadrant).

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10.9 Component Symbols

The symbols not only represent a specific plant component but also serve as selection devices used to open faceplates through which control inputs are made. The symbols are defined in the U.S. EPR Display Symbol Library (Reference [5]).

10.10 Symbol Orientation

Valve, damper, blower and pump symbols can be shown in any horizontal or vertical orientation on the display.

The use of different orientations should be used as a form of coding and to facilitate identifying similar items and to help simplify the flow paths shown.

10.10.1 Symbol Sizing

Some symbols may be re-sized, as defined in the symbol library, in high density situations where the space on the display is limited. The size of these symbols does not have to be representative of the actual size of the component relative to the other components on the display.

10.10.2 Static Symbols

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10.10.3 Dynamic Symbols

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10.10.4 Controllability

Details concerning the coding of controllability will be determined later.

10.10.5 Pump Symbols

10.10.6 Valve Symbols

10.10.7 Blower/ Compressor/ Ventilator Symbol

The blower / compressor / ventilator symbol is used for all blowers and compressors, regardless of the actual type or drive device used.

Blower/ compressor/ ventilator symbol shall be oriented so that the narrower interior part of the symbol is pointing in the direction of the normal discharge path.

The orientation of the blower / compressor / ventilator symbol used on the faceplate shall match the orientation of the blower / compressor / ventilator symbol used to open the faceplate from the display. (Reference [4])

10.10.8 Heat Exchanger Symbols

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10.10.9 Damper Symbol

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10.10.10 Actuator Types

The pump, blower, damper, and valve symbols used on the displays and faceplates do not include indication of motive or control type used (i.e., no separate symbols are provided to distinguish between motor-driven, solenoid, or pneumatic / hydraulic-operated valves, etc.) (Reference [4])

10.10.11 Controller Symbols

Special symbols indicate various types of open and closed loop controllers. These symbols shall be shown on the displays with the component that requires that type of controller.

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10.10.12 Showing Control / Input Signals

Control signals are not typically shown on the higher level system displays. On the lower level PICS displays, electrical (I&C) control signals should only be shown when including such information reduces the likelihood of an identified error situation. Such situations would be when it is not otherwise obvious which components receive control input from a particular control device or indicated signal.

Inputs from sensors should lead to the associated controller rather than to the controlled device, (e.g., pump or valve), when the controller is shown on the display. (Reference [4])

10.10.13 Status Coding

Component status, such as inoperable and tagged out for repair, as well as signal validity shall be noted. This may be accomplished using color codes, frames around the symbols or signals, or special flag signals.

Details of the codes and convention will be determined at a later date.

10.10.14 Symbols for structural walls

The following conventions apply to symbols representing divisions or showing cross sections through structural walls.

10.10.14.1 Separation between adjacent areas

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10.10.14.2 Separation between non-adjacent areas

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10.10.15 Orientation of Ventilation or Building Compartments

When the display is primarily a depiction of a ventilation or distribution system showing distributions to many components in different levels of the same building, the display format should have the levels shown in relative order (i.e., higher elevation items on top of lower ones.)

10.10.15.1 Orientation of Multiple Rooms / Compartments

If there are no compelling operational reasons to show physical spatial relationships, it is be acceptable to show all compartments at the same level in simple alphanumeric order or by some other functional grouping as applicable.

10.10.15.2 Orientation of Multiple Buildings

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10.11 Display Labeling Requirements

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10.11.1 Labeling on Faceplates

Each faceplate shall have the entire unique plant identification code as well as a text description for the equipment being controlled. This label shall be shown at the top of the faceplate.

10.11.2 Labeling for Symbols

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10.11.3 Labeling of Line Origin or Termination Points

Whenever possible, the only labeling on piping or electrical lines should be the plant identification code of the equipment or system / train from which or to which the flow path leads.

10.11.4 Labeling of Jump Buttons

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10.11.5 Labeling to Identify Buildings / Rooms / Compartments

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10.11.6 Labeling to Identify Compartment Contents

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10.11.7 Labeling of Multiple Rooms / Compartments

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10.11.8 Label Location

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11.0 PANEL SPECIFIC GUIDANCE

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11.1 Workstation Layout

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11.2 Panel Inclusion Guidance

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11.2.1 Duplication of items on SICS panels

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11.2.2 Absence of Hierarchy on SICS Panels

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11.2.3 Including Individual Redundant Controls

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11.2.4 Components from other Systems on Panels

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11.3 Panel Symbols

Only the controlled components and the associated labeling shall be used on the SICS panels. The symbols for the indication and monitoring components shall not be included.

Static symbols of process components that can not be controlled from the SICS panel may be included to facilitate users understanding the panel and ability to locate the applicable controls.

The symbols used on the SICS panels should match those used for the displays which are defined in the U.S. EPR Display Symbol Library (Reference [5]).

11.3.1.1 Orientation of SICS Panel Symbols

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11.3.1.2 Level of Detail Shown on Individual Symbols and Figures

Only highly stylized symbols and figures are available for use on the panels. When a suitable figure is not available and it is necessary to indicate a process device on the panel, a simple label box should be used to represent the device.

11.3.1.3 Status Coding

Component status, such as inoperable and tagged out for repair, as well as signal validity shall be noted.

Details of the codes and convention will be determined at a later date.

11.4 Panel Labeling Requirements

11.4.1 Equipment labeling on panels

All plant control devices and indicators shall have the plant identification code and text description displayed on the tiles.

11.4.2 Labeling of static items

Ordinarily static items shown on the panels should not be labeled. Labeling should only be added on a case-by-case basis if required for clarity.

11.4.3 Preferred Location of Labels

The labeling should ordinarily appear below horizontally oriented items or to the left of vertically oriented items.

The label should be centered on the symbol with which it is associated.

11.5 Panel-Specific Layout Guidelines

The SICS panel layout shall distribute the controls and indicators so that individual operator movement is not excessive and operators do not physically interfere with each other.

The following guidelines and recommended dimensions are based on anthropometric considerations provided in NUREG-0700 (Reference [7]). These dimensions are based on the 5th percentile female and 95th percentile male.

11.5.1 Display Height

Displays shall be placed in an area between 41 and 70 in. above the floor.

Displays that must be read precisely shall be placed in an area between 50 and 65 in. above the floor.

11.5.2 Location of Frequently Monitored Displays on SICS Panels

Displays that require frequent or continuous monitoring or that may display important information, such as alarms, shall be located within 35° left/right and 35° up/25° down from the perpendicular line-of-sight to the panel center.

11.5.3 Location of Controls

The user should be able to perform tasks at a panel without extreme movement, such as stepping to the side. To accomplish this, the following guidelines are established to determine location of the controls.

11.5.3.1 Lateral Spread of Controls

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11.5.3.2 Control Separation

Controls shall be separated to avoid inadvertent or simultaneous actuation. See Table 11.3 of NUREG-0700 (Reference [7]) for specific separation guidelines.

11.5.3.3 Control Height

Control height requirements are based on reach distances which depend on basic panel geometry.

The highest controls shall be located within the reach of the 5th percentile female (below 63 inches for the U.S. EPR SICS panel); the lowest controls within the reach of the 95th percentile male (above 27 inches for U.S. EPR SICS panel).

12.0 COMPUTER-BASED PROCEDURE

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13.0 REFERENCES

6. NUREG-0711, "Human Factors Engineering Program Review Model," Rev. 2, February 2004.

7. NUREG-0700, "Human System Interface Design Review Guideline," Rev. 2, U.S. Nuclear Regulatory Commission (NRC), 2002