Enclosure 6

Technical Report MPWR-TECR-005002 (Redacted) babcock & wilcox nuclear energy

Human Factors Engineering Program Management Plan MPWR-TECR-005002 Revision 000 May 2012 (Redacted Version)

a progressive energy solution

B&W mPower™ Reactor Program
Babcock & Wilcox Nuclear Energy, Inc.
109 Ramsey Place
Lynchburg, VA 24501

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SIGNATURES			
Prepared By:	Daniel Laughman	[signature]	5/30/12
	Name	Signature	Date
Reviewed By:	Dominick LoGalbo	Dominick L LoGalbo	5/30/12
	Name	Signature	Date
Approved By:	Thomas Graham	[signature]	5/31/12
	Name	Signature	Date
Approved By:	Sandra Sloan	Sandra M. Sloan	5/31/2012
	Name	Signature	Date

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ABSTRACT

This technical report describes how the overall human factors engineering (HFE) program is managed and integrated into the plant development, design, and design evaluation. This report details the requirements for the HFE program and how these requirements are met through the various elements of the HFE program. Topics covered include a description of the HFE organization within the overall organization, composition of the HFE design team, and HFE program elements and their administration. Additionally, the HFE design team's placement within the overall Babcock and Wilcox mPower™ organization and the tools used in the HFE process are presented.

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1. INTRODUCTION

1.1 Applicability

This document is applicable to all human factors design activities for the Babcock & Wilcox (B&W) mPower™ reactor. This includes all B&W employees and contractors assigned to design activities of the B&W mPower reactor within the scope of the human factors engineering (HFE) program described in this report.

1.2 Scope and Objective

The scope of this technical report is to describe the management of the overall HFE program. This includes the purpose of the HFE department, team members and their qualifications, and a description of HFE within the B&W mPower organization. Additionally, the integration of HFE processes into the design, development, and evaluation of the B&W mPower reactor is discussed. This report also describes the various elements of the HFE program, and tools used for the developing and testing within these elements.

The program addresses the human-system interface (HSI) and analysis of tasks for the main control room, remote shutdown station, technical support center, emergency operations facility, and risk-important local control stations.

The B&W mPower design goals support a human-centered design for the safe and efficient operation of the B&W mPower reactor and include:

- Personnel tasks are accomplished within time and performance criteria.
- The HSIs, procedures, staffing and qualifications, training, and management and organizational support create high operating crew situational awareness.
- The plant design and allocation of functions allows for operation vigilance and provides acceptable workload levels (neither too high nor too low).
- The operator interfaces minimize operator error and provide for error detection and recovery capability.
- A complete design lifecycle approach considers operator procedures, training, and HSI needs from the beginning of the design activities through the construction, operation, and retirement of the plant. As a result, all HFE products support a safe, efficient, and reliable performance of tasks (i.e., operation, maintenance, test, inspections; and surveillance).

The objective of the HFE program management plan is to establish the required framework for the HFE program integration and execution within the overall engineering process. The establishment of an HFE design team within the B&W mPower organizational structure, with the responsibility and authority to ensure HFE principles are met, is essential to the performance of the individual elements of the HFE program.. The HFE program identifies all the elements necessary to produce the HSIs, procedures, and training in accordance with HFE principles.

This plan also describes how these elements are evaluated during the design process and verified and validated when the design is complete. A description of the tools used for the HFE programs is presented in Section 3.4. This HFE program is designed to be implemented early in the design process to minimize the risk of late stage design changes.

[

] **[CCI per Affidavit 4(a)-(d)]**

Systems within the scope of HFE design process are analyzed by the HFE design team using the processes documented in this report.

[

] **[CCI per Affidavit 4(a)-(d)]**

1.3 Responsibilities

Work performed within the scope of this technical report is under the direction of the Unit Manager of the Operations/Integration Design Process for the Human Factors Engineering Program. The individuals performing the work are selected from the HFE design team. These HFE design team members include, at a minimum, operations and systems engineering personnel. Engineers outside of the HFE design team may be consulted on an as-needed basis. Other engineering personnel may be assigned to work within the bounds of the HFE process and follow the direction of the HFE design team members.

2. BACKGROUND

Operation of a nuclear reactor is supported by procedures, training, and a control system developed using the HFE program input described in this report. General Design Criteria 19 requires that a control room be provided from which actions can be taken to safely operate the nuclear power plant under normal, abnormal, and emergency conditions. These abnormal and emergency conditions are specified through accident analyses. Equipment at appropriate locations outside the control room is provided with a design capability for hot shutdown of the reactor and subsequent cold shutdown of the reactor through suitable procedures. In order to design these HSIs and develop training and procedures, a process is developed for the integration of the human into the overall plant control system design. Implementing this human-centered approach early in the design process, reduces the chances of adverse cost and schedule impacts during project execution from late design changes. The human-centered approach can also ensure fully integrated system designs that will reduce operation and maintenance work-arounds such as, lengthier training, more complex operating procedures, more complex and lengthier maintenance schedules, and resulting higher error rates in operations and maintenance personnel.

Following the Three Mile Island accident, regulations were put in place to require that future plants use state-of-the-art HFE principles. The HFE program supports determination of the minimum inventory of alarms, controls, and indications needed to implement the emergency operating procedures and complete risk-important human actions identified in the probabilistic risk assessment (PRA)/human reliability analysis (HRA). The B&W mPower plant includes the ability to automatically monitor bypassed and inoperable status of safety systems, and state-of-the-art human factors principles are applied during the design process.

The systems integration for HFE matches the human user (and testers and maintainers) with the technology to be used within the environment in which it is used. The entire process is guided by a systems engineering controlled process. A systems engineering approach develops requirements based on the needs of the system. Systems engineering then develops system, train, and component designs that satisfy system functional requirements (and any applicable regulatory requirements). This life-cycle view considers the design through concept, construction, use, maintenance, refinement, and decommissioning/disposal phases.

3. METHODOLOGY

3.1 HFE Program Approach Overview

The HFE program uses a human-centered approach to the design and design process. This follows a top-down systems engineering methodology to the design lifecycle. The HFE process ensures that the completed plant design incorporates HFE aspects in the eight primary lifecycle processes: design development, verification, deployment, construction, support, operation, training, and disposal. Incorporating human factors considerations for each systems engineering life-cycle process enables the HFE design team to develop a total system design solution, balancing cost, schedule, performance, and risk, which results in a complete HSI design that enables operators to safely and efficiently operate the plant.

The principles of as low as reasonably achievable (ALARA) are used to guide the design arrangement of HSI and local control stations to ensure that personnel dose is kept as low as reasonably achievable. The HFE program interacts with members of the design team in order to consider the needs of the whole design. Operating experience (OE), PRA, and HRA provide initial input to the design process (as available) and also feed into the process iteratively to ensure the design is risk-informed and incorporates industry lessons learned. This initial input is fed to the functional requirements analysis (FRA), which identifies those functions required to maintain safe and efficient electrical power production.

The HFE program interacts with other engineering disciplines during the design to ensure HFE principles are incorporated into all aspects of the control system design.

PRA results ensure that the design considers possible accident conditions, operating scenarios, and events that pose the greatest risks to plant equipment or the safety of the general public. The HFE process considers the results of the PRA analysis during the design development to build defense-in-depth within the design. This defense-in-depth includes not only the plant systems, but also procedures and training.

During the analysis of the functions and tasks, ALARA principles guide the design arrangement of HSI and local control stations. The tasks are analyzed through a static methodology, which is then performed through a dynamic environment once the procedures, training, and HSI are fully developed. This dynamic portion of task analysis is the design assessment.

Verification and validation is performed after the design has been satisfactorily evaluated through the design assessment. Documentation is reviewed to ensure that the design was built using the design process and that the design can perform all the specified design requirements.

3.2 HFE Program

The HFE program, illustrated in Figure 1, contains all the elements of the NUREG-0711 process including:

- Program management plan
- Operating experience review
- Human reliability analysis
- Functional requirements analysis and function allocation
- Task analysis (with staffing and qualifications)
- Procedure and training development (interface to provide relevant task information to the procedure and training groups)
- Human-system interface design
- Human factors verification and validation
- Design implementation
- Human performance monitoring

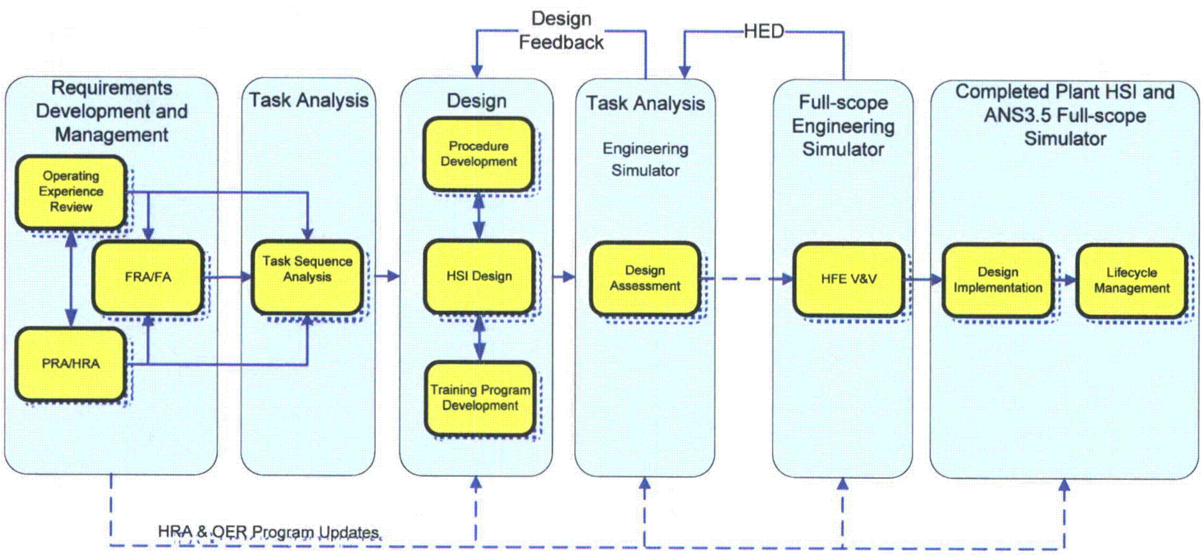

Figure 1. HFE Process Overview

Under the HFE program, the task analysis and staffing and qualification elements are combined to take advantage of the fact that these elements follow identical processes but focus on different aspects of the outcome. As an input to the task analysis, a thorough function analysis defines tasks required to support the function as well as the staffing and qualifications required for successful task completion.

The HFE procedure and training development processes are limited to the method of transferring all the relevant task information to the procedure and training groups who actually perform those functions.

Human performance monitoring is conducted through all facets of the operational lifecycle in accordance with the systems engineering process. Therefore, the human performance monitoring element is presented in the Operational Lifecycle Monitoring technical report. All of these elements of the HFE program are meant to work together as one overall process. Following the HFE process, the entire design becomes human centered and results in a safely operated design.

Each HFE program element is described in a separate technical report. In addition to their respective technical reports, some HFE process elements have associated engineering instructions that describe specific steps that must be completed to implement the element, as well as any supporting information. An engineering instruction describes the inputs, outputs, performer's qualifications and responsibilities, and step-wise actions to take to complete its respective HFE element. HFE program element engineering instructions are listed below:

- Operating Experience Review (OER) Program: Describes the steps for operating experience collection, analysis, and feedback into the design process, including long term documentation of collected OE and its design incorporation.
- Plant Level Functional Requirements Analysis/Function Allocation (FRA/FA): Describes the steps for performing an FRA from the plant level down to the system level and includes any necessary gap analyses.
- System Level FRA/FA: Describes the steps for the system level FRA/FA down to the component level.
- Task Analysis: Describes the steps to perform the initial task analysis as well as the design assessment. Feedback from simulation participants is utilized in the design assessment. The task analysis also defines the fundamental elements of a staffing and/or qualification review of the design. All reviews and analyses defined in the task analysis can be performed concurrently.
- Human-System Interface (HSI): Defines the required inputs and outputs for developing a well-formed HSI as well as the steps of the HSI design process.
- Verification and Validation (V&V): Describes the procedure for performing V&V, including task support verification, design verification, and selection of test subjects and scenarios for a complete integrated system validation (ISV).
- Issue Tracking System: Describes the use of the HFE issue tracking system.

The following subsections provide high-level descriptions of each of the elements of the HFE process.

3.2.1 Human Reliability Analysis

Human reliability analysis is a structured approach used to identify potential human failure events and the probability of an event occurrence by using data analysis, models, or expert judgment. HRA is a technical element of a PRA and considers the types and mechanisms of various human actions. The HFE program analyzes this information with the goal of minimizing personnel errors, providing error detection, and supporting recovery capabilities by reducing the probability of human errors documented in the HRA. By incorporating HRA analysis results into HFE efforts, the bases for comprehensive mitigating strategies and a risk-informed design are created. The application of HFE practices ensures a diligent analysis and provides consideration of performance shaping factors found in HRA. Incorporating HRA data within the HFE program provides greater attention to plant scenarios, human actions, and HSIs that are important to plant safety and reliability. Assumptions made in the HRA are clarified and analyzed in the HFE program so that subsequent design changes lower human error probability or the consequences of human error when the HRA is recalculated.

Additional information can be found in the *Human Factors Engineering Integration of Human Reliability Analysis* technical report (MPWR-TECR-005006).

3.2.2 Operating Experience Review

Incorporation of lessons learned into the design process ensures that positive aspects of predecessor designs are retained and lessons learned from past events are incorporated into the B&W mPower design. The process provides for researching documented OEs and providing the relevant information to project members for potential incorporation into the design, construction, and modification processes. B&W applies a structured OE collection implementation method during the design process with features that allow the licensees of the B&W mPower reactor to continue using the program material. The OER process is established early in the design process and begins with OE collection and analysis for applicability to various design efforts. Performing the OER early in the design process avoids the potential costs and schedule delays of design changes late in the design or implementation process. Operating experience review is an ongoing process that provides continual operating experience feedback throughout the life of the design effort.

Additional information can be found in the *Operational Experience Program* technical report (MPWR-TECR-005003).

3.2.3 Functional Requirements Analysis and Function Allocation

The OER and PRA/HRA outputs are used as input to the FRA/FA. The FRA is the beginning of the operational analysis. The FRA provides the basis for all in scope plant and system functions for the B&W mPower project. Functional requirements mapping provides a method for linking all systems, structures, and components to the governing regulatory requirements for plant safety and power generation objectives. The FRA identifies power generation objectives as well as plant safety functions that are required by regulations. The safety and power generation functions follow the requirements necessary for safe, affordable, and dependable electrical generation.

Function allocation is considered when determining control requirements for plant equipment at the plant level. Function allocation establishes the criteria, guidance, and methods for assigning control requirements for equipment at the system and component levels to the human, machine, or a combination of both. This allocation maximizes the human and system performance by utilizing the strengths and qualities of the human while minimizing the human weaknesses within the system. The allocation of functions is designed to maintain operation vigilance and provide acceptable workloads. It is important to note that all functions have a certain degree of human involvement. The automation of any function is assessed for human supervisory roles.

The output of the FRA/FA process provides the basis for task analysis. Additional information can be found in the *Functional Requirements Analysis and Function Allocation* technical report (MPWR-TECR-005004).

3.2.4 Task Analysis

The task analysis (TA) is comprised of two parts: static (initial TA) and dynamic (design assessment). Both parts fall under the same concept and are performed when possible during the design phase. Task analysis and design assessment consider personnel defined in both Title 10 of the Code of Federal Regulations (CFR) Part 50.54m and 10 CFR 50.120 as noted below:

- Operations Staff
  - licensed operators
  - non-licensed operators
  - shift supervisor
  - shift technical advisor
- Support Staff
  - instrument and controls technician
  - electrical maintenance personnel
  - mechanical maintenance personnel
  - radiological protection personnel
  - chemistry technician
  - engineering support personnel

The HFE process is focused on the operation of the plant. The number and qualifications of the control room operation staff begins with the initial staffing assumptions. This initial assumption is then vetted through the task analysis. Any exemptions that are necessary for the number or qualification of operations personnel would be submitted at the end of task analysis. The support staff is viewed from an operational perspective. The number and qualifications of support staff are only addressed to the extent that they interact with the operational needs of the plant. The HFE program does not fully define the number of support personnel or their roles and responsibilities beyond this operational interaction.

The initial TA considers the initial design information in current preliminary design documents, design drawings, and/or logic diagrams that are available. Each system and its associated personnel tasks are determined in a preliminary manner.

The design assessment utilizes the information derived by the initial TA and integrates this information with the existing HSIs, procedures, and training material to test and evaluate the tasks. This dynamic portion of the task analysis is performed later in the process but before the HFE V&V.

3.2.4.1 Initial Task Analysis

The initial TA uses a static (table-top) methodology. The initial functions derived by the FRA are allocated to the human, machine, or a combination of both. Functions that are allocated to the human are analyzed in relation to the human's needs. The TA technical report describes the number and type of tasks that are analyzed as well as the screening criteria. Tasks that are analyzed include critical safety functions, staffing and qualification changes, abnormal and emergency operations, and human actions that are determined as risk-important by HRA. Task evaluations consider personnel actions during normal, abnormal, and emergency operations and consider all alarms, controls, and indications necessary to complete the task. The task is analyzed starting with the initiating cues, then operation indication and controls, to the completion or suspension cues. All considerations for the task performance are documented, including: subsystem performance, precautions, operating limitations, inputs and outputs of the task, and task performance steps. Task analysis results describe the steps to perform a task along with the necessary controls and indications. Additional information is documented, such as the cues that indicate when to start the task, how to monitor and control the task, and how to complete the task and verify that it is secured. This information is documented for each automatic sequence to allow human intervention if or when it is needed. The TA results are documented and subsequently used by the HSI designers, procedure developers, and the training development group.

All additional information can be found in the *Task Analysis* technical report (MPWR-TECR-005005).

3.2.4.2 Design Assessment

Design assessment is the second part of the TA. Design assessment uses a dynamic methodology and is performed after using the most complete available procedures, training, and HSI designs that support operator task performance. This approach accounts for the operator in the use and design of the HSI. An HSI design is therefore considered incomplete until the human component of the interface is tested along with the mechanical components. This requires the system to include the human, all necessary procedures, training, and HSI in a functioning environment. All risk-important human actions are considered during these assessments.[

] **[CCI per Affidavit 4(a)-(d)]**

Additional information can be found in the *Task Analysis* technical report (MPWR-TECR-005005).

3.2.5 Procedure Development

The HFE group will supply the task information sheets to the procedure development group after performing the initial task analysis. The HFE process supplies OER, FRA, HRA, TA, and HSI design results and information to the procedure development process. This information provides the expected staffing and qualifications of the personnel performing tasks as well as detailed information regarding all aspects of task performance. The procedures include all operations, accident management, maintenance, test, inspection, and surveillances.

The use of computer based procedures is considered in all elements of the HFE program that receive input from the procedure development process. The HSI necessary for the implementation of the computer based procedures is developed through HFE HSI development process (Section 3.2.7).

Additional information is found in the Procedure Development technical report.

3.2.6 Training Program Development

The HFE process supplies OER, FRA, HRA, TA, plant procedures, and HSI design results and information to the training development group. This information provides the expected staffing and qualifications of the personnel performing tasks as well as detailed information regarding all aspects of task performance for use in training development. Training includes all operations, accident management, maintenance, test, inspection, and surveillances.

Additional information is found in the Training Program Development technical report.

3.2.7 Human-System Interface Development

The HSI development process involves translating the alarm, control, and indication requirements defined in TA into a usable HSI design and layout. An effective HSI design allows the operator to perform all required tasks safely and efficiently. The HSI development process includes the display screens and HSIs within the main control room, remote shutdown station, technical support center, emergency operations facility, and risk-important local control stations. The HSI development process uses a methodical approach to select a potential HSI, performs testing and evaluation, and determines a final HSI design. This is refined through the design assessment portion of the task analysis. The HSI development process specifies and defines the layouts. Inputs to the HSI process include:

- OER with applicable HSI lessons learned
- FRA/FA requirements
- TA output
  - staffing and qualifications
- Risk-important human actions

- Control and logic system constraints
- Design assumptions and constraints
- Concept of operations (describes the manner in which the controls are used)

The formation of the HSI follows the general systems engineering process flow. The initial HSI design effort involves building a conceptual design of the control room and key safety displays. A detailed design is developed using the HSI style guide and evaluations are performed throughout the design process. When multiple design solutions are identified, trade-off evaluations are conducted in a controlled environment in order to determine the best design while reducing confusion and bias. The resulting HSI provides the operator with a clear understanding of plant status as it relates to task performance as well as the ability and resources to execute task steps without errors. In the event of error, the HSI provides the operator with the alarms, control, and indications needed to detect, diagnose, and recover from the error. System and control feedback is accessible to the operator and provides a clear understanding of all automatic processes and the ability to intervene if necessary. The operator is then able to determine when the task is completed.

Computer based procedures are developed for use within the HSI design and incorporate the usability aspect as well as the transference to hard-copy procedures as necessary at all places where computer based procedures are used.

Additional information is found in the Human-System Interface Development technical report.

3.2.8 Verification and Validation

Verification and validation functions are performed on the completed design. The V&V activities start with an operational condition sampling that identifies the range of operational conditions that are representative of the range of events that could be encountered during the operational lifecycle of the plant. These conditions also reflect the characteristics that contribute to system performance variation. The operational condition sampling process identifies a testing population that is representative of the plant conditions, personnel tasks, and situational factors that are known to challenge personnel performance.

The verification portion of the process subjects those events selected by operational condition sampling to two processes:

- Design verification – This review verifies that the HSIs that are within scope as defined by the operational condition sampling process meet their individual design requirements.
- Task support verification – This review verifies that the HSI inventory provides all alarm, control, and indication capabilities required to complete the tasks within scope as defined by the operational condition sampling process.

The integrated system validation (ISV) portion of the V&V process uses a dynamic testing environment to test the system design as an integral unit (i.e., hardware, software, human element, HSI, and procedures). The ISV is performed using a high-fidelity, full-scope simulator in an environment that represents the actual environment to the maximum extent possible. The reason for this is to provide evidence to validate:

- The role of the plant personnel
- Staffing supports the successful performance of all functions
- Risk-important actions and assumptions are supported
- The design is fault tolerant
- Tasks can be performed within the time and performance requirements
- The design provides adequate cues, information, controls, and feedback for safe operation
- Acceptable cognitive and physical workload levels are maintained throughout all tasks performed

Personnel performing the tasks are representative of the personnel that are expected to operate the plant. All bias is removed from the ISV scenarios to provide the closest approximation to real life events. Successful completion of the ISV indicates that the integrated HSI and supporting procedures and training can be used to safely and efficiently operate the plant. Any issues encountered during the ISV are documented as human engineering deficiency (HEDs) and tracked until resolved.

Additional information is found in the HFE Verification and Validation technical report.

3.2.9 Design Implementation

This is the plan for conducting the pre- and post-installation testing of the distributed control system and for analyzing the design during construction. The implemented design is analyzed to determine if the constructed design accurately reflects the design that was verified and validated. The design implementation verifies that all issues from the issue tracking system and any remaining HEDs are addressed. Issues that were not addressed during, or are identified after, V&V are addressed using the HED V&V resolution method.

A full-scope simulator is insufficient for testing certain aspects of the control room. These aspects are checked during final construction and include:

- Changes to the procedures (e.g., content, layout, font) resulting in differences from those used during the V&V process
- Changes to the training process resulting in differences from that used during the V&V process

- Noise levels and acoustics of the control room that were not tested or differ from what was tested during V&V
- Control room lighting levels and lighting layout that were not tested or differ from what was tested during V&V
- Control room layout features and environmental conditions (e.g., temperature and humidity control, changes in console placement, movement pathway changes, etc.) that were not tested or differ from what was tested during V&V
- Plant communications – includes all communication equipment, and medium for communications that were not tested or differ from what was tested during V&V

Additional information is found in the Design Implementation technical report.

3.2.10 Operational Lifecycle Monitoring

Operational Lifecycle monitoring ensures that the quality of human performance and skills (while interfacing with the HSI) are maintained and considers the entire life of the plant. Monitoring human performance over time verifies that plant personnel have maintained adequate skills, knowledge, and abilities. The operational lifecycle monitoring process provides reasonable assurance that:

- The design can be effectively used by the plant operating staff, including inside the main control room as well as between the main control room and other stations (e.g., operational support center, technical support center, emergency operations facility, local control stations).
- Future modifications to the HSI, procedures, or training do not adversely affect an individual and/or team performance.
- Human actions can be performed within established time and performance criteria.
- The level of performance found acceptable during the integrated system validation is maintained.
- Appropriate measures are provided to approximate data in actual performance when the actual personnel or plant parameter cannot be measured.

The operational lifecycle management should be tied into the corrective action program so that appropriate monitoring and trending can be accomplished over the life of the plant. This monitoring process ensures that should degradation of operator knowledge, skills, or abilities begin to occur, the issues are detected and corrected before plant safety and reliability are adversely impacted.

Additional information is found in the Operational Lifecycle Monitoring technical report.

3.3 HFE Design team

The roles and responsibilities of each HFE program element are fulfilled by the persons with the applicable skill set. These personnel are trained to perform the functions prescribed within the individual technical reports.

3.3.1 HFE Unit Manager

The HFE unit manager responsibilities include:

- The development of all HFE plans, processes, and procedures
- Oversight and review of all HFE design, development, test, and evaluation activities
- The initiation, recommendation, and provision to fix problems noted within the program elements
- Evaluation and resolution of team recommendations
- Assurance that HFE activities comply with all HFE plans and procedures
- Scheduling of activities and milestones
- HFE input into the overall design process
- HFE input into training and procedure activities

It is within the design authority HFE program manager's purview to adjust standards for individuals performing work to satisfy specific elements of the B&W mPower HFE program provided that a bases for qualification are documented.

3.3.2 The HFE design team composition

The HFE design team is a multi-disciplinary team that collectively fulfills the qualifications listed in Section 3.3.3 (see Table 1). This does not necessarily mean that there is a dedicated team member for each specialty area. Some HFE design team members may fulfill multiple roles or possess various qualifications. The term "team" is used to denote the fact that the organization as a whole can supply the qualified staff for conducting HFE activities. The HFE design team is managed by the unit manager for operations/integration. The individual assignments are dependent on the needs of the different sections of the HFE program.

3.3.3 HFE Design Team Integration for Tasks

HFE design team member responsibilities are assigned as applicable to each of the program elements. Each element of the HFE program is evaluated for the types of tasks associated with that element. The team members are then assigned responsibilities according to those needs. Table 1 shows the B&W mPower HFE design team member task assignments. This distribution of responsibility for task assignments does not preclude other disciplines from participating in an individual element if it is deemed necessary. Some team members are qualified in multiple disciplines and can therefore perform various HFE program element functions.

Table 1. HFE Design Team Member Task Assignments

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[CCI per Affidavit 4(a)-(d)]

3.3.4 HFE Design Team Qualifications

- Technical Project Management
  - Minimum qualifications
    - Bachelor's degree

        - Possesses a working knowledge of 10 CFR Part 52 and NUREG-0800 requirements
        - Demonstrates an understanding of requirements management and systems engineering principles
        - 5 years of experience in nuclear power plant design or operations
        - 3 years of management experience
    - Typical responsibilities
        - Develops and maintains the project schedule to integrate HFE activities with all design activities
        - Provides a central point of contact for the management of the HFE design and implementation process
- Systems Engineering
    - Minimum qualifications
        - Bachelor of Science degree
        - 4 years of cumulative experience in at least three of the following areas of systems engineering: requirements management, design, development, integration, operation, and test and evaluation
    - Typical responsibilities
        - Documents system requirements for each operational mode and power level as appropriate
        - Documents how system requirements are satisfied through design, configuration, and operation
        - Verify that functional requirements are satisfied by system design
        - Provide knowledge of the purpose, operating characteristics, and technical specifications of major plant systems
        - Participates in development of initial system alarm list and design details for each alarm including basis, set point(s), expected response action(s), and significance
        - Participates in the development of procedures and scenarios for task analyses and integrated system validation
- Nuclear Engineering
    - Minimum qualifications
        - Bachelor of Science degree
        - 4 years of experience in nuclear design, development, testing, or operations

- Possesses a working knowledge of pressurized water reactor core physics and reactor thermo-hydraulics
- Possesses a working knowledge of pressurized water reactor technical specification and the safety limits

- Typical responsibilities
  - Provides knowledge of the processes involved in reactivity control and power generation
  - Provide input to HFE analysis, especially function analysis and task analysis
  - Participates in the development of scenarios for task analyses and integrated system validation

- Instrumentation and Control (I&C) Engineering
  - Minimum qualifications
    - Bachelor of Science degree
    - 4 years of experience designing of hardware and software aspects of process control systems
    - Experience in at least one of the following areas of I&C engineering: development, power plant operations, and test and evaluation
    - Familiarity with the theory and practice of software quality assurance and control
  - Typical responsibilities
    - Provides detailed knowledge of the HSI design, including control and display hardware selection, design, functionality, and installation
    - Provides knowledge of information display design, content, and functionality
    - Participates in the design, development, test, and evaluation of the HSI
    - Participates in the development of scenarios for HRA evaluations, validation, and other analyses involving failures of HSI data processing systems
    - Provides input to software quality assurance programs
- Architect Engineering
  - Minimum qualifications
    - Bachelor of Science degree in engineering
    - 4 years of experience designing power plant control rooms
  - Typical responsibilities
    - Provides knowledge of the overall structure of the plant, including performance requirements, design constraints, and design characteristics of

the following: containment building, control room, remote shutdown area, and local control stations

    - Provides knowledge of the configuration of plant components within the plant
    - Provides input to analyses, especially function analysis and task analysis, and to integration of systems and structures
    - Participates in the development of scenarios for task analyses and integrated system validation

- Human Factors Engineering
  - Minimum qualifications
    - Bachelor's degree in human factors engineering, engineering psychology, or a similar science
    - 4 years of cumulative experience related to the human factors aspects of human-computer interfaces
    - 4 years of cumulative experience related to the human factors aspects of workplace design (e.g., design, development, test and evaluation of workplaces)
    - Demonstrated ability and experience implementing, assessing, and verifying that HSI designs satisfy NUREG-0700 requirements
  - Typical responsibilities
    - Provides knowledge of human performance capabilities and limitations, applicable human factors design and evaluation practices, and human factors principles, guidelines, and standards
    - Develops and performs human factors analyses
    - Participates in the resolution of human factors issues
- Plant Operations
  - Minimum qualifications
    - Current or prior senior reactor operator with 2 years of on-shift licensed experience

    OR

    - Current or prior reactor operator with 6 years of on-shift licensed experience
  - Typical responsibilities
    - Provides knowledge of operational activities including characterizing tasks, HSI, and environment technical requirements related to operational activities
    - Provides knowledge of operational activities in support of HSI activities such as development of HSIs, procedures, and training programs

    - Participates in the development of scenarios for HRA evaluations, task analyses, HSI tests and evaluations, and V&V
    - Participates in preliminary validation exercises for design assessment using static mockups, engineering part-task simulators and full-scope simulation to provide input related to the expected plant response
    - Participates in final validation exercises on a simulator by observing and evaluating the subject operator's response

- Computer System Engineering
  - Minimum qualifications
    - Bachelor's degree in electrical engineering or computer science or graduate degree in another engineering discipline
    - 4 years experience designing digital computer systems and real-time systems applications
    - Familiarity with the theory and practice of software quality assurance and control
  - Typical responsibilities
    - Provides knowledge of data processing associated with displays and controls
    - Participates in the design and selection of computer-based equipment such as controls and displays
    - Participates in the development of scenarios for HRA, validation, and other analyses involving failures of the HSI data processing systems
- Plant Procedure Development
  - Minimum qualifications
    - Bachelor's degree
    - 4 years experience in developing nuclear power plant operating procedures
  - Typical responsibilities
    - Provides knowledge of operational tasks and procedure formats such as normal, abnormal, and emergency operating procedures from current or predecessor power plants
    - Participates in the development of scenarios for HRA evaluations, task analyses, HSI tests and evaluations, validation, and other evaluations
    - Provides input for the development of emergency operating procedures, procedure aids, computer based procedures, and training systems
- Personnel Training
  - Minimum qualifications

        - Bachelor's degree
        - 4 years experience developing personnel training programs for power plants
        - Experience in the application of systematic training development methods
    - Typical responsibilities
        - Develop the content and format of personnel training programs for licensed and non-licensed plant personnel
        - Coordinates training issues that arise from activities such as HRA, HSI design, and procedure development with the training program
        - Participates in the development of scenarios for HRA evaluations, task analyses, HSI tests and evaluations, and V&V
- Systems Safety Engineering
    - Minimum qualifications
        - Bachelor of Science degree
        - 4 years experience in system safety engineering
    - Typical responsibilities
        - Identifies safety concerns and performs a system safety hazard analysis
        - Provides results of system safety hazard analysis to PRA/HRA and human factors analyses
- Maintainability and Inspectability Engineering
    - Minimum qualifications
        - Bachelor of Science degree
        - 4 years experience in at least two of the following areas of power plant maintainability and inspectability engineering: design, development, integration, and test and evaluation
        - Experience in analyzing and resolving plant I&C system or equipment-related maintenance problems
    - Typical responsibilities
        - Provides knowledge of maintenance, inspection, and surveillance activities including task characteristics, HSI characteristics, human performance demands, environmental characteristics, and technical requirements related to the conduct of these activities
        - Supports the design, development, and evaluation of the control room and other HSIs throughout the plant to provide reasonable assurance that they can be inspected and maintained at an acceptable level of performance and reliability

        - Provides input in the areas of maintainability and inspectability to the development of procedures and training
        - Participates in the development of scenarios for HSI evaluations, including task analyses, HSI design tests and evaluations, and validation
- Reliability and Availability Engineering
    - Minimum qualifications
        - Bachelor's degree
        - 4 years of cumulative experience in at least two of the following areas of power plant reliability engineering activity: design, development, integration, and test and evaluation
        - Knowledge of computer-based, human-interface systems
    - Typical responsibilities
        - Provides knowledge of plant component and system reliability and availability and assessment methodologies to the HSI development activities
        - Participates in human reliability analyses
        - Participates in the development of scenarios for HSI evaluations with emphasis upon validation
        - Provides input to the design of HSI equipment to provide reasonable assurance that it meets reliability goals during operation and maintains the required level of availability

3.4 Design Tools

3.4.1 Requirements Management Tool

The requirements management tool is used by the HFE design process to document HFE requirements and to organize these requirements into individual line items for clarity, accountability, and traceability. Specific system requirements are addressed in the applicable system description documents. The requirements management tool captures the plant information and provides the ability to link the design information to each of the governing requirements, codes, or standards as well as other plant documents that may affect the design. The use of a tool enhances collaboration and transparency. The plant requirements become standardized and can be effectively updated for project members. By linking each requirement to the corresponding fulfillment statement(s), updates or modifications are managed through a controlled change management system. The use of a tool provides a cohesive and unified view of the design lifecycle change process and includes requirements as part of the design change process through all phases of the design lifecycle.

3.4.2 Operating Experience Review Database

Operating experience reports are compiled by members of the HFE design team to inform the design process about lessons learned and best practices from various database sources. General recommendations for the designers are provided in order to mitigate potentially negative impacts of issues and positive design features that should be retained. The recommendations and supporting documentation are reviewed by other disciplines for incorporation into the design.

Designers and engineers review OER data and determine applicability of the OE to their system. Applicable OE is documented when included in the design because of the following:

- Changes to the design are incorporated.
- The design is shown to have already addressed/eliminated/mitigated the OE issue.
- The issue is addressed by other means (procedures, training, etc.).

The design review process considers the feedback from all reviewers and may either accept or reject the incorporation of the OE. All OE database entries are preserved and version control is maintained for referencing purposes. The search feature of the database allows a user to quickly find reports that match any search criteria and use the information for design purposes or progress reporting.

3.4.3 HFE Issue Tracking System

The HFE issue tracking system is an integrated database system that provides a collaboration and communication tool between units involved in issue resolutions. The system provides electronic record of issues, retains version control, and includes all supporting information for referencing and documentation.

3.4.4 Screen Design Tool

The screen design tool supports the creation of HSI screens by members of the HFE design team. These screens are used in both the plant control systems and simulations.

3.4.5 Modeling and Simulation

Modeling and simulation of the plant environments is described in Section 5. The use of modeling as an aid in design engineering allows for the discovery of errors in the design before the actual construction.

3.5 Configuration Management

The HFE management plan is aligned to follow all B&W configuration management policies and procedures. The configuration management program consists of two general parts: pre-operational and operational. During the pre-operational phase, the configuration management programs require the identification, collection, and management of all relevant information necessary to establish and maintain the design basis. The operational phase of the configuration management program maintains the measures to ensure the capture and management of linkages to structures, systems, and components, and associated operations and maintenance programs. Changes to the design are controlled as part of the overall configuration management process. Change requests are submitted, documented, evaluated, and any resulting changes to the design are implemented within the formal design change process. Additionally, this process ensures that any plant systems, processes, groups, procedures, or training affected by design changes are addressed as part of the change to ensure the continued safety and efficiency of the plant.

The constructed plant will be turned over to the licensee and follow their operating phase configuration management process.

3.6 Quality Management

The HFE program is aligned to follow all applicable B&W quality management policies and procedures.

3.7 Schedule Management

Schedule management is accomplished in accordance with the project management of the B&W mPower reactor project. HFE activities are integrated with other discipline activities and are coordinated through the schedule tool.

3.8 Defense-in-Depth

The important aspects of the diversity, defense-in-depth as identified in Regulatory Guide 1.174 account for the uncertainties in equipment and human performance. These aspects are considered during initial design and any subsequent plant modification. Utilizing the defense-in-depth principles ensures there are some protections even when the barriers break down in a particular area. The protections afforded by the defense-in-depth principles include:

- A reasonable balance is preserved among prevention of core damage, prevention of containment failure, and consequence mitigation.
- There is no overreliance on programmatic activities to compensate for weaknesses in plant design. This may be pertinent to changes in human actions.
- System redundancy, independence, and diversity are preserved commensurate with the expected frequency, consequences of challenges to the system, and uncertainties.
- Defenses are established against potential common cause failures which include human actions.
- Independence of barriers is not degraded.

- Defenses against human errors are preserved (e.g., peer checks, independent verifier, etc.).
- Safety margins can be used in deterministic analyses to account for uncertainty and provide an added margin to provide adequate assurance that the various limits or criteria important to safety are not violated.

4. HFE ISSUE RESOLUTION

Issues identified during the HFE analysis and design activities are resolved through the provisions of the individual element that governs the issue. All individuals on the project document all HFE issues as they are discovered. The issue is tracked through the issue tracking system. The HFE issue is considered throughout the design process for appropriate resolution. The HFE issue tracking system documents, evaluates, tracks, and provides for the resolution of HFE related issues.

4.1 HFE Issue Tracking System

[

]

[CCI per Affidavit 4(a)-(d)]

4.1.1 Issue Tracking Process and Responsibilities

4.1.1.1 Initiator

[

] **[CCI per Affidavit 4(a)-(d)]**

4.1.1.2 Assessor

Issues that are submitted for review by an initiator are screened by an assessor. [

] **[CCI per Affidavit 4(a)-(d)]**

4.1.1.3 Reviewer

Reviewers may include anyone in the design process whose area of responsibility might be impacted by the issue. [

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[CCI per Affidavit 4(a)-(d)]

[

]

Figure 2. Issue Tracking System Process **[CCI per Affidavit 4(a)-(d)]**

4.1.1.4 Design Review Process

Open issues in the issue tracking system are reviewed through the configuration management/change management process for any status updates and progress tracking. [

] **[CCI per Affidavit 4(a)-(d)]**

4.2 Human Engineering Discrepancy

HEDs are issues that are identified during the V&V element of the HFE program. [

] **[CCI per Affidavit 4(a)-(d)]**

5. HFE SIMULATION PLATFORMS

The B&W HFE design process uses [ ] of modeling methods: [

] **[CCI per Affidavit 4(a)-(d)]**

Simulator Development Strategy and Integration

[

]

Figure 3. Simulator Development Strategy and Integration

[CCI per Affidavit 4(a)-(d)]

5.1 [

] **[CCI per Affidavit 4(a)-(d)]**

5.2 [

] **[CCI per Affidavit 4(a)-(d)]**

5.3 [

] **[CCI per Affidavit 4(a)-(d)]**

5.3.1 [

] **[CCI per Affidavit 4(a)-(d)]**

5.3.2 [

] **[CCI per Affidavit 4(a)-(d)]**

5.4 HFE/Simulator Milestones

[

] **[CCI per Affidavit 4(a)-(d)]**

[

]

Figure 4. Design and Testing Process **[CCI per Affidavit 4(a)-(d)]**

6. SUMMARY RESULTS AND DOCUMENTATION

HFE documentation produced by the HFE design team comprises the output reports specified by the individual technical reports of the individual HFE program elements. The end result of the documentation is a fully tested control room, associated control stations, emergency operations facility, technical support center, and remote shutdown system that allows for ease of operation and an optimized safe and reliable performance of the operator. These individual HFE summary reports and results are as follows:

OER: The output from this process produces a list of design changes due to the inclusion of OE into the design. The OER database contains the individual system reports and all the responses to these reports by individual system engineers.

HRA: The output from this process is the complete and final list of the risk-important human actions and their use within the design.

FRA/FA/TA: The output from this process is an information assessment and information flow structure that contains the completed work from all of these activities in an auditable format.

HSI: The output of this process is a completed hard and soft HSI design. These are all the controls and indications necessary for the operation of the B&W mPower reactor.

V&V: The output from this process is the completed task support verification, staffing verification, design verification, integrated system validation, and all HEDs along with their disposition.

Design Implementation: The documentation of this process includes all design changes due to as-built considerations and completed evaluations of aspects of the final design not addressed during HFE V&V.

Operational Lifecycle Management: This documents the plan for ongoing monitoring and degradation mitigation processes. This is the description of the strategy to monitor human performance over the life of the plant to ensure that the operator staffing and knowledge, skills, and abilities found acceptable during V&V do not degrade.

The results of the procedure development process are not documented through the HFE program. However, the HFE program provides all input to the procedure development process and verifies the procedures during integrated system validation. This delivers the final plant procedures that are necessary for operation of the plant under all conditions.

The results of the training development process are also not documented through the HFE program. However, the HFE program provides all input to the training development process and validates staffing assumptions. The results are a fully developed training program and fully developed training material.

7. DEFINITIONS, ABBREVIATIONS, AND ACRONYMS

7.1 Definitions

The following list of definitions captures all definitions used throughout HFE-related documents for the B&W mPower development project. Individual reports only list the definitions used in that particular document.

Term	Definition
Behavioral Achieve Function	Task that shows a change of state for completion of the function. (e.g., change valve line-up to place pump in service).
Behavioral Maintain Function	Task that does not show a change of state for the completion of the function (e.g., maintain temperature at 80°F).
Benchmarking	Review of another system or technology to establish a point of reference for equipment application, usage, operation, and maintenance especially in relation to new technology equipment.
Configuration Management	The systematic approach for identifying, documenting, and changing the characteristics of a facility's structures, systems and components, to ensure that the conformance is maintained between the requirements, the physical configuration and configuration information.
Design Basis	The high-level functional requirements, interfaces, and expectations of a facility's structures, systems, and components that are based on regulatory requirements or facility analysis. Individual bases are contained in design information and may be reflected in any combination of criteria, codes, standards, specifications, computations, or analyses identifying pertinent constraints, qualifications, or limitations. The design basis identifies and supports the reasons a design requirement is established.
Function Allocation	The process of assigning responsibility for function accomplishment to human or machine resources, or to a combination of human and machine resources.

Term	**Definition**
Function Distribution	This is the process of assigning responsibility for function accomplishment across different levels of the organizational structure. This function essentially remains the same but the level of organization changes for the completion of the functions.
Functional Requirements Analysis	The examination of system goals to determine what functions are needed to achieve them.
Human Action	A manual action completed by a person in order to accomplish a task.
Human Error Probability	A measure of the likelihood that various failure modes for plant personnel to obtain the correct, required, or specified action or response in a given situation. The human error probability is the probability of the human failure event.
Human-System interface	A human-system interface is that part of the system through which personnel interact to perform their functions and tasks. This interaction includes the alarms, displays, controls, and job performance aids (e.g., procedures, instructions, etc.).
Interoperability	The ability to manage and electronically communicate product and project data between collaborating firms and within individual companies' design, procurement, construction, maintenance, operations, and business process systems.
Local Control Station	An operator interface related to local plant process control that is not located in the control room. This includes multifunction panels, as well as, single function local control stations such as controls (e.g., valves, switches, and breakers) and displays (e.g., meters) that are operated or observed during normal, abnormal, or emergency operations.
Logical Constraint	The relationship between the spatial or functional layout of components and the objects that they are affected by. This starts with the development of the functional requirements flow-down process. This is a major factor in the development of natural mapping for the task analysis.
Main Control Room	The room within the plant control building that houses and protects control room personnel and the human-system interface equipment provided for command and control of plant equipment to support the safe and efficient operation of the plant.

Term	Definition
Modification	Any type of change or modernization made to HSI components or plant systems that may influence personnel performance. This is defined as an action that can only occur after the original design certification is completed.
NASA Task Load Index	A measure of mental workload placed on an operator during and after task performance. It measures six sub-scales: mental, physical, and temporal demand; performance, effort, and frustration levels.
Operating Experience Review	A review of operating experiences from industry operations, maintenance, design, and construction tasks for collection, analysis, and documentation of lessons learned. This also includes interviews with plant staff or design personnel with operations backgrounds.
Performance Shaping Factors	Factors that influence human reliability through their effects on performance. Performance shaping factors include factors such as environmental conditions, human-system interface design, procedures, training, and supervision.
Plant	For the B&W mPower reactor design, a plant is one set of standard reactors and corresponding secondary systems. This twin-pack arrangement is the basic unit marketed as one plant.
Probabilistic Risk Assessment	A qualitative and quantitative analysis of the risk associated with plant operation under normal, abnormal, and emergency conditions. This assessment measures frequency of occurrence of adverse outcomes such as core damage or the release of radioactive material and the affects of these adverse outcomes on the health and safety of the public.
Risk-important human actions	Actions that are performed by plant personnel to provide reasonable assurance of plant safety. Actions may be made up of one or more tasks. There are both absolute and relative criteria for defining risk-important actions. From an absolute standpoint, a risk-important action is any action whose successful performance is needed to provide reasonable assurance that probabilistic design objectives are met. From a relative standpoint, the risk-important actions may be defined as those with the greatest risk contribution in comparison to all risk contributors.

Term	**Definition**
Safety Function	Functions that serve to verify high-level objectives and are often defined in terms of a boundary or entity that is important to plant integrity and the prevention of the release of radioactive materials. A typical safety function is "reactivity control." A high-level objective, such as preventing the release of radioactive material to the environment, is one that designers strive to achieve through the design of the plant and that plant operators strive to achieve through proper operation of the plant.
Safety-Related	A term applied to those nuclear structures, systems, and components that prevent or mitigate the consequences of postulated accidents that could cause undue risk to the health and safety of the public (see 10 CFR 50, Appendix B). These are the structures, systems, and components on which the design-basis analysis of the safety analysis report is performed. They also should be part of the full quality assurance program.
Situation Awareness Control Room Inventory	A method of measuring operator situation awareness that involves a simulation freeze with displays hidden from view. The operator is asked a series of questions comparing the past, current, and predicted future states of various systems using the answers 'increase', 'decrease, 'remains the same'. A score can be calculated using the percentage of correct answers or by evaluating partially correct or close answers.
Situational Awareness	The relationship between the operator's understanding of the plant's condition and its actual condition at any given time.
Static Analysis	This is a tabletop exercise done with only paper or on a static mockup of task to be analyzed.
Task Analysis	A method for determining and describing what plant personnel must do to achieve the purposes or goal of their tasks. The description can be in terms of cognitive activities, actions, and supporting equipment.
Validation	Also termed Integrated System Validation. This is an evaluation using performance-based tests to determine whether an integrated system design (i.e., hardware, software, and personnel elements) meets performance requirements and acceptably supports safe operation of the plant.

Term	Definition
Verification	The process by which the design is evaluated to determine whether it acceptably satisfies personnel task needs and HFE design guidance.

7.2 Abbreviations and Acronyms

The following list of abbreviations and acronyms captures all those used throughout HFE-related documents for the B&W mPower development project. Individual reports only list the abbreviations and acronyms used in that particular document.

ALARA	as low as reasonably achievable
B&W	Babcock and Wilcox
CDF	core damage frequency
CFR	Code of Federal Regulations
CM	configuration management
DCS	distributed control system
DI	design implementation
DRB	design review board
EOC	error of commission
EOF	emergency operations facility
EPG	emergency procedure guideline(s)
EPRI	Electric Power Research Institute
FA	function allocation
FRA	functional requirements analysis
FRM	functional requirements management
FSAR	final safety analysis report
FV	Fussell-Vesely importance measure
HA	human action
HED	human engineering deficiency
HEP	human error probability
HFE	human factors engineering
HPM	human performance monitoring
HRA	human reliability analysis
HSI	human-system interface
I&C	instrumentation and control
IEEE	Institute of Electrical and Electronics Engineers
INPO	Institute of Nuclear Power Operations

INSAG	International Nuclear Safety Group
ISV	integrated system validation
ITS	issue tracking system
K & A	knowledge and abilities
LCS	local control station
LOCA	loss of coolant accident
LRF	large release frequency
MCR	main control room
NASA-TLX	NASA Task Load Index
NRC	U.S. Nuclear Regulatory Commission
OE	operating experience
OEPC	operating experience program coordinator
OER	operating experience review
P&ID	piping and instrumentation diagram
PFRA	plant-level functional requirements analysis
PM	project management
PORV	pressure-operated relief valves
PRA	probabilistic risk assessment
PSF	performance shaping factor
PWR	pressurized water reactor
RAW	risk achievement worth
RCP	reactor coolant pump
RMT	requirements management tool
RSS	remote shutdown system
SACRI	Situational Awareness for Control Room Indications
SG	steam generator
SGTR	steam generator tube rupture
SFRA	system-level functional requirements analysis
SSC	structures, systems, and components
TA	task analysis
TMI	Three Mile Island
TSC	technical support center
V&V	verification and validation

8. REFERENCES

8.1 Code of Federal Regulations

8.1.1 10 CFR 50, Domestic Licensing of Production and Utilization Facilities, United States Nuclear Regulatory Commission

8.1.2 10 CFR 50, Appendix B – Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, United States Nuclear Regulatory Commission

8.1.3 10 CFR 50.34, Contents of Applications; Technical Information, United States Nuclear Regulatory Commission

8.1.4 10 CFR 50.120, Training and Qualification of Nuclear Power Plant Personnel, United States Nuclear Regulatory Commission

8.1.5 10 CFR 52, Licenses, Certifications, and Approvals for Nuclear Power Plants, United States Nuclear Regulatory Commission

8.1.6 10 CFR 55, Operators' Licenses, United States Nuclear Regulatory Commission

8.2 U.S. Nuclear Regulatory Guidance

8.2.1 NUREG-0700, Human-Systems Interface Design Review Guidelines, United States Nuclear Regulatory Commission

8.2.2 NUREG-0711, Human Factors Engineering Program Review Model, United States Nuclear Regulatory Commission

8.2.3 NUREG-0800, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition, United States Nuclear Regulatory Commission

8.2.4 Regulatory Guide 1.174, An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis, United States Nuclear Regulatory Commission

8.3 Other Documentation

8.3.1 ANSI Standard 3.5, Nuclear Power Plant Simulators for Use in Operator Training (2009)

8.3.2 MPWR-TECR-005003, Operational Experience Program

8.3.3 MPWR-TECR-005004, Functional Requirements Analysis/Function Allocation

8.3.4 MPWR-TECR-005005, Task Analysis

8.3.5 MPWR-TECR-005006, Human Factors Engineering Integration of Human Reliability Analysis