2.9 HUMAN FACTORS ENGINEERING

2.9.1 Design Description

The human factors engineering (HFE) program ensures that each human-system interface (HSI) reflects the latest human factors principles and satisfies the applicable regulatory requirements. Most of the human-system interface system (HSIS) is fully computerized, although there are some portions that utilize conventional switches and indicators.

2.9.1.1 General HFE Program and Scope

The goals of the US-APWR HFE Program are to ensure that an adequate HFE program is developed and the program is implemented. The general objectives of the HFE program are stated in human-centered terms, which, as the HFE program develops, are defined and used as a basis for HFE test and evaluation activities.

The HFE program addresses the HSIS in the following areas~~facilities~~: A

- Main control room (MCR)
- Remote shutdown room (RSR)
- Technical support center (TSC)
- Local control stations (LCSs) - consideration of HFE activities for LCSs are limited to those LCSs that support:
  - On-line testing, radiological protection activities, and required chemical monitoring supporting technical specifications
  - Maintenance required by technical specifications
  - Emergency and abnormal conditions response
- Emergency operations facilities (EOFs) (communications and information requirements only)

2.9.1.2 HFE Program Elements

The completion of following elements of the HFE technical program, including the analyses, design, evaluation and implementation, is performed in accordance with the overall HFE process and the methodologies proposed in the individual implementation plans. The results and outcomes of the activities are summarized in individual results summary reports. B

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2. Deleted.

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5. Task Analysis is performed in accordance with the US-APWR Task Analysis Implementation Plan.

6. A staffing and qualifications analysis is performed in accordance with the requirements of the Staffing and Qualifications Implementation Plan. D

7. The HSI design process is conducted in accordance with the requirements of the HSI Design Implementation Plan.

8. Procedure development is conducted in accordance with an implementation procedure that reflects the requirements of the Procedure Development Implementation Plan.

9. Training program development is conducted in accordance with the requirements of the Training Program Development Implementation Plan.

10. The Verification and Validation (V&V) program is conducted in accordance with the requirements of the V&V Program Implementation Plan.

11. Design Implementation is conducted in accordance with the requirements of the Design Implementation Plan.

~~1.~~12. Human performance issues are identified as HEDs and are tracked and dispositioned in accordance with the Human Performance Monitoring (HPM) Implementation Plan.

~~2.9.1.2 HFE Analyses~~

~~2.9.1.2.1 Operating Experience Review~~

~~The objective of the HFE operating experience review (OER) is to identify and analyze HFE-related problems and issues encountered in previous nuclear plant designs that are similar to the US-APWR, so that the negative features are not repeated and the positive features are retained. This review includes information pertaining to the human factors issues related to the predecessor plant(s) or highly similar plants and plant systems, recognized nuclear industry HFE issues, issues related to HFE technology, and issues related to advanced reactor design. Personnel interviews serve to determine operating experience related to predecessor plants or systems. The OER identifies risk-important human action (HA) that have been identified as different or where errors have occurred.~~ E

~~Issues identified during the OER are entered into the HFE issues tracking system. Each OER item that is determined by analysis to be appropriate for incorporation in the design is documented in the HFE issues tracking system. The HFE issues tracking system provides the appropriate level of reviews to ensure that issues are tracked to completion. The OER is documented in the US-APWR operating experience review report.~~

~~2.9.1.2.2 Functional Requirements Analysis and Function Allocation~~

~~The objective of the functional requirements analysis and function allocation is to ensure that the safety functions of the US-APWR are assigned properly as HAs or to automated systems. The functional requirements analysis and function allocation was assigned for the Japanese APWR design. The analysis and allocation were reconfirmed and with additional analysis was performed to account for the differences in the US-APWR design.~~

~~The major function allocation (FA) changes for the US-APWR as compared to the standard Japanese PWR plants are to re-allocate manual actions to automatic actions for:~~

- ~~Automatic isolation of a failed steam generator (SG)~~
- ~~Automatic establishment of recirculation for emergency core cooling system (ECCS)~~

~~2.9.1.2.3 Task Analysis~~

~~The task analysis is based on the Japanese APWR design with additional analysis performed to account for differences in the US-APWR design. The objective of the task analysis is to identify the specific tasks that are needed for function accomplishment and the associated information, control, and task-support requirements.~~

~~The scope of the task analysis includes: selected representative and important tasks (from operations, maintenance, testing, inspection, and surveillance areas); full range of plant operating modes (startup, normal operations, abnormal and emergency operations, transient conditions, low-power and shutdown conditions); risk important HAs that have been found to affect plant risk by means of probabilistic risk assessment (PRA) importance and sensitivity analyses; where critical functions are automated, the analysis considers all human tasks, including monitoring of the automated system and execution of backup actions if the system fails; and, identification of information and control requirements to enable specification of detailed requirements for alarms, displays, data processing, and controls.~~

~~The task analysis results are documented in the Task Analysis report. The task analysis results provide input to the design of HSIs, procedures, and personnel training programs.~~

~~2.9.1.2.4 Staffing and Qualifications~~

~~A fundamental US-APWR HFE design assumption is that it is possible to operate the plant with just one reactor operator (RO) and one senior reactor operator (SRO) in the MCR during postulated plant operating modes. The normal MCR staff is supplemented by one additional SRO and one additional RO that are at the plant to accommodate unexpected design conditions such as conditions where the HSIS is degraded. While the HSIS is designed to support the minimum MCR and plant staffing, the space and layout~~

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of the MCR is designed to accommodate the foreseen maximum number of operating and temporary staff.

Plant personnel positions that are addressed by the HFE program include licensed control room operators and the following categories of personnel:

- Nonlicensed operators (Note 1)
- Shift supervisor
- Shift technical advisor
- Instrumentation and control (I&C) technician (Note 1)
- Electrical maintenance personnel (Note 1)
- Mechanical maintenance personnel (Note 1)
- Radiological protection technician (Note 1)
- Chemistry technician (Note 1)
- Engineering support personnel (Note 1)

Note 1: Staffing analysis of personnel in these positions is limited to those performing the following activities: on line testing and maintenance required by technical specifications; radiological protection activities supporting technical specifications, required maintenance, and emergency and abnormal response; and required chemical monitoring supporting technical specifications, and abnormal and emergency response.

In addition, any other plant personnel who perform tasks that are directly related to plant safety are addressed.

A staffing and qualification analysis is developed and documented in the staffing and qualifications analysis report. The staffing and personnel qualifications required for the US-APWR are demonstrated by the V&V process to be adequate for plant personnel who perform tasks that are directly related to plant safety. Changes to staffing levels or personnel used in the HFE development are documented and analyzed for their potential impact on HSIs. Those staffing and qualification program issues that negatively impact human performance are identified as human engineering discrepancies (HEDs) and are tracked and dispositioned.

2.9.1.2.5 Human Reliability Analysis (HRA)

HRA/PRA results are incorporated into the HFE design analysis and the HFE design process interacts iteratively with the HRA/probabilistic risk assessment (PRA). The proper interaction of HFE design process and HRA/PRA most effectively contributes to minimizing personnel errors, allowing human error detection, and providing human error recovery capability. The scope of the HRA/PRA incorporation into the HFE design effort encompasses risk-important HAs. Incorporating HRA/PRA results into the HFE design process involves identifying risk-important HAs, addressing the HAs in the HFE analysis and design process, and validating HSI design changes.

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The HFE/HRA integration report documents the following:

- the risk significant HAs
- optimization of the HSI design to minimize human error probabilities
- consistency between the HFE design process and the PRA assumptions for traceability of risk significant tasks into each element of the HFE program, including task analysis, HSI design, procedures and training, V&V, and human performance monitoring

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2.9.1.3 HFE Design Process

Applicable HSIs, procedures, and training developed and evaluated by the HFE program include operations, accident management, maintenance, test, inspection and surveillance interfaces (including procedures) for those systems that are important to safety

2.9.1.3.1 HSI Design

The HSI resources include the wall panel information system, alarm system, plant information system (non safety-related displays), qualified data processing system (safety-related displays), and soft and dedicated controls.

The HFE program addresses the design of the MCR, remote shutdown console (RSC), TSC, EOF, and LCSs with a safety-related function as defined by a detailed task analysis.

The MCR provides a suitable workspace environment for use by MCR operators for the safe control and operation of the plant. The MCR includes reactor operator workstations, supervisor workstation(s), safety-related displays, and safety-related controls. The MCR includes a minimum inventory of displays, visual alerts and fixed-position controls to support the following design criteria:

a. Spatially dedicated continuously visible (SDCV) HSI for:
   - Bypassed and inoperable status indication
   - Type A and B PAM variables
   - Safety parameter displays including status of critical safety functions and performance of credited safety systems and preferred non safety systems
   - Prompting alarms for credited manual operator actions and risk important HAs identified in the HRA
   - Conventional switches for system level actuation of safety functions

b. Class 1E HSI for control of all safety related components and monitoring of all safety-related plant instrumentation

c. HSI for degraded HSI conditions, including:

- Loss of non safety HSI
- Loss of safety and non safety HSI due to CCF
- Evacuation of the MCR
- Single HSI failures

The RSC is used for achieving and maintaining safe shutdown conditions in the event that the MCR is not available due to any conditions, including fire which results in catastrophic damage to I&C equipment located in the MCR. The RSC includes non safety Remote Shutdown VDUs, which provide monitoring and control of process equipment in both safety and non safety divisions. The RSC also provides Safety VDUs as a back-up which provide control for only safety systems.

The mission of the LCSs is to provide the resources, outside of the MCR, for operations personnel to perform local monitoring and control activities.

2.9.1.3.2 Procedure Development

The objective of the procedure development program is to produce procedures that support and guide human interactions with plant systems and control plant-related events and activities. HFE principles and criteria are applied along with all other design requirements to develop procedures that are technically accurate, comprehensive, explicit, easy to use, and validated. The operating and emergency operating procedure (EOP) development program addressed in this section is primarily that necessary to support HSI design engineering and subsequent integrated human factors V&V.

The US-APWR Procedures program includes the development of computer-based procedures (CBP) with corresponding paper procedures and stand-alone paper procedures. CBP generated by this program are an integral part of the HSI V&V process.

All procedures are verified and validated, and include the following:

- Technical reviews to verify that procedures are correct and can be carried out.
- Final validation to be performed in a simulation of the integrated system as part of the V&V activities described in the human factors V&V element.
- Verification of adequate content, format, and integration is performed when procedures are modified. The procedures also are assessed through validation if a modification substantially changes personnel tasks that are significant to plant safety. The validation verifies that the procedures correctly reflect the characteristics of the US-APWR plant, and can be carried out effectively to restore the plant to a safe condition.

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~~2.9.1.3.3 Training Program Development~~

~~The objective of the training program is to develop personnel training that incorporates the elements of a systems approach to training, evaluates the knowledge and skill requirements of personnel, coordinates training program development with the other elements of the HFE design process, and implements the training in an effective manner that is consistent with human factors principles and practices. The US-APWR training program addresses applicable requirements that are necessary to ensure that training provided to personnel supporting the HSI design and V&V process is acceptable to permit realistic response to the US-APWR reference plant conditions. The detailed training program development process is documented in the training program report.~~

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~~2.9.1.4 Human Factors Verification and Validation~~

~~The Human Factors Verification and Validation (V&V) program involves design verification activities (HSI task support verification and HSI design verification) and the integrated system validation activities. The development of the integrated US-APWR HSIS is conducted in a specifically established HFE development facility. In addition to HSIS development and testing, a V&V process is conducted. This facility provides the updated proof-of-concept testing and "factory testing".~~

~~HSI task support verification is an evaluation whose purpose is to verify that the HSI supports personnel task requirements as defined by task analyses. HSI task support verification confirms that the HSI provides all alarms, information, and control capabilities required for personnel tasks.~~

~~HFE design verification is an evaluation to confirm that the HSI is designed to accommodate human capabilities and limitations as reflected in HFE guidelines. HFE design verification confirms the characteristics of the HSI and environment in which it is used conform to HFE guidelines.~~

~~The integrated system validation is performed to determine if the integrated system design (i.e., hardware, software, and personnel elements) acceptably supports safe operation of the plant. Integrated system validation is conducted using actual dynamic HSI with high fidelity plant model simulation.~~

~~Human engineering discrepancy (HED) resolution is performed iteratively throughout all V&V activities. HEDs identified during a V&V activity are evaluated to determine if they must be resolved prior to conducting other V&V activities. HED resolution verification is conducted to document that HEDs have been addressed in the final design.~~

~~2.9.1.5 Implementation and Operation~~

~~2.9.1.5.1 Design Implementation~~

~~The objective of the HSI design implementation is to demonstrate that the HSI design that is implemented (i.e., the "as-built" design) accurately reflects the verified and validated design.~~

~~The scope of HSI design implementation includes the effect on personnel performance resulting from design changes and provides the necessary support to ensure safe operations and that the as-built design conforms to the verified and validated design that resulted from the HFE process.~~

~~The referenced changes after V&V apply to the changes made to the US-APWR design following V&V.~~

~~Facility design changes are documented and analyzed for their potential impact on HSIs. Those design implementation issues that negatively impact human performance are identified as HEDs and are tracked and dispositioned. HFE design modifications are documented in a periodic status report.~~

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~~2.9.1.5.2 Human Performance Monitoring~~

~~Human performance monitoring applies after the plant is in operation. Human performance monitoring within the scope of this program specifically applies to the following:~~

- ~~Time critical operator actions~~
- ~~Correct diagnosis of abnormal plant events~~
- ~~Accuracy of procedure execution~~

~~Monitoring of human performance in other areas is within the scope of other plant programs (such as, "Fitness for Duty").~~

~~Human Performance issues are identified as HEDs and are tracked and dispositioned in accordance with the site specific QA program. HED disposition is documented in a periodic status report.~~

2.9.2 Inspection, Tests, Analyses, and Acceptance Criteria

Table 2.9-1 describes the ITAAC for HFE.

Table 2.9-1 Human Factors Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. Deleted.	1. Deleted	1. Deleted
2. Deleted.	2. Deleted.	2. Deleted.
3. Deleted.	3. Deleted.	3. Deleted.
4. Deleted.	4. Deleted.	4. Deleted.
5. Task analysis is performed in accordance with the US-APWR task analysis implementation plan.~~, and includes the following functions:~~ ~~selected representative and important tasks that affect plant safety from the areas of operations, maintenance, test, inspection, and surveillance~~ ~~full range of plant operating modes, including startup, normal operations, abnormal and emergency operations, transient conditions, and low-power and shutdown conditions~~ ~~risk-important human actions that have been found to affect plant risk by means of HRA and PRA importance and sensitivity analyses~~ ~~internal and external initiating events and actions affecting the PRA Level I and II analyses~~ ~~human tasks including monitoring of the automated system and execution of backup actions if the system fails~~	5. An inspection is performed on the Task Analysis results summary report(s).~~The task analysis will be performed.~~	5. A results summary report exists that concludes that the Task Analysis activity was conducted in accordance with the implementation plan.~~The function-based task analyses are conducted in conformance with the task analysis implementation plan and include the following functions:~~ ~~- selected representative and important tasks that affect plant safety from the areas of operations, maintenance, test, inspection, and surveillance~~ ~~- full range of plant operating modes, including startup, normal operations, abnormal and emergency operations, transient conditions, and low-power and shutdown conditions~~ ~~- risk-important human actions that have been found to affect plant risk by means of HRA and PRA importance and sensitivity analyses~~ ~~- internal and external initiating events and actions affecting the PRA Level I and II analyses~~ ~~– human tasks including monitoring of the automated system and execution of backup actions if the system fails~~

Table 2.9-1 Human Factors Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6. A staffing and qualifications analysis is performed ~~to ensure that personnel are acceptable to permit realistic response to normal and emergency plant conditions. The analysis is conducted~~ in accordance with ~~an implementation procedure that reflects~~ the requirements of the Staffing and Qualifications Implementation Plan.	6. An inspection of ~~T~~the staffing and qualifications analysis results summary report will be performed.	6. A report exists and concludes that ~~documents~~ the staffing and qualifications analysis~~, demonstrates that the analysis~~ has been performed in compliance with the Staffing and Qualifications Implementation Plan~~, and concludes from a human factors point of view that the staffing and qualifications of plant personnel are acceptable to perform safety significant tasks for normal and emergency operations~~.
7. ~~The scope of HSI design, which is developed and/or evaluated by the HFE program, includes operations, accident management, maintenance, tests, inspections and surveillances that are important to safety.~~ The HSI design process is conducted in accordance with ~~an implementation procedure that reflects~~ the requirements of the HSI Design Implementation Plan.	7. An inspection will be performed of the HSI design results summary report.~~for operations, accident management, maintenance, tests, inspections and surveillances~~	7. A results summary report exists ~~that documents~~ and concludes that the HSI design ~~for operations, accident management, maintenance, tests, inspections and surveillances that are important to safety, and demonstrates that the design process~~ has been conducted in compliance with the HSI Design Implementation Plan.
7a.~~HSI panels and associated instrumentation, within the scope of the HFE program, comply with quality standards and records~~Deleted.	7a.Deleted~~An analysis will be performed of the panels and associated instrumentation within the scope of the HFE program~~.	7a. Deleted~~The design documentation exists to verify that panels and associated instrumentation, within the scope of the HFE program, comply with General Design Criteria 1 in Appendix A to 10 CFR 50 for quality standards and records~~.
7b. Deleted~~The MCR includes a non safety reactor operator workstation, a non safety supervisor workstation, and a workstation for safety related displays and controls~~.	7b. Deleted~~An inspection of the as-built MCR workstations will be performed~~.	7b. Deleted~~The as-built MCR includes a non safety reactor operator workstation, a non safety supervisor workstation, and a workstation for safety related displays and controls~~.
7c. Deleted~~A MCR exists to provide the safety related and non safety related HSI~~.	7c. Deleted~~An inspection will be performed of the as-built plant building configuration~~.	7c. Deleted~~The as-built MCR exists to provide the safety related and non safety related HSI~~.

Table 2.9-1 Human Factors Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7d. Deleted ~~HSI resources available in the MCR include checking the standby condition of equipment before operation, monitoring the plant parameters and identifying plant behavior during operation~~.	7d. Deleted ~~An inspection of the as-built HSI resources available in the as-built MCR will be performed~~.	7d. Deleted ~~The as-built HSI resources in the as-built MCR include the HSI that is needed to check the standby condition of equipment before operation, monitor the plant parameters, and identify plant behavior during operation~~.
7e. Deleted ~~Means are provided in the MCR for manual initiation of protective functions at the system level~~.	7e. Deleted ~~An inspection of the as-built manual initiation functions in the as-built MCR will be performed~~.	7e. Deleted ~~The capability for the as-built manual initiation of protective functions at the system level exists in the as-built MCR~~.
7f. Deleted. ~~Spatially dedicated continuously visible (SDCV) HSI is provided in the MCR for:~~ ~~Bypassed or inoperable status indication~~ ~~Type A and B PAM variables~~ ~~Safety parameter displays including status of critical safety functions and performance of credited safety systems and preferred non safety systems~~ ~~Prompting alarms for credited manual operator actions and risk important HAs identified in the HRA~~ ~~Conventional switches for system level actuation of safety functions~~	7f. Deleted ~~An inspection of the as-built SDCV HSI in the as-built MCR will be performed~~.	7f. Deleted. ~~The following minimum inventory of SDCV displays, visual alerts and controls exists for the as-built MCR :~~ ~~Bypassed or inoperable status indicators on the Large Display Panel for each safety system or function.~~ ~~Numeric indicators for each Type A and B PAM variable on the Safety VDUs~~ ~~Status indicators for each critical safety function, and numeric indicators for key parameters which represent the performance of credited safety system and performance of preferred non safety systems on the Large Display Panel~~ ~~Prompting alarms for credited manual operator actions and risk important HAs identified in the HRA on the Large Display Panel.~~ ~~Conventional switches for system level actuation of safety functions on Operator Console.~~
7g. Deleted. ~~Class 1E HSI is provided in the MCR for control of all safety related components and monitoring of all safety related plant instrumentation.~~	7g. Deleted. ~~An inspection of the as-built Class 1E HSI in the as-built MCR will be performed.~~	7g. Deleted. ~~The as-built MCR includes the Class 1E HSI for control of all safety related components and monitoring of all safety related plant instrumentation.~~

Table 2.9-1 Human Factors Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7h. Deleted. ~~The MCR includes HSI for degraded HSI conditions, including:~~ ~~– Loss of non safety HSI~~ ~~– Loss of safety and non safety HSI due to CCF~~ ~~– Single HSI failures~~	7h. Deleted. ~~An inspection of the as-built HSI redundancy and diversity in the as-built MCR will be performed.~~	7h. Deleted. ~~The as-built MCR includes alternate HSI for the following degraded HSI conditions:~~ ~~– Loss of non safety HSI~~ ~~– Loss of safety and non safety HSI due to CCF~~ ~~– Single HSI failures~~
7i. Deleted. ~~A remote shutdown console (RSC) is provided to achieve safe shutdown in the event of evacuation of the MCR. The RSC includes operator workstation(s) from which operators could perform remote shutdown operations.~~	7i. Deleted. ~~An inspection of the as-built RSC will be performed.~~	7i. Deleted. ~~To achieve safe shutdown in the event of MCR evacuation, the as-built RSC has Operator workstation(s) from which operators could perform shutdown operations. These workstations have the same functions as the MCR operator console for conducting safe shutdown.~~
7j. Deleted. ~~Manual control and monitoring capability is installed at the LCSs (only manned on demand) for the following functions:~~ ~~– On-line testing, radiological protection activities, and required chemical monitoring supporting technical specifications~~ ~~– Maintenance required by technical specifications~~ ~~– Emergency and abnormal response~~	7j. Deleted. ~~An inspection of the as-built local control and monitoring functional capability required for the as-built LCSs will be performed.~~	7j. Deleted. ~~The as-built LCSs exist at selected locations throughout the plant for the following required functions;~~ ~~– On-line testing, radiological protection activities, and required chemical monitoring supporting technical specifications where HSI is not provided in the MCR.~~ ~~– Maintenance required by technical specifications where HSI is not provided in the MCR.~~ ~~– Emergency and abnormal response for events where MCR HSI cannot be credited.~~
7k. Deleted. ~~A TSC and EOF exist where effective direction can be given and effective command control can be performed during an emergency.~~	7k. Deleted. ~~An inspection of the as-built TSC and EOF will be performed.~~	7k. Deleted. ~~An as-built TSC and EOF exist from which effective direction can be given and effective command control can be exercised during an emergency.~~
7l. Deleted. ~~Provisions exist for communications among the MCR, TSC, and EOF; and between the plant, the state and local emergency operations centers, and the field assessment teams; and the appropriate NRC Regional Office Operations Center.~~	7l. Deleted. ~~An inspection of the as-built communications functions will be performed.~~	7l. Deleted. ~~The as-built functions are made for communications among the MCR, TSC, and EOF; and between the plant and the state and local emergency operations centers, and the field assessment teams; and the appropriate NRC Regional Office Operations Center.~~

Table 2.9-1 Human Factors Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
8. ~~The scope of procedures, which is developed and/or evaluated by the HFE program, includes operations, accident management, maintenance, tests, inspections and surveillances that are important to safety. The procedures guide and support human interactions with plant systems and control plant related events and activities. The p~~Procedure development is conducted in accordance with ~~an implementation procedure that reflects~~ the requirements of the Procedure Development Implementation Plan.	8. An inspection of the ~~as-built~~ procedure~~s~~ development results summary report will be performed~~will be performed for operations, accident management, maintenance, tests, inspections and surveillances~~.	8. A results summary report exists ~~that documents the procedures for accident management, maintenance, tests, inspections and surveillances that are important to safety. The report demonstrates~~ and concludes that the procedure development process has been conducted in compliance with the Procedure Development Implementation Plan.
8a. ~~The procedures development process ensures that procedures guide and support human interactions with plant systems and control plant-related events and activities.~~Deleted.	8a. Deleted. ~~An inspection of the as-built procedures development process will be performed.~~	8a. Deleted. ~~The as-built procedures exist to support functions important to ensuring plant safety during normal and abnormal operating conditions. These procedures conform to the Procedure Writer's Guide.~~
9. ~~The scope of training, which is developed and/or evaluated by the HFE program, includes operations, accident management, maintenance, tests, inspections and surveillances that are important to safety. The training provided to operations and maintenance personnel is acceptable to maintain plant safety and respond to abnormal plant conditions. The t~~Training program ~~has been~~ development is conducted in accordance with ~~an implementation procedure that reflects~~ the requirements of the Training Program Development Implementation Plan.	9. An inspection of the ~~as-built~~ training program development results summary report will be performed ~~for operations, accident management, maintenance, tests, inspections and surveillances~~.	9. A results summary report exists and concludes that ~~documents the training program for accident management, maintenance, tests, inspections and surveillances that are important to safety. The report demonstrates that~~ the training program has been developed in compliance with the Training Program Development Implementation Plan.

Table 2.9-1 Human Factors Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 8)

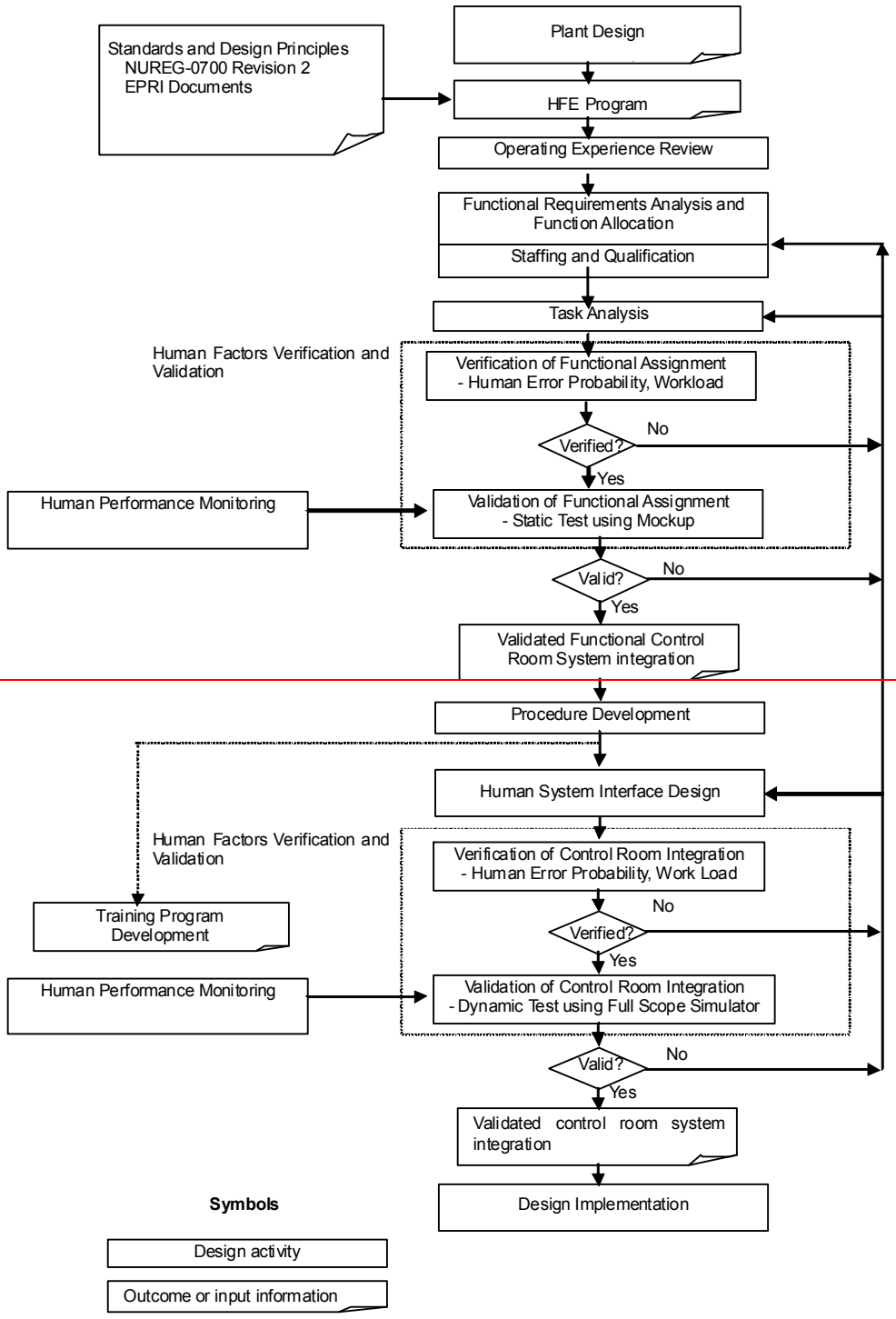
Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9a. ~~The training development process ensures that training provided to operations and maintenance personnel is acceptable to maintain plant safety and respond to abnormal plant conditions.~~ Deleted.	9a. Deleted. ~~An inspection of the as-built training development process will be performed.~~	9a. Deleted. ~~The as-built training program includes plant operations and maintenance activities which are important to maintain plant safety and respond to abnormal plant conditions. The training material conforms the Training Developer's Guide.~~
10. The Verification and Validation (V&V) program is conducted in accordance with the requirements of the V&V Program Implementation Plan. ~~The HFE verification and validation (V&V) program ensures the following:~~ ~~1) HSI task analysis encompasses a representative range of risk important operational scenarios, events, transients and accidents~~ ~~2) The inventory and characteristics of the alarms, information, and controls support the tasks generated by the function-based task analyses and the operational sequence analyses, and the HSI design is consistent with the HSI design style guide.~~ ~~3) The integrated HSI system supports the safe operation of the plant.~~ ~~The V&V activities are conducted in accordance with an implementation procedure that reflects the requirements of the V&V Implementation Plan.~~	10. An inspection of the V&V program results summary report will be performed. ~~An inspection of the HFE V&V activities will be performed.~~	10. A results summary report exists and concludes that ~~documents the V&V activities, demonstrates that~~ the V&V program has been performed in compliance with the V&V Implementation Plan~~, and concludes that the HSI has been adequately verified and validated~~.
10a. ~~HED resolution during V&V is performed iteratively throughout all V&V activities.~~ Deleted.	10a. Deleted. ~~An inspection of the HED resolution during the HFE V&V process will be performed.~~	10a. Deleted. ~~HEDs are identified and addressed iteratively throughout all V&V activities and there are no safety significant unresolved HEDs in the final design.~~
10b. Deleted. ~~HSI in the MCR permits execution of tasks by operators to establish operations, accident management, maintenance, test, inspection and surveillances for those systems that are important to safety.~~	10b. Deleted. ~~Tests will be performed on the execution of representative tasks by the actual MCR operators.~~	10b. Deleted. ~~Test results demonstrate that the as-built MCR HSI can establish operations, accident management, maintenance, test, inspection and surveillances for those systems that are important to safety.~~

Table 2.9-1 Human Factors Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 7 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
10c. Deleted. ~~HSI at the RSC permits execution of tasks by operators to establish and maintain cold shutdown.~~	10c. Deleted. ~~Tests will be performed on the execution of tasks for the as-built RSC.~~	10c. Deleted. ~~Test results demonstrate that actual operators can establish and maintain cold shutdown from the as-built RSC.~~
11. Design Implementation is conducted in accordance with the requirements of the Design Implementation Plan. ~~The design that is implemented (i.e., the "as-built" design, including procedures) accurately reflects the verified and validated design, with appropriate modifications. Conformance to the verified and validated design is confirmed in accordance with an implementation procedure that reflects the requirements of the Design Implementation Plan. Modifications from the verified and validated design, such as resolution of outstanding HFE-related issues from the verification and validation program, changes from the verified and validated design or other design features that were not included in the simulator verification and validation, are evaluated using an appropriate V&V method.~~	11. An inspection of the ~~as-built~~ HSI ~~d~~Design Implementation results summary report will be performed.	11. A results summary report exists and concludes that ~~documents the as-built HSI design, demonstrates that~~ the HSI design has been implemented in accordance with the Design Implementation Plan, ~~and concludes~~ that the as-built HSI design is the same as the design verified and validated in the simulator, ~~or~~ and that any changes from the simulator design V&V have been confirmed using ~~adequate~~ supplemental V&V methods.

Table 2.9-1 Human Factors Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 8 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
12. Human performance issues are identified as HEDs and are tracked and dispositioned by the strategy and process developed in accordance with the Human Performance Monitoring (HPM) Implementation Plan. ~~Human Performance issues are identified as HEDs and are tracked and dispositioned in accordance with the site specific QA program.~~	12. An inspection of the as-built human performance monitoring ~~process~~ results summary report will be performed.	12. A results summary report exists and concludes that the human performance monitoring strategy is developed and documented in accordance with the HPM Implementation Plan. ~~A human performance monitoring strategy is developed and documented. The US-APWR HFE procedure guides the human performance monitoring for the life of the plant and the process to identify and disposition human performance issues. This human performance monitoring procedure is applicable after the completion of integrated HSI validation and operator training.~~ ~~This process evaluates the impact of facility design and operating changes and addresses the following topics:.~~ ~~• Human performance monitoring includes confirmation of the following criteria:~~ ~~– Effectiveness of HSIs~~ ~~– Personnel performance impacts of HSI, procedure, and training changes~~ ~~– Operator actions meet time and performance criteria~~ ~~– Human performance criteria established during integrated system validation are maintained~~ ~~• Human Performance Trending includes the following:~~ ~~– Performance degradation~~ ~~– Failures~~ ~~– Detection sensitivity~~ ~~– Safety Importance~~ ~~• Human performance evaluation criteria includes the following:~~ ~~– Specific cause determination~~ ~~– Safety Importance~~ ~~– Feedback of information~~ ~~– Corrective actions~~



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~~Figure 2.9-1 Overall HFE Design Process~~