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Subject: **Submittal of ESBWR Licensing Topical Report NEDO-33277, ESBWR Human Factors Engineering Human Performance Monitoring Implementation Plan (HPM), Revision 3**

Licensing Topical Report (LTR) NEDO-33277, ESBWR Human Factors Engineering Human Performance Monitoring Implementation Plan (HPM), Revision 3, is being submitted for your review and use in accordance with the corresponding HFE program element identified in Reference 1.

Attachment 1 of this letter contains LTR NEDO-33277, Revision 3, dated May 2008.

If you have any questions or require additional information, please contact me.

Sincerely,

Charles W. Boyd
for

Richard E. Kingston
Vice President, ESBWR Licensing

D068
NRO

Reference:

1. NUREG-0711, Revision 2, Human Factors Engineering Program Review Model, issued February 2004

Attachment:

1. MFN 08-268, ESBWR Licensing Topical Report NEDO-33277-ESBWR Human Factors Engineering Human Performance Monitoring Implementation Plan (HPM), Revision 3

cc:	AE Cubbage	USNRC (with enclosures)
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	DH Hinds	GEH/Wilmington (with enclosures)
	GB Stramback	GEH/San Jose (with enclosures)
	EDRF	0000-0052-9520, Rev. 5

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Attachment 1

NEDO-33277
Revision 3

ESBWR Licensing Topical Report – ESBWR Human Factors Engineering Human Performance Monitoring Implementation Plan (HPM), Revision 3

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Revision 3
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LICENSING TOPICAL REPORT

ESBWR HUMAN FACTORS ENGINEERING HUMAN PERFORMANCE MONITORING IMPLEMENTATION PLAN

INFORMATION NOTICE

This document NEDO-33277, Revision 3, contains no proprietary information.

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

The information contained in this document is furnished as reference to the NRC Staff for the purpose of obtaining NRC approval of the ESBWR Certification and implementation. The only undertakings of GE Hitachi Nuclear Energy (GEH) with respect to information in this document are contained in contracts between GEH and participating utilities, and nothing contained in this document shall be construed as changing those contracts. The use of this information by anyone other than that for which it is intended is not authorized; and with respect to any unauthorized use, GEH makes no representation or warranty, and assumes no liability as to the completeness, accuracy, or usefulness of the information contained in this document.

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1. OVERVIEW

This plan addresses human performance monitoring (HPM) during ESBWR operations. HPM employs diverse programmatic inputs and an integrated system of evaluation. This plan also links human factor engineering (HFE) results developed during design with methods for monitoring human performance during operation by the Combined Operating License (COL) licensee. The human performance monitoring implementation plan (HPMIP), as described by Figure 2, illustrates how the HFE activities are performed to support ESBWR operations. This implementation plan is one of the twelve elements for HFE review identified in NUREG-0711, Rev. 2.

The fleet-wide owners' group provides a means for consistently maintaining safety performance levels established through staffing, training, procedures, and design as described in the ESBWR Design Control Document (DCD). Individual ESBWR licensees' programs may vary in content and level of detail; however, the standards established by the fleet-wide owners' group are followed.

1.1 PURPOSE

The objective of the ESBWR HPMIP is to ensure that no safety degradation occurs due to changes in design, procedures, training, or staffing. The HPMIP incorporates a strategy for monitoring the performance of personnel and equipment that is integrated with existing programs. Preservation and improvement of human performance and economic efficiency are predicated on the continued and coordinated operation of a standardized fleet.

HPM integration with existing programs provides an assurance that the ESBWR HFE design bases remain valid during the operational phase of the plant. These programs include:

- Corrective Action Program (CAP)
- Maintenance Rule (MR)
- Human Reliability Analysis/Probabilistic Risk Assessment (HRA/PRA)
- In-service Inspection / In-service Testing (ISI/IST)

This HPMIP builds upon the HFE design activities that are carried forward into the operational phase. The ESBWR licensees' CAP, procedures, and training programs are incorporated to support the HPMIP.

1.2 SCOPE

This document illustrates how HPM elements employ HFE information developed during the ESBWR HSI design. Completion and documentation of the initial plant HFE/HSI design verification provides a basis for HPM when plant operations begin. For example, the HPMIP uses benchmarks for human performance, established during the ESBWR design for specific tasks defined in the task analysis, and verified during simulator testing in the ESBWR HFE Verification and Validation Plan.

The monitoring of performance relative to these benchmarks ensures sufficient margin to fulfill assumptions supporting the General Design Criteria (GDC). The HPM strategy provides a

reasonable assurance that the ability to interface among various HSIs within each facility is maintained effectively throughout the ESBWR operational phase in the following areas:

- Main control room (MCR)
- Remote shutdown station (RSS)
- Risk-important local control stations (LCS)
- Emergency support centers:
  - Emergency operating facility (EOF)
  - Technical support center (TSC)

There are three entities that are tasked with executing the HPMIP during the ESBWR operating phase:

- GEH
- ESBWR licensee
- Fleet-wide owners' group

1.2.1 Responsibilities of GEH

GEH supports safe and economic ESBWR fleet operation by:

- Determining and documenting the scope and structure of the HPMIP
- Forming and chairing a fleet-wide owners' group, that addresses ESBWR fleet issues
- Maintaining the certified ESBWR HFE design basis during the operating life of the ESBWR program
- Providing analysis of design issues arising during V&V, start-up testing, and plant operation, as commissioned by the fleet-wide owners' group
- Providing procedure analysis and requisite changes during V&V, start-up testing, and plant operation, as commissioned by the fleet-wide owner's group
- Reviewing operational issues related to the standard design and producing periodic reports, as commissioned by the fleet-wide owners' group
- Processing standard design changes that are in the long-term interest of the ESBWR partners, as commissioned by the fleet-wide owners' group

1.2.2 Responsibilities of ESBWR Licensee

Required elements of the Licensees' HPM program include:

- Implementation of the plant-level strategy for HPM during the operating life of the plant by assessing:
  - Design information
  - Risk importance measures

  - Operating Experience Reviews (OER)
  - Training simulator capabilities
- Participating in the fleet-wide owners' group
- Performing start-up and design implementation testing
- Evaluating operating events
- Determining if the standard design is potentially impacted
- Forwarding events that have the potential to impact the standard design to the fleet-wide owners' group for analysis and review
- Implementing standard design changes and timeline mandated by the fleet-wide owners' group
- Implementing pilot changes to the standard design and restoring facilities to standard design when the pilot change has expired

1.2.3 Responsibilities of Fleet-Wide Owners' Group

Required elements of the fleet-wide owners' group HPM program include:

- Reviewing data from individual plants
- Trending data from individual plants
- Evaluating operating events for importance
- Analyzing events to determine the root cause
- Trending simulated performance of critical tasks to identify change
- Developing corrective actions (CAs) for significant events
- Evaluating pre-operational V&V and functional test results and determining whether pursuit of a change to the standard design is warranted
- Commissioning GEH to evaluate standard design related issues
- Commissioning GEH to change the standard design for the long-term benefit of continued safe and economic operation of the ESBWR fleet
- Maintaining the HFE Issue Tracking System (HFEITS) to record, track, and trend HFE issues, impacts, evaluation, and resolution during the operating phase of the ESBWR
- Determining the type, scope, and duration of pilot changes to the standard design
- Monitoring the effectiveness of the CAs

1.3 DEFINITIONS AND ACRONYMS

1.3.1 Definitions

Several terms are defined to provide a common basis for developing HPM recommendations referred to in this plan.

Accident Sequence - a representation in terms of an initiating event followed by a combination of system, function and operator failures or successes, of an accident that can lead to undesired consequences, with a specified end state (for example, core damage or large early release). An accident sequence may contain many unique variations of events (minimal cut sets) that are similar. (ASME PRA Std.)

Accident Situation - from the operator's perspective, an abnormal plant state occurring during an event, which may lead to a new damage condition. Operations staffs' actions can prevent, mitigate or exacerbate the accident progression using the HSI. (IEEE working group)

Function - An activity or role performed by a human, structure, or automated system to fulfill an objective. (NEDO-33219, ESBWR Functional Requirements Analysis Implementation Plan)

HFE Issue Tracking System (HFEITS) - An electronic database used to document human factors engineering issues not resolved through the normal HFE process and human engineering discrepancies (HEDs) from the design verification and validation activities. Additionally, the database is used to document the problem resolutions.

Human-System Interfaces - A human-system interface (HSI) is that part of the system through which personnel interact to perform their functions and tasks. In this document, "system" refers to a nuclear power plant. Major HSIs include alarms, information displays, and controls. Procedures are also HSIs, but are developed and treated in a separate activity plan, and are treated separately in this plan. Operator controls and information displays, however, for the purposes of displaying on-line procedures are HSIs in the context of this activity.

Initiating Event - any event either internal or external to the plant that perturbs the steady state operation of the plant, if operating, thereby initiating an abnormal event such as transient or LOCA within the plant. Initiating events trigger sequences of events that challenge plant control and safety systems whose failure could potentially lead to core damage or large early release.

Local Control Station (LCS) - An operator interface related to nuclear power plant (NPP) process control that is not located in the main control room. This includes multifunction panels, as well as single-function HSIs such as controls (for example, valves, switches, and breakers) and displays (for example, meters) that are operated or consulted during normal, abnormal, or emergency operations.

Maintenance - Activities carried out to keep systems and equipment available. Specific types of maintenance include preventive, and corrective. Activities associated with preventive maintenance include testing, surveillance, inspection, and calibration. Activities associated with corrective maintenance include repair, replace, and modify.

Response - to react to a cue for action in initiating or recovering a desired function.

Standard Design – The ESBWR design as defined by the DCD, the results of approved DAC and ITAACS, and changes analyzed and verified by the process described in DCD chapter 18.

Task - A collection of activities with a common purpose, often occurring in temporal proximity, with an identifiable start and end point for which human actions are performed. (NEDO-33221, ESBWR HFE Task Analysis Implementation Plan).

1.3.2 Acronyms

The following is a list of acronyms used in this plan:

Acronym	Description
AOF	Allocation of Function
BRR	Baseline Review Record
CA	Corrective Action
CAP	Corrective Action Program
COL	Combined Operating License
D3	Defense-in-Depth and Diversity
DCD	Design Control Document
EOC	Extent of Condition
EOF	Emergency Operations Facility
FRA	Functional Requirements Analysis
FSS	Full Scope Simulator
GDC	General Design Criteria
HFE	Human Factors Engineering
HFEITS	Human Factors Engineering Issue Tracking System
HPM	Human Performance Monitoring
HPMIP	Human Performance Monitoring Implementation Plan
HRA	Human Reliability Analysis
HSI	Human System Interface
INPO	Institute of Nuclear Power Operations
ISI/IST	In-Service Inspection / In-Service Testing
LCS	Local Control Station
MCR	Main Control Room
MR	Maintenance Rule
OER	Operating Experience Review
PRA	Probabilistic Risk Assessment
RSS	Remote Shutdown Station
S&Q	Staffing and Qualification

TA	Task Analysis
TSC	Technical Support Center
V&V	Verification and Validation

2. APPLICABLE DOCUMENTS

Applicable documents include supporting documents, and supplemental documents. Codes and standards are also provided in this section. Supporting documents provide the input requirements to this plan. Supplemental documents are used in conjunction with this plan. Codes and standards are applicable to this plan to the extent specified herein.

2.1 SUPPORTING AND SUPPLEMENTAL GEH DOCUMENTS

2.1.1 Supporting Documents

The following supporting documents were used as the controlling documents in the production of this plan. These documents form the design basis traceability for the requirements outlined in this plan.

(1) ESBWR DCD, Chapter 13, Rev 5, (GEH 26A6642BL)

(2) ESBWR DCD, Chapter 18, Rev 5, (GEH 26A6642BX)

(3) ESBWR DCD, Chapter 19, Rev 5, (GEH 26A6642BZ)

(4) NEDE-33217P and NEDO-33217, Rev 4, ESBWR Man-Machine Interface System and Human Factors Engineering Implementation Plan

2.1.2 Supplemental Documents

The following supplemental documents are used in conjunction with this document plan.

(1) NEDO-33219, Rev 2, ESBWR HFE Functional Requirements Analysis Implementation Plan

(2) NEDO-33220, Rev 2, ESBWR HFE Allocation of Functions Implementation Plan

(3) NEDO-33221, Rev 2, ESBWR HFE Task Analysis Implementation Plan

(4) NEDE-33226P and NEDO-33226, Rev 3, Software Management Program Manual

(5) NEDO-33262, Rev 2, ESBWR HFE Operating Experience Review Implementation Plan

(6) NEDO-33266, Rev 2, ESBWR HFE Staffing and Qualifications Implementation Plan

(7) NEDO-33267, Rev 3, ESBWR HFE Human Reliability Analysis Implementation Plan

(8) NEDO-33268, Rev 3, ESBWR HFE Human System Interface Design Implementation Plan

(9) NEDO-33274, Rev 3, ESBWR HFE Procedures Development Implementation Plan

(10) NEDO-33275, Rev 2, ESBWR HFE Training Program Development Implementation Plan

(11) NEDE-33276P and NEDO-33276, Rev 2, ESBWR HFE Verification and Validation Implementation Plan

2.2 CODES AND STANDARDS

(1) ANSI/ANS 3.1-1993; R1999: Selection, Qualification, and Training of Personnel for Nuclear Power Plants (American Nuclear Society).

(2) ANSI/ANS-3.2-1994; R1999, "Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants."

(3) ANSI/ANS-3.4-1996; R2002, "Medical Certification and Monitoring of Personnel Requiring Operator Licenses for Nuclear Power Plants."

(4) ANSI/ANS 3.5-1998: Nuclear Power Plant Simulators for Use in Operator Training and Examination (American Nuclear Society).

(5) IEEE Std 610 -1991, "IEEE Standard Computer Dictionary, A Compilation of IEEE Standard Computer Glossaries."

2.3 REGULATORY GUIDELINES

(1) CN Number 05-030 NRC Inspection Manual: Chapter 0609, Significance Determination Process, 2001.

(2) CN Number 05-031 NRC Inspection Manual: Chapter 2515, Light-Water Reactor Inspection Program - Operations Phase, 2002.

(3) IP 71715: Sustained Control Room and Plant Observation. (NRC, periodically updated).

(4) NUREG-1649, Rev. 3, Reactor Oversight Process, 2000.

(5) NUREG-0700, Rev. 2, Human-System Interface Design Review Guidelines, 2002.

(6) NUREG-0711, Rev. 2, Human Factors Engineering Program Review Model, 2004.

(7) NUREG-0737, Clarification of TMI Action Plan Requirements Supplement 1, Requirements for Emergency Response Capability, 1983.

(8) NUREG-0800, Section 13.2.1, Rev 2, Reactor Operator Training, 2005.

(9) NUREG-0800, Section 13.2.2, Rev 2, Training for Non-Licensed Plant Staff, 2005.

(10) Regulatory Guide 1.149, Rev. 3, Nuclear Power Plant Simulation Facilities for Use in Operator Training and License Examinations, 2001.

(11) Regulatory Guide 1.174, Rev 1, An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis, 2002.

(12) Regulatory Guide 1.8, Rev. 3, Qualification and Training of Personnel for Nuclear Power Plants, 2000.

(13) 10 CFR 50.120 "Training and Qualification of Nuclear Power Plant Personnel," Title 10, "Energy."

2.4 DOD AND DOE DOCUMENTS

None.

2.5 INDUSTRY/OTHER DOCUMENTS

Additional reference documents or those that have been removed may be re-added to the next revision, as they become available to the HFE design team.

(1) EPRI-TR-016780-V2R8, Advanced Light Water Reactor Utility Requirements Document, Vol. II ALWR Evolutionary Plant, Chapter 10, Man-Machine Interface Systems, Rev. 8, 1999.

(2) EPRI-NP-1567, Human Factor Review of Power Plant Maintainability, 1980.

(3) EPRI-NP-2360, Human Factors Methods for Assessing and Enhancing Power Plant Maintainability, 1982.

(4) EPRI NP-3659, Human Factors Guide for Nuclear Power Plant Control Room Development, 1984.

(5) EPRI-NP-3701, Computer-generated Display System Guidelines Vol. I and II, revised 1984.

(6) IAEA INSAG-13 Management Of Operational Safety In Nuclear Power Plants, 1999.

(7) IAEA Safety Series No. 75-INSAG-4: "Safety Culture," 1991.

(8) IAEA - Technical Report Series (TECDOC-596), "Reviewing operational experience feedback," IAEA, 1991.

(9) IAEA- Technical Report Series (TECDOC-525), Guidebook on Training to Establish and Maintain the Qualification and Competence of Nuclear Power Plant Operations Personnel, Vienna, 1989.

(10) IAEA- Technical Report Series (TECDOC-668), The Role of Automation and Humans in Nuclear Power Plants, IAEA, Vienna, 1992.

(11) Rasmussen, J., "Information Processing and Human-Machine Interaction, An Approach to Cognitive Engineering," Elsevier Science Publishing Company, New York, 1986.

(12) INPO 85-017, Rev. 2, Guidelines for the Conduct of Operations at Nuclear Power Stations.

3. METHODS

HPMIP identifies areas needing improvement to enhance the operation and maintenance of the ESBWR fleet. This plan is part of an overall HFE process that enhances the HSI in the design of a nuclear power plant, as illustrated in Figure 1, HFE Implementation Process. HPM provides the mechanism to improve human performance, mitigate, and prevent human errors through changes in design, staffing, procedures, and training.

The HPMIP provides a process to ensure that events are documented, trended, and analyzed to identify changes necessary to enhance the safe operation of the ESBWR fleet. These identified changes are implemented fleet-wide to ensure all ESBWR units benefit from the OER of individual plants.

The essential elements for developing an HPM strategy include considerations for data collection, evaluating for importance, analyzing events to determine the cause, and for trending and developing CAs. Where possible, the elements of the HPMIP draw upon existing information sources and programs.

Risk and reliability techniques used in the nuclear industry are developed to provide up-to-date risk and reliability information to the control room. Such tools are used to support asset management by including trip monitors and de-rate models. The goal of these models is to provide estimates of the trip or de-rate probability as a function of configuration changes in the plant. This permits operators to more clearly understand complex relationships between systems undergoing maintenance and testing. The use or non-use of this tool, as it relates to an event, provides the HPM program the mechanism to evaluate the operators' actions and decisions. In addition, any modifications necessary for training, procedures, or the decision-making tools are evaluated.

This section describes the following four activities:

- Design implementation and testing
- Operation and monitoring
- Changes to the standard design
- Pilot changes to the standard design

3.1 DESIGN IMPLEMENTATION AND TESTING

3.1.1 Background

The HPMIP is structured to ensure that the implemented design:

- Remains consistent with the design evaluated by the V&V plan
- Reconciles operating units to the verified design
- Monitors human actions commensurate with risk importance

3.1.2 Goals

The goals of the HFE design implementation and testing section include:

- Assurance that the rendered design meets the HFE V&V acceptance criteria
- Identification of HFE issues prior to the operating phase
- Provision of an impetus to issue resolution

3.1.3 Basis and Requirements

Required elements of the Licensees' HPM program include the following:

- Establishing acceptance criteria and bases prior to start-up testing.
- Establishing performance requirements using baseline V&V testing results.
- Pre-operational testing of systems and subsystems as early as practical.
- Integrated simulation testing prior to operational phase.
- Assessing the impact on risk via the HRA/PRA models and data. (When actual conditions cannot be simulated, monitored, or measured, the available information that most closely approximates performance data in actual conditions is used).
- Performing start-up testing concurrent with initial heat-up.
- Evaluating start-up/functional tests, performing required CAs, and verifying CA effectiveness in a timely manner.
- Detecting and correcting degradation in performance before plant safety margin is compromised.
- Documenting identified deviations, issues, and CAs in the HFEITS.

3.1.4 General Approach

The HFE design team, when allocating specific human actions to systems and integrated accident management processes, establishes the basic human performance requirements for the ESBWR.

The V&V portion of the HFE strategy provides a reasonable assurance that:

- The HSI design accommodates control room personnel and coordination among the control room, local control stations, and support centers to address expected transients, design basis events, operating events, and hypothetical accident scenarios identified by the HRA/PRA.
- The staffing plan and initial training assure that human actions using HSI information, cues, and controls are accomplished within margins on time to meet GDC performance criteria used to determine the probability of success assessments for the HRA/PRA.
- Plant procedures are adequate to ensure that critical tasks support GDC requirements and do not contribute to the initiation of an operating event.

The HPM design implementation and testing section ensure that the human performance requirements demonstrated during the HFE V&V are confirmed during startup and design change testing. In addition, HPM ensures that any significant degradation in human performance is identified, evaluated, and reconciled. Once a significant issue or change to the standard ESBWR is identified or developed, it is evaluated for influence on human performance.

Changes with the potential to impact human performance are modeled into a Full Scope Simulator (FSS) or hardware training platform to measure and evaluate the impact on human performance. When the evaluation shows that the change enhances plant operation /safety, it is implemented in the ESBWR fleet.

3.1.5 Application

The HPMIP:

- Evaluates deviations from the verified standard design
- Identifies possible latent errors embedded in the application of the standard design
- Determines if the standard design needs modification

3.2 OPERATION AND MONITORING

3.2.1 Background

During the operational phase of the ESBWR the HPM strategy provides reasonable assurance that:

- The acceptable level of performance established during the integrated V&V is maintained.
- The changes made to standard ESBWR HSIs, procedures, staffing, and training are evaluated for standard design impact and consistently applied at all ESBWRs in a timely manner. Verification that targeted deficiencies have been mitigated and that changes have not created new deficiencies or degrades personnel performance (for example, a change that interferes with previously trained skills).
- The changes made to the HSI are tested in a FSS prior to implementation in the plant.

3.2.2 Goals

The goals of HFE operation and monitoring include:

- Detection of degrading human performance before design margin is eroded
- Identification of latent errors that have the potential to contribute to an operating event
- Identification of active errors that have the potential to contribute to an operating event

3.2.3 Basis and Requirements

Required elements of the Licensees' HPM program include the following:

- Trending operator training simulator evaluation results
- Licensee CAP evaluating entries for adverse conditions with the potential to impact the standard design
- Promptly forwarding issues with the potential to impact the standard design to the fleet-wide owners' group
- Trending and analyzing issues on a fleet-wide basis

3.2.4 General Approach

The ESBWR licensee maintains a database of events, significance evaluations, cause determinations, and CAs taken during the event evaluation to support trending of performance degradation and failures.

Existing programs, such as licensed operator training and the CAP, include appropriate data for trending human performance as well as other performance indicators for the plant. The HPM plan uses existing utility and industry programs for data collection, rather than developing new monitoring programs.

The strategic elements are implemented through the use of a FSS during periodic training exercises. An assumption for use during the HSI design process is that the control room simulator is maintained and upgraded to match the actual control room with good interface and dynamic response fidelity (ANSI/ANS 3.5).

Periodic evaluation and trending of operators' performance of tasks with respect to time and accuracy goals are performed to demonstrate performance consistent with that developed during the various analyses that support the standard design (or justify/validate changes to the standard design).

The plan uses precursor analysis to understand the impact of the deviations. The impact of human deviations and system or component failures is mapped into generic accident sequence event trees as ones and zeros to produce a change in the accident sequence probability under the identified conditions. This precursor analysis is an ongoing process continuing through all phases of the ESBWR plant life cycle including:

- Pre-operational plant simulation
- FSS training
- Construction and testing
- Initial start-up and low-power testing
- Power ascension and warranty testing
- ESBWR operating phases (including abnormal, emergency, and transient)
- Changes to the standard design
- Pilot changes to the standard design

This process is superseded, if the HRA/PRA of the plant is sufficiently detailed to model the deviation then the standard risk-importance measures are used. The risk-importance prioritization scheme includes:

- Evaluating and trending of operating occurrences
- Systematic assessment for potential nuclear safety impact
- CAs, scope, and timeframe evaluations
- Aggregate plant (ESBWR fleet) risk-sensitivity

3.2.5 Application

The HPMIP:

- Collects and processes operating, training, and equipment data
- Identifies trends that have the potential to contribute to an operating event through precursor monitoring and licensed operator evaluation trending
- Evaluates deviations in training evaluation results
- Identifies possible latent errors embedded in the application of the standard design through precursor monitoring and licensed operator evaluation trending
- Assesses the impact of issues on the standard design

3.3 CHANGES TO THE STANDARD DESIGN

3.3.1 Background

An important element of HPM is to understand the impact of deviations on plant operation and safety. A root cause analysis is typically conducted to determine corrective and/or adaptive actions to mitigate the cause(s) or consequence(s) of the deviation or component failure.

3.3.2 Goals

The goals of this section include:

- Maintain the ESBWR fleet as a standard design
- Provide an economically efficient method to update/maintain the standard ESBWR design
- Maintain the HFE design bases during the operating phase of ESBWR
- Identify possible latent errors that have the potential to contribute to an operating event
- Identify possible active errors that have the potential to contribute to an operating event

3.3.3 Basis and Requirements

ESBWR licensee and fleet-wide owners' group requirements for changes to standard design, procedures, and training include:

- Issues are resolved by the licensee and fleet-wide owners' group within time constraints consistent with safety significance.
- Issue resolutions benefit the long-term safe and economic operation of the ESBWR fleet.
- Human performance is restored before design margin is eroded.

3.3.4 General Approach

The changes to the standard design section ensures that human performance requirements are maintained during the operating phase by allowing controlled fleet-wide changes to the standard design which include response to:

- Obsolescence
- Operating events
- New technologies
- Changing expectations

Once a significant issue or change to the standard ESBWR is identified or developed, it is tested for impact on human performance. Changes that have the potential to impact human performance are modeled into the FSS or hardware training platform to measure and evaluate the impact on human performance. When the evaluation shows that the change provides enhancement to the fleet operation/safety, it is implemented throughout the ESBWR fleet. Change implementation timetables are determined by agreement among the licensee(s) and the fleet-wide owners' group.

3.3.5 Application

The HPMIP:

- Identifies possible latent errors embedded in standard design changes
- Determines how the standard design is modified
- Evaluates deviations in training evaluation results
- Assesses the impact of issues on the standard design

3.4 PILOT CHANGES TO THE STANDARD DESIGN

The pilot change process allows deviations from the standard design that are:

- Limited in scope and/or duration
- Economically or technologically necessary
- Promoted by the fleet-wide owners' group
- Benefit the ESBWR fleet as a whole

3.4.1 Background

A pilot change is a change to the standard design that does not affect all ESBWR plants. A pilot change can be long-term or short-term to allow for deviation from the standard design due to issues such as obsolescence, component availability, technology changes, and so forth. The pilot change allows new plants to employ modern technology while not forcing existing plants to immediately upgrade systems that are performing adequately.

3.4.2 Goals

The goals of pilot changes to the standard design include:

- Restoration of human performance before design margin is eroded
- Flexibility in design, training, and/or procedures to meet operational needs

- Maintenance of a standardized ESBWR fleet through standard design, procedures, training, and monitoring
- Identification of possible latent errors that have the potential to contribute to an operating event
- Identification of possible active errors that have the potential to contribute to an operating event

3.4.3 Basis and Requirements

ESBWR licensee HPM program requirements for pilot changes to standard design, procedures, and training include:

- Issues are resolved within time constraints consistent with safety significance.
- Scope and duration of pilot changes are managed by the licensee and fleet-wide owners' group.
- Issue resolutions benefit the long-term safe and economic operation of the ESBWR fleet.
- Human performance is restored before design margin is eroded

3.4.4 General Approach

The pilot changes to the standard design section ensures that the human performance requirements are maintained during the operating phase by allowing controlled, fleet-wide changes to the standard design which include response to:

- Obsolescence
- Operating events
- New technologies
- Changing expectations

Controlled variance from fleet-wide standard design, procedures, training, or monitoring methodologies (pilot changes) are made when flexibility is required to improve plant operation/safety. Once an issue or change is identified that impacts only a portion of the ESBWR fleet (therefore not warranting a change to the standard design) the scope and duration of the pilot change is determined. Pilot changes that have the potential to impact human performance are modeled into the FSS or hardware training platform to measure and evaluate the impact on human performance. When the evaluation shows that the pilot change provides enhancement to plant operation/safety, it is implemented in the pilot plant(s). While the pilot change is in effect, data is collected to assess its impact on operation/safety and human performance. This assessment may result in the following:

- Incorporating the pilot change into a change to the standard design per Section 4.3
- Expanding the pilot change scope to a larger portion of the ESBWR fleet
- Contracting the pilot change scope or duration
- Restoring the pilot plant to the fleet standard design as verified by testing

3.4.5 Application

The HPMIP:

- Identifies possible latent errors embedded in pilot changes to the standard design
- Determines how the standard design is modified
- Evaluates deviations in training evaluation results
- Assesses the impact of issues on the standard design

4. IMPLEMENTATION

The HPM plan executes the following four activities:

- Design implementation and testing
- Operation and monitoring
- Changes to the standard design
- Pilot changes to the standard design

4.1 DESIGN IMPLEMENTATION AND TESTING

4.1.1 Assumptions

- Design, training program, and operating procedures are common within the ESBWR fleet
- The design, training program, and operating procedures are developed and maintained through the HFE process
- A FSS is used to perform V&V of the HFE design, training program and operating procedures

4.1.2 Inputs

These sources include:

- Examination of OER documents
- Review of events in the integrated HFE Issue Tracking System
- Evaluation of HRA data sources and tools
- Criteria and bases used for the HFE V&V
- The fleet-wide owners' group charter
- Dynamic simulation of plant accident sequences
- Measurement and trending of operator performance and plant responses

4.1.3 Process

The following are HPM process options:

- The ESBWR licensee constructs the plant per the COL and standard design.
- The ESBWR licensee performs start-up testing.
- The fleet-wide owners' group evaluates start-up test results.
- The fleet-wide owners' group determines if a change to the standard design is recommended.
- If no changes to the standard design are recommended, then the ESBWR licensee operates the plant per Section 4.2, Operation and Monitoring.

- If standard design changes are recommended, then the fleet-wide owners' group processes the change per Section 4.3, Changes to the Standard Design.

4.1.4 Outputs

The HPM outputs include the following:

- Start-up and change test reports
- Training evaluation reports
- Identification and resolution of HFE issues
- Determinations to pursue fleet-wide and pilot changes to the standard design in the areas of:
  - Training
  - Procedures
  - Changes to HSI software
  - HSI hardware upgrades

4.2 OPERATION AND MONITORING

4.2.1 Assumptions

The HPM operations and monitoring assumptions include the following:

- Design, training program, and operating procedures are common within the ESBWR fleet
- Each licensee maintains a standardized and effective CAP
- Each licensee participates in the fleet-wide owners' group

4.2.2 Inputs

ESBWR licensee-monitored CAP includes the following inputs:

- Industry OER
- Simulator performance of critical tasks supporting the GDCs
- Maintenance Rule Program
- HRA/PRA updates
- In-Service Inspection/ In-Service Testing (ISI/IST) Program
- INPO/NRC inspection/evaluation results
- NRC and other regulatory initiatives

4.2.3 Process

The following includes the HPM process elements:

- The ESBWR licensee operates the plant per the COL.

- The ESBWR licensee monitors the plant and personnel performance during the operating phase.
- The ESBWR licensee determines the significance of operating events.
- The ESBWR licensee stores and trends operating event data.
- The ESBWR licensee determines the causes and circumstances surrounding the failure or degraded human performance.
- The ESBWR licensee illuminates the mode and effect of the nonconformance and develops appropriate CAs.
- The ESBWR licensee assesses the extent of condition (EOC) for plant and personnel deficiencies.
- The ESBWR licensee evaluates operating events, causes, and CAs to determine if the standard design is affected.
- The ESBWR licensee provides CAP reports, HFE issues, and operating trends that potentially impact the standard design to the fleet-wide owners' group.
- The fleet-wide owners' group evaluates issues that potentially impact the standard design.
- The fleet-wide owners' group determines if a change to the standard design should be pursued per Section 4.3, Changes to the standard design.
- The fleet-wide owners' group determines if a pilot change to the standard design should be pursued per Section 4.4, Pilot Changes to the standard design.

4.2.4 Outputs

Outputs include:

- Operating data, trends, and reports
- Training evaluation trends and reports
- Determinations to pursue fleet-wide and pilot changes to the standard design in the areas of:
  - Training
  - Procedures
  - Changes to HSI software
  - HSI hardware upgrades

4.3 CHANGES TO THE STANDARD DESIGN

4.3.1 Assumptions

- Design, training program, and operating procedures are common within the ESBWR fleet
- The standard design is developed through the HFE process

- A full scope simulator is used to perform the HFE V&V of the design
- Each licensee participates in the fleet-wide owners' group

4.3.2 Inputs

- Recommendation to pursue a standard design change
- OER data

4.3.3 Process

The changes to the standard design elements include:

- The fleet-wide owners' group evaluates issues that impact the standard design.
- The fleet-wide owners' group determines if a change to the standard design is recommended.
- The fleet-wide owners' group determines the type of change(s) to recommend from the following:
  - Staffing and Qualifications
  - Procedures
  - Training
  - Design Change
- The fleet-wide owners' group commissions GEH to perform a formal evaluation.
- GEH evaluates the request for change and determines if a change to the standard design is required.
- GEH prepares the change to the standard design, including a recommended implementation timeline.
- Changes are implemented and tested per Section 4.1, Design Implementation and Testing.

4.3.4 Outputs

The changes to the standard design outputs include:

- Standard design changes
- Design changes
- Procedure changes
- Training program changes
- Staffing and qualification changes

4.4 PILOT CHANGES TO THE STANDARD DESIGN

4.4.1 Assumptions

The following assumptions are pertinent to the pilot changes to the standard design:

- Design, training program and operating procedures are common within the ESBWR fleet
- The standard design is developed through the HFE process
- A FSS is used to perform the HFE V&V of the design
- Each licensee participates in the fleet-wide owners' group

4.4.2 Inputs

The pilot changes to the standard design require the following inputs:

- Recommendation to pursue a pilot design change
- OER data

4.4.3 Process

The pilot change to the standard design process includes the following elements:

- The fleet-wide owners' group evaluates issues that impact the standard design.
- The fleet-wide owners' group determines if a "pilot change" to the standard design is recommended.
- The fleet-wide owners' group determines the type, scope, and duration of the proposed pilot change to the standard design.
- The fleet-wide owners' group commissions GEH to evaluate the proposed pilot change.
- GEH performs analysis of proposed pilot change to the standard design.
- GEH determines if a pilot change to the standard design is required.
- GEH prepares the pilot change (including, evaluation and close out implementation timelines) and supports the proposed pilot change to the standard design through NRC review and approval.
- ESBWR licensee obtains NRC approval and implements pilot change(s) to the standard design.
- ESBWR licensee performs functional testing on pilot change(s).
- ESBWR licensee operates the plant and collects data per Section 4.2, Operation and Monitoring.
- The fleet-wide owners' group evaluates data from pilot plant(s).
- The fleet-wide owners' group recommends:
  - Applying the pilot change(s) fleet-wide per Section 4.3, Changes to the Standard Design

  - Continuing operation and monitoring with pilot change(s)
  - Restoring from pilot change to the standard design
- ESBWR Pilot Plant licensee(s) restores the pilot plant(s) design and facility to the standard ESBWR configuration.
- ESBWR Pilot Plant licensee(s) performs V&V testing to assure that the plant has been restored in accordance with the standard design.

4.4.4 Outputs

Pilot change to the standard design outputs include:

- Pilot changes to the standard design
- Pilot design changes
- Pilot procedure changes
- Training program pilot changes
- Staffing and qualification pilot changes

5. RESULTS

5.1 HPM RESULTS SUMMARY REPORT

The results of the HPMIP are summarized in the HPM result summary report. The report is the main source of information used to demonstrate that efforts conducted in accordance with the plan, satisfy the applicable review criteria of NUREG-0800. The report describes the HPM strategy including:

- The scope, structure, and provisions for specific cause determination, trending of performance degradation and failures, and CAs.
- The database to track activities and CAs.

5.2 PERIODIC REPORTS

- The ESBWR licensee provides operating data per Figure 2 in a timely manner to the fleet-wide owners' group.
- The fleet-wide owners' group publishes a periodic operating summary report (documenting ESBWR standard design issues, issue resolution, implementation status and operating results) no less frequently than bi-annually.
- GEH publishes an updated standard design report bi-annually incorporating all approved changes.
- The reporting frequencies above are the minimum requirements; frequencies are to be commensurate with the seriousness, scope, and urgency of the initiating event and/or issue(s).

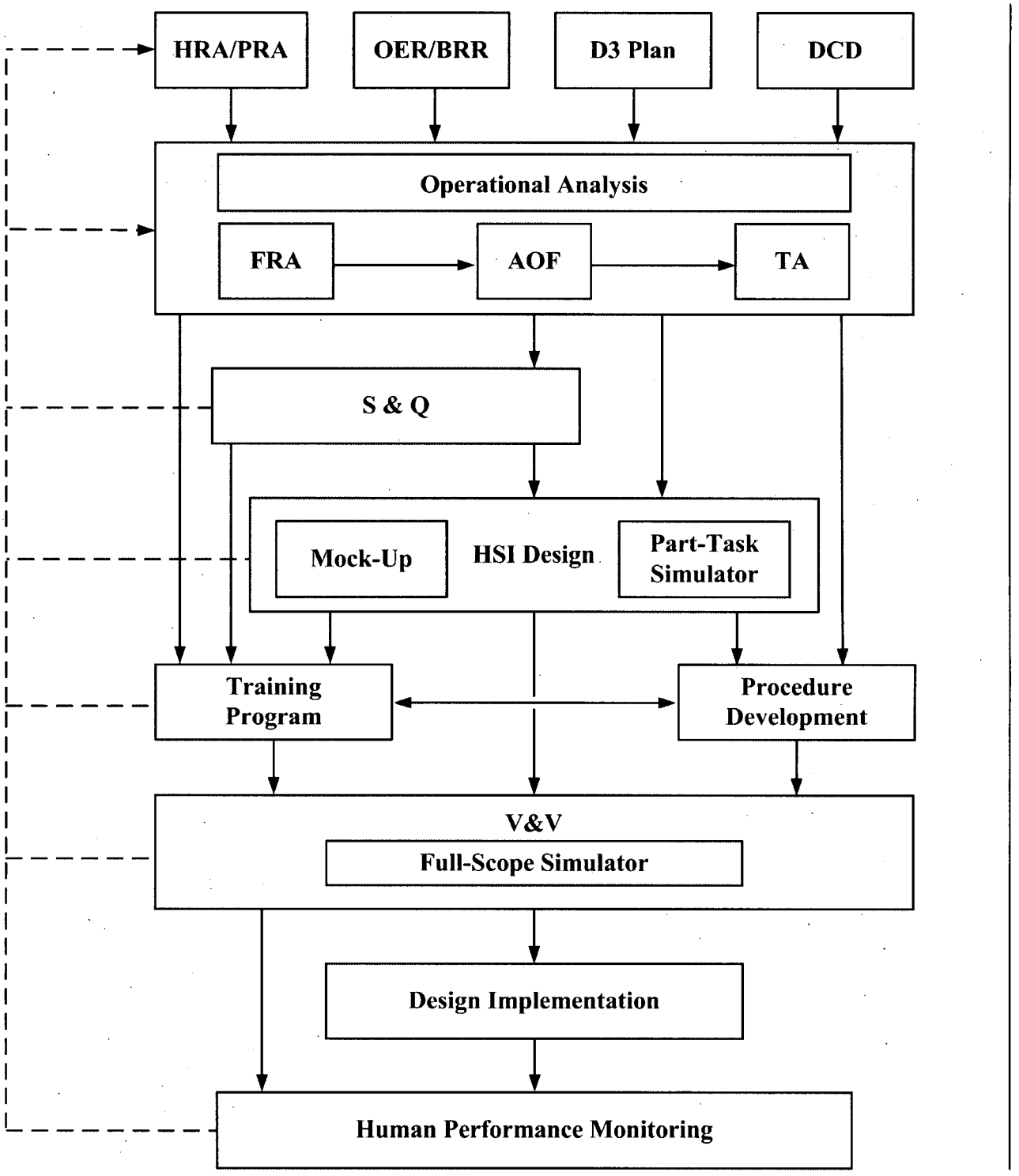

Figure 1 - HFE Implementation Process

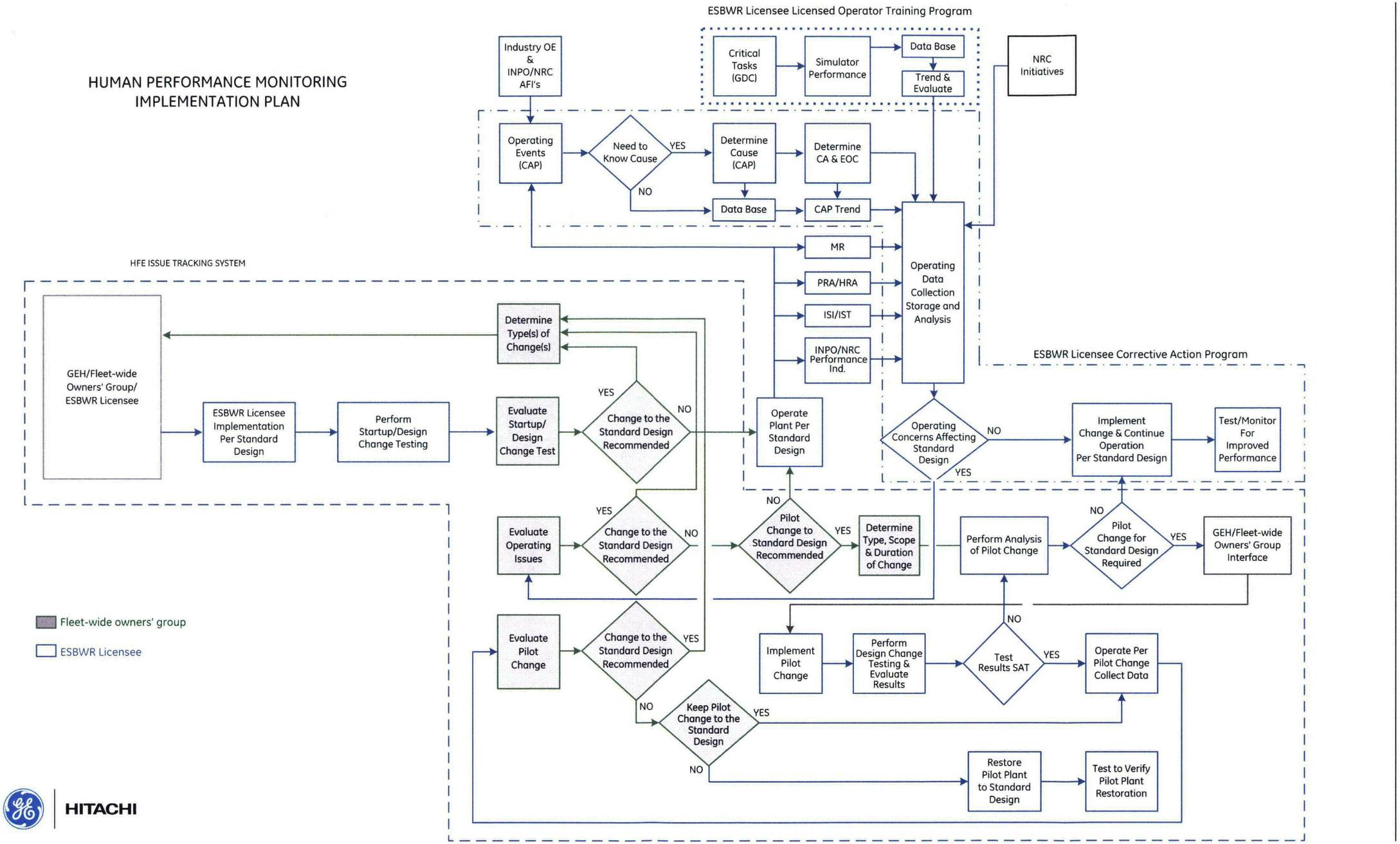

Figure 2 - Human Performance Monitoring Implementation Plan Flow Chart