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Subject: Submittal of Response to NRC Request Related to ESBWR Design Certification Application Chapter 18 - Human Factors Engineering - RAI Number 18.8-47 S03 – Minimum Inventory List and *ESBWR Design Comparison to BWROG EPG/SAG Revision 2*

The purpose of this letter is to submit a response to Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) 18.8-47 S03. Please note that this RAI supplement response is being submitted as committed to in the GEH response to RAI 18.8-47 S02.

The response to RAI 18.8-47 S02 was provided in Reference 1. Supplement 1 was provided in Reference 2 as requested by Reference 3. The original response to RAI 18.8-47 was provided via Reference 4 in response to NRC request (Reference 5).

Enclosure 1 contains GEH's response which includes the Minimum Inventory List. Additionally as requested, please find attached in Enclosure 2, the *ESBWR Design Comparison to BWROG EPG/SAG, Revision 2,* (Delta Document) for your review. This document is being submitted per our commitment to you in the telecom meeting with you on January 14, 2009.

D068
NRO

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

Sincerely,

Lee F. Dougherty for

Richard E. Kingston
Vice President, ESBWR Licensing

References:

1. MFN 08-859 - Submittal of Response to NRC Request Related to ESBWR Design Certification Application Chapter 18 - Human Factors Engineering RAI Number 18.8-47 S02, dated November 18, 2008
2. MFN 07-334 - Submittal of *"ESBWR DCD Chapter 18, Human Factors Engineering - RAI to DCD Roadmap Document"* dated June 27, 2007
3. Transmittal from AE Cubbage to DL Lewis, *List of Chapter 18 RAIs for Roadmap Request*, dated 5/18/07
4. MFN 06-443 - *Response to Portion of NRC Request for Additional Information Letter No. 71 – ESBWR Human Factors Engineering NEDO-33268, Rev. 1, Human-System Interface Design Implementation Plan – RAI Numbers 18.8-1 through 18.8-49*, dated November, 20, 2006
5. MFN 06-383 – Letter from Nuclear Regulatory Commission to David H. Hinds (GEH) "*Request for Additional Information Letter No. 71 Related to ESBWR Design Certification Application*", dated October 10, 2006

Enclosures:

1. MFN 09-024 – Submittal of Response to NRC Request Related to ESBWR Design Certification Application Chapter 18 - Human Factors Engineering - RAI Number 18.8-47 S03 – Proprietary Version
2. MFN 09-024 – *ESBWR Design Comparison to BWROG EPG/SAG, Revision 2*
3. MFN 09-024 - Markups for Response to RAI 18.8-47 S03 – Tier 1 - 2.3 HUMAN FACTORS ENGINEERING, Tier 2 - 18.1 OVERVIEW, Tier 2 - 18.5 TASK ANALYSIS

cc: AE Cubbage USNRC (with enclosure)
RE Brown GEH/Wilmington (with enclosure)
DH Hinds GEH/Wilmington (with enclosure)

eDRF 0000-0092-9324 (RAI 18.8-47 S03 response)
0000-0093-4723 (Delta Document)

Enclosure 1

MFN 09-024

Submittal of Response to NRC Request Related to ESBWR Design Certification Application Chapter 18 Human Factors Engineering

RAI Number

18.8-47 S03

NRC RAI 18.8-47 S03

***Note: No letter or email was received for this supplement. It is being internally generated to track the Minimum Inventory generation issue with the NRC. ***

RAI 18.8-47 S02 (MFN 08-859) stated:
"The next revision to this RAI will include the minimum inventory list and the associated proposed procedure changes to include this list and its development process description"

GEH Response

GEH has developed an ESBWR Minimum Inventory list. Background, context and regulatory interrelationship discussions are presented below (and are substantially similar to RAI 18.8-47 S02 discussions of the same subjects). The detailed process used to develop the ESBWR minimum inventory is provided in Attachment A. This process will be summarized in the Design Control Document (DCD). The minimum inventory list is provided in Attachment B. This list will be included in the DCD.

Changes to Licensing Topical Reports (NEDO-33221, "*ESBWR Human Factors Engineering Task Analysis Implementation Plan"* and NEDO-33268, "*ESBWR Human Factors Engineering Human-System Interface Design Implementation Plan*") will be addressed as a revision to the GEH response to RAI 18.5-27 and submitted as Supplement 03.

Background and Context

In the time that has passed since the GEH response to RAI 18.8-47 (SO1) was submitted to the NRC, a significant amount of industry and NRC discussion relating to minimum inventory has taken place. The primary vehicle for this interaction has been the NEI/NRC Task Working Group 5, which has been working on an industry document designed to provide a consistent process to develop minimum inventory.

Participation in the September 15, 2008 NRC TWG 5 public meeting at the NRC White Flint offices made it apparent that the industry minimum inventory process document would not be available in the near term and that the NRC required an ESBWR minimum inventory list in support of the plant design certification. As a result, GEH developed a process and implemented it in order to define the "minimum inventory of fixed alarms, displays, and controls, necessary for the operators to implement the emergency operating procedures, and to carry out those human actions shown to be important from the applicant's PRA"(SECY 92-053). The process presented in Attachment A is consistent with the current industry process as discussed with the Staff in NEI/NRC TWG 5 meetings.

Regulatory Overview and Interrelationships

Background: Applicable portions of SECY 92-053, RG 1.97 Rev 4, NUREG 0800 Rev 0, and NUREG 0711 Rev 2 and how they are addressed:

1. SECY 92-053 provides for the use of Design Acceptance Criteria (DAC) during 10 CFR Part 52 design certification reviews. One of the areas of DAC usage addressed is control room design. The SECY allows for plant design certification to take place without a completed control room design, so long as a minimum inventory of alarms, displays, and controls is included in the design certification. The "minimum inventory of fixed alarms, displays, and controls, necessary for the operators to implement the emergency operating procedures, and to carry out those human actions shown to be important from the applicant's PRA" is established via the minimum inventory development process presented in this document. "The second part of the staff's review will utilize DAC to ensure the implementation of a systematic approach to the incorporation of human factors principles in completing the design of operator workstations in the control room" and will be completed in accordance with the processes presented in ESBWR Design Control Document (DCD) Chapter 18. It should be noted that inclusion in the Minimum Inventory list does not supplant Chapter 18 processes for a given human-system interface (HSI). All ESBWR control room, remote shutdown system (RSS), and risk important local control stations' HSIs are subject to the human factors engineering (HFE) processes documented in DCD Chapter 18.

2. Regulatory Guide 1.97 Revision 4 and the IEEE Std 497-2002 it endorses (subject to some regulatory positions) are post accident monitoring guidance documents. These documents provide guidance for selecting, categorizing, and assigning design requirements to key accident monitoring variables.
IEEE Std 497-2002 Introduction states that: "Accident monitoring variable selection must be consistent with the plant specific emergency operating procedures (EOPs) and abnormal operating procedures (AOPs). The variables selected from these procedures need to be the minimum set to assess that safety-related functions are performed and safety systems operate acceptably. Also, instrumentation for shutdown from outside the main control room (i.e., remote shutdown) is outside the scope of this standard."
Information characteristics guidance implemented during detailed design includes:

   - Selection criteria defining 5 variable types ultimately used to assign design characteristics. "Type A is accident specific and needed for preplanned operator action, Type B and Type C allow a supervisory overview approach to accident monitoring by allowing a review of critical high level safety functions, Type C additionally allows extended range monitoring of defense-in-depth variables. Type D and Type E allow monitoring of performance of appropriate safety and radiation monitoring systems."

- "The basis for display characteristics for accident monitoring variables shall include the results of an analysis of the system functions required to respond to an accident and analysis of the tasks required of the operator to implement those functions during design basis events. Display characteristics shall be identified that include, as a minimum; range, instrument accuracy, precision, display format (e.g., status, value, or trend), units, and response time."

Regulatory Guide 1.97's focus is fundamentally different from that of SECY 92-053 in that it focuses on the execution of the detailed control room design process. The Regulatory Guide specifies accident monitoring instrument selection criteria and assigns design requirements that the detailed design process must accommodate. By contrast, the SECY 92-053 minimum inventory precedes the detailed design process. The two concepts significantly overlap in the area of variable selection but SECY 92-053 minimum inventory culminates in design certification while Regulatory Guide 1.97 & IEEE 497 guide the detailed design process and culminate in final design.

3. NUREG 0800 Revision 0 Section 14.3.9 (March, 2007 revision) and Chapter 18 provide the review requirement that DCD "Tier 1 includes a minimum inventory of displays, controls, and alarms that are necessary to carry out the vendor's emergency procedure guidelines (i.e., Owners' Groups Generic Technical Guidelines) and critical actions identified from the applicant's PRA and task analysis of operator actions." These review requirements establish the scope of the minimum inventory development process presented in this document.

4. NUREG 0711 Revision 2 provides guidance intended to ensure that applicant's detailed design processes are conducted in accordance with accepted HFE practices and guidelines. Aspects of 0711 Rev 2 relevant to the process presented in this document include:

   - "The task analysis results should be used to define a minimum inventory of alarms, displays, and controls necessary to perform crew tasks based on both task and instrumentation and control requirements."

     The minimum inventory development process presented in this document governed the function and task analysis performed to define the ESBWR minimum inventory of alarms, displays, and controls. The process performed function / task analysis of the ESBWR Design Comparison to BWROG EPG/SAG Rev 2 and the risk important human actions identified in the ESBWR PRA. Analysis of these tasks and the information and controls required to successfully complete them determined the alarms, displays, and controls included in the ESBWR minimum inventory list.

- "The HFE aspects of the plant should be developed, designed, and evaluated based on the basis of a structured analysis using accepted HFE principles." This top-down process is a fundamental part of the ESBWR design process as described in ESBWR DCD Rev 5 Chapter 18. As was stated above: all ESBWR control room, remote shutdown system (RSS), and risk important local control stations' HSIs are subject to the human factors engineering (HFE) processes. During detailed design, all applicable HSIs (including those within the scope of SECY 92-053 and Regulatory Guide 1.97 Rev 4) will be subject to this rigorous analysis.

  The top-down HFE analysis process works in conjunction with all other applicable guidance and regulatory requirements to specify the content, layout, function, and other detailed design requirements of the HSI analyzed.

In summary, the selection of the minimum inventory of HSIs and their designation as alarm, display, or control has been completed prior to, and in support of, design certification (consistent with SECY 92-053). Content, presentation, and level of detail is in keeping with precedent as documented in the minimum inventory listings contained in the DCDs of the ABWR and AP-1000. Detailed analysis and design (performed in accordance with the ESBWR DCD and applicable regulatory guidance and requirements, including NUREG 0711) formally categorizes HSIs within the scope of Regulatory Guide 1.97 and assigns the detailed design requirements to all HSIs. Completion of these detailed design requirements are reviewed by the Staff in accordance with NUREG 0800.

DCD Impact

DCD Tier # 1, Section 3.3 will be revised as noted in the attached markup.

DCD Tier # 2, Section 18.1 and 18.5 will be revised as noted in the attached markup

Attachment A

OVERVIEW

In support of ESBWR design certification, GEH submits the "minimum inventory of fixed alarms, displays, and controls necessary for the operators to implement the emergency operating procedures, and to carry out those human actions shown to be important from the applicant's PRA"(SECY 92-053). This document presents a minimum inventory derivation process consistent with the current industry process as discussed with the Nuclear Regulatory Commission (NRC) in Nuclear Energy Institute / NRC - Task Working Group 5.

This document presents the methodology used to determine minimum inventory Human System Interfaces (HSIs) for the Main Control Room (MCR) and Remote Shutdown System (RSS).

The minimum inventory of alarms, displays, and controls encompasses those Human System Interfaces (HSIs) that are needed to:

- Implement the ESBWR Emergency Operating Procedures (EOPs)
- Perform the risk important human actions specified in the ESBWR Probabilistic Risk Assessment (PRA)

The minimum inventory task analysis, identification, and documentation process is performed independent of the operational analysis process presented in NEDO-33217, "ESBWR Man-Machine Interface System And Human Factors Engineering Implementation Plan" Rev 4. Additional design details and requirements are assigned to the minimum inventory HSIs during the Task Analysis Process presented in NEDO-33221, "ESBWR Human Factors Engineering Task Analysis Implementation Plan" Rev 2.

Attachment A

ESBWR Minimum Inventory

The HFE design team applies the criteria and logic presented in this plan during the minimum inventory development process to select minimum inventory HSIs.

Assumptions

ESBWR minimum inventory development process assumptions includes:

- Minimum Inventory HSI is defined as the fixed alarms, displays, and controls necessary for the operators to implement the emergency operating procedures, and to carry out those human actions shown to be important from the PRA.
- The minimum inventory development team, with the support of other engineering staff, performs the analysis and documentation activities described in this plan, and manages the activity through verification. The minimum inventory development team is comprised of personnel with experience in at least the following areas:
    - Plant operations
    - Plant procedure development and implementation
    - EOP/SAG development and implementation

  The duties of the minimum inventory development team are to establish and perform the activities as defined in this plan
- The ESBWR design basis provides the events used to determine the minimum inventory of alarms, displays, and controls
- The ESBWR is designed to operate with a high degree of automation so as to minimize the need for operator action in response to design basis events. All ESBWR automatic actions function as designed
- The majority of operator actions in both the MCR and the RSS employ software based alarms, displays, and controls
- Fixed position alarms, displays, and controls are available at a fixed location (or locations) but are not necessarily continuously displayed
- Fixed position alarms, displays, and controls that are not continuously displayed are quickly and easily retrievable, typically accessible by one operator action ("one touch accessible")
- An alarm is a visual or audible cue designed to capture an operator's attention and communicate information of a cautionary or warning nature that alerts the operator to the need to take manual actions or verify automatic actions. ESBWR minimum inventory alarms may consist of a visual cue, audible cue, or both

- An event resulting in the evacuation of the MCR is not expected to occur in conjunction with any other design basis event. The RSS provides the capability to achieve and maintain safe, stable shutdown conditions with the ESBWR systems functioning as designed
- The ESBWR can be maintained in safe, stable shutdown for an indefinite period using passive safety systems. ESBWR technical specifications recognize "Stable Shutdown Mode" as an acceptable safe shutdown condition with plant temperatures below 215.6 degrees C (420 degrees F)
- For the purpose of determining the RSS minimum inventory, operators successfully scram the reactor prior to leaving the MCR (ESBWR Design Control Document (DCD) Chapter 15 MCR evacuation analysis).

Inputs

ESBWR minimum inventory inputs include:

- BWROG EPG/SAG Rev 2 (*BWROG EPG*)
- ESBWR Design Control Document Rev 5 (*ESBWR DCD*)
- ESBWR Design Comparison to BWROG EPG/SAG Revision 2 (*ESBWR delta doc*)
- AP-1000 and ABWR minimum inventory lists as presented in their DCDs
- The ESBWR PRA revision 3, risk important human actions as documented in *ESBWR DCD* Chapter 19, Table 19.2-3

Process

The following paragraphs describe the detailed and comprehensive process by which the functions and tasks "necessary for the operators to implement the emergency operating procedures, and to carry out those human actions shown to be important from the applicant's PRA" are broken down into elements (discrete task, action, or function). Also presented is the process by which these elements are analyzed through task analysis to determine what HSIs (alarms, displays, and controls) need be present to provide for their successful completion.

The ESBWR HFE operational analysis process described in *ESBWR DCD* Chapter 18 is designed to be a multi-step process that implements the guidance contained in NUREG 0711, Rev 2. The ESBWR minimum inventory development process steps presented below carry out a similar analysis but do so using different mechanisms and focus upon HSI variables at the parameter level; no set points or decision point values are specified. In general, the process steps below take credit for the functional analysis, allocations, and task sequence determinations performed or specified during the performance of the ESBWR PRA and the development of the *ESBWR delta doc.*

Attachment A

Functional Requirements Analysis

ESBWR delta doc- Functional Analysis:

Substantial industry functional and task analysis over many years has gone into the creation of the *BWROG EPG* document. This analysis has resulted in the high level emergency operating procedure guidelines that are applied by industry BWRs.

The detailed plant design required to draft an ESBWR specific EPG was not complete at the time minimum inventory HSIs was to be specified. Because of this, the *BWROG EPG* strategies, steps, and actions were evaluated in the context of the ESBWR plant and systems design and operating strategies as documented in the *ESBWR DCD*. This analysis culminated in the development of the *ESBWR delta doc* that demonstrates (at a high level) how EPG strategies will be implemented in the ESBWR. This document is at the parameter level; no set points or decision point values are included.

Within each section, *BWROG EPG* steps are replicated, and the differences between the *BWROG EPG*'s and ESBWR design are discussed in a paragraph associated with the step. Where the ESBWR design and operating strategies are similar to the designs that formed the basis for the *BWROG EPG*, the BWROG guidance was implemented as recommended. Where the ESBWR design or operating philosophy differs from the *BWROG EPG* basis reactors, a comparison between the BWROG guidance and ESBWR implementation was performed and the basis for any differences is presented. The SAG strategies are not required for the development of minimum inventory, and were not encompassed by this document.

Every step and caution in the *BWROG EPG* was addressed such that the *ESBWR delta doc* constitutes a complete picture of how ESBWR specific EPGs and the ESBWR Emergency Operating Procedures will ultimately be written. Because of this completeness, the *ESBWR delta doc* constitutes a valid analytical tool for the derivation of the ESBWR minimum inventory.

The process used to develop the *ESBWR delta doc* is a functional analysis linking the strategy and task guidance contained in the BWROG document with the design specifics and system capabilities of the ESBWR.

The *ESBWR delta doc* produced from this analysis describes each of the elements for which task analysis will determine minimum inventory HSI requirements.

PRA Risk Important Human Action - Functional Analysis:

Using the analytical approach presented in *ESBWR DCD* Chapter 19, design basis accidents, event strategies, sequences, steps, and actions were evaluated. Any human actions included in these sequences were analyzed in the context of the ESBWR plant and systems design and operating strategies to determine error probabilities and consequences. Using the ranking methodologies and cutoff criteria presented in Chapter 19, risk important human actions were identified. The operator actions having the highest risk importance as determined by the ESBWR PRA were documented in the *ESBWR DCD*, Table 19.2-3.

Attachment A

The process used to identify risk important human actions is an analytical functional analysis linking the ESBWR operating and accident mitigation strategies with the specific design and system capabilities of the ESBWR. Those human actions determined to be risk important constitute the elements for which task analysis will determine minimum inventory HSI requirements.

Task Analysis and HSI Requirements Determination

Task analysis processes the function and task elements assigned to operators (input into this process in the form of the *ESBWR delta doc* and the ESBWR PRA risk important human actions) to determine what alarms, displays, and controls are needed to meet plant design goals and requirements.

Analysts evaluate operator MCR actions within the context of the *ESBWR delta doc* and PRA identified risk important human actions to identify, prioritize, and organize plant and system tasks. RSS operator actions are evaluated within the context of the design basis MCR evacuation scenario and assumptions contained in the *ESBWR DCD*. The analysis context attributes provided by these documents include:

- System function priorities
- Direction for user focus
- Plant and system task sequences
- Task conditions, priorities, sequences, and initiation relationships
- Successful task completion criteria

Through analysis team review, each element is analyzed in the context of the strategy or event sequence of which it is part. The purpose of the sequence containing an element provides the context within which an element is performed. Analysts use this context to help determine the HSIs needed to ensure successful completion of the element. Differing combinations of alarms, displays, and/or controls may be assigned depending upon whether the analyzed element's emphasis is upon alerting, monitoring, diagnosing, and/or operating equipment in response to an event.

During the task analysis of the elements described above, minimum inventory HSIs are designated if they meet the following selection criteria:

- HSIs that provide for the implementation of the Emergency Operating Procedures (as presented in the *ESBWR delta doc*)
    - HSIs that provide for the performance of safety-related functions to respond to design basis events for which there is no automatic control
    - HSIs that provide for assessing, accomplishing, or maintaining safety functions and safe shutdown conditions
    - HSIs that provide dedicated safety system actuation such as reactor scram, MSIV isolation, and ATWS response initiation

- HSIs that provide for the performance of risk important human actions as identified in the ESBWR PRA
- HSIs that provide for achieving and maintaining safe, stable shutdown from the RSS following a design basis MCR evacuation event.

Using the *ESBWR delta doc*, analysts evaluate each human action within the context of the task sequence containing it (for example: an implementation action analysis considers the goals of the strategy being implemented and any preceding steps). During the analysis consideration is given to HSIs needed to prompt action, support any decision-making imbedded in the action, perform the action, and monitor plant response to the action.

Where appropriate, analysts combine alarms, displays, and controls at high levels while still meeting HSI needs identified during task analysis. For example, analysts might specify reactor water level indication and/or alarm as a minimum inventory HSI in lieu of individual flow indications for each injection system.

Minimum inventory HSIs may be identified in any of the following areas of EOP implementation, PRA risk important human actions, or remote shutdown manual actions:

- Cues supporting manual actions:
  - Plant-level prompting indications
  - Plant-level prompting alarms
  - System-level or component prompting indications
  - System-level or component prompting alarms
  - Component controls and immediate feedback indications
  - System-level or component performance indicators
  - System-level or component performance alarms
- Monitoring of safety functions, manual backup actions, and manual actions
  - Plant-level indications of the status of safety functions
  - Plant-level alarms indicating challenges to safety functions
  - Indications of the status of fission product barriers
  - Alarms on fission product barriers
  - System-level indications of the status of safety functions
  - System-level alarms indicating challenges to safety functions
  - System-level or component indications related to safety system operation
  - Alarms on safety system operation

- Indications of safety system actuation status
- Alarms on safety system actuation failures
- Manual system-level actuation controls
- Manual component controls

- Perform additional post-accident monitoring
  - Plant-level indications
  - Plant-level alarms
  - System-level and component indications
  - System-level and component alarms

Minimum inventory analysis considerations are:

- HSIs needed to support decision making
  - Determine if there are any imbedded decisions
  - Determine the type of decision required and the data to be analyzed to make the decision
  - Determine what supporting information is needed
  - Determine the minimum inventory information required for the performance of each decision task
- HSIs needed to support plant manipulations
  - Determine what plant manipulation tasks are required.
  - Determine the minimum inventory HSI required for performing the task
- HSIs needed to support monitoring task success criteria
  - Determine what criterion demonstrates the successful completion of the task
  - Identify the alarms, displays, and/or controls that must be present to provide the information operators will measure against the criteria
  - Determine the minimum inventory information required for monitoring the success of each task
- How the variable is to be presented to operators for each of the tasks determined above
  - Alarms
    - Determine what alarms associated with the task being analyzed need to be incorporated into minimum inventory HSIs to support

performance or identify system and plant parameters operating outside expected range using the following criteria:

- Alarms should be used to alert the operator regarding abnormal or degrading conditions that require the operator response

- Document any minimum inventory alarms needed to supply the operator alerts required for each task

- Displays
  - Determine what information is necessary during task performance
  - Determine what abort criteria is applicable to the task (if any) and what information is needed to assess task performance against the abort criteria
  - Determine the parameters or conditions that would indicate that the end state (or objective) of the task has been accomplished and is functioning as intended
  - Determine the parameters or conditions that would indicate that the end state (or objective) of this activity is achieving the desired results
  - Determine the parameters or conditions that would indicate that the end state (or objective) of this activity is no longer needed and can be terminated
  - Document any minimum inventory displays needed to supply the plant information required for each task
- Controls
  - Determine what controls are necessary for task performance
  - Determine how the above control is provided (specific component control, high level system control, etc)
  - Document any minimum inventory controls needed to perform each task

ESBWR minimum inventory HSIs are documented in a table that lists the parameter and whether the associated HSI consists of an alarm, display, and/or control.

Attachment A

Comparison With Industry Precedent for Scope and Level of Detail

The HSI list created using the process above is compared to the minimum inventory lists contained in the public DCDs of the AP-1000 and ABWR. This analysis compares the HSI list with specific industry precedent to identify differences in scope and level of detail. This comparison ensures that the ESBWR minimum inventory listing captures a similar general scope and level of detail as is contained in the DCDs for the two comparison certified designs.
Item by item comparison is not undertaken due to physical design differences between the reactors (PWR vs BWR, Active BWR vs Passive BWR, etc) and their operating strategies (event based versus symptom based EOPs, etc).

Internal Instrumentation & Controls and Customer Review

Engineering product reviews are conducted in accordance with internal GEH engineering procedures and the following discussion is intended to provide insight into this process rather than override or supplant it.
Reviews are formal adequacy evaluations that are performed by knowledgeable persons other than those directly responsible and accountable for the engineering product.

The Instrumentation and Controls (I&C) and customer reviews of this document are used to evaluate the following for adequacy:

- ESBWR minimum inventory development process
- Minimum inventory selection criteria and compliance with regulatory requirements
- Consistency with industry precedent
- ESBWR minimum inventory list

Additionally, the ESBWR minimum inventory review is used to verify that the product and associated documentation meets customer requirements.
The ESBWR minimum inventory list and associated documentation is judged to be adequate when at least the following criteria have been met:

- The EBSWR minimum inventory list is complete and final
- The MCR minimum inventory HSIs meet the requirement to support both EOP implementation and successful completion of PRA risk important human actions
- The RSS minimum inventory HSIs meet the requirement to support achieving and maintaining safe, stable shutdown following a MCR evacuation

Attachment A

Resolution of Comments

Minimum inventory development analysts incorporate changes, as necessary, to the ESBWR minimum inventory based on feedback and comments from the review team members. The analysts resolve any questions and/or concerns with adequate resolution.

Verification of Minimum Inventory List

The ESBWR minimum inventory will undergo formal verification in accordance with GEH internal engineering department verification procedures and the following discussion is intended to provide insight into this process rather than override or supplant it. Verifiers in both the I&C and HFE branches of the ESBWR engineering department verify the content and correctness of the ESBWR minimum inventory list. Verifiers will use the *ESBWR delta doc*, the ESBWR design as documented in *ESBWR DCD*, and PRA analysis results (specifically, the risk important human actions identified in the *ESBWR DCD* Table 19.2-3) as basis documents. Using these basis documents, verifiers will ensure that the ESBWR minimum inventory correctly identifies the minimum inventory HSIs as described in SECY 92-053.

Items requiring verification include, but are not limited to:

- Design output
    - The minimum inventory HSIs meet the requirement to support both EOP implementation and successful completion of PRA risk important human actions
    - The RSS minimum inventory HSIs meet the requirement to support achieving and maintaining safe, stable shutdown following a MCR evacuation
- Documents
    - ESBWR minimum inventory development process
    - ESBWR minimum inventory list is complete and final

Outputs

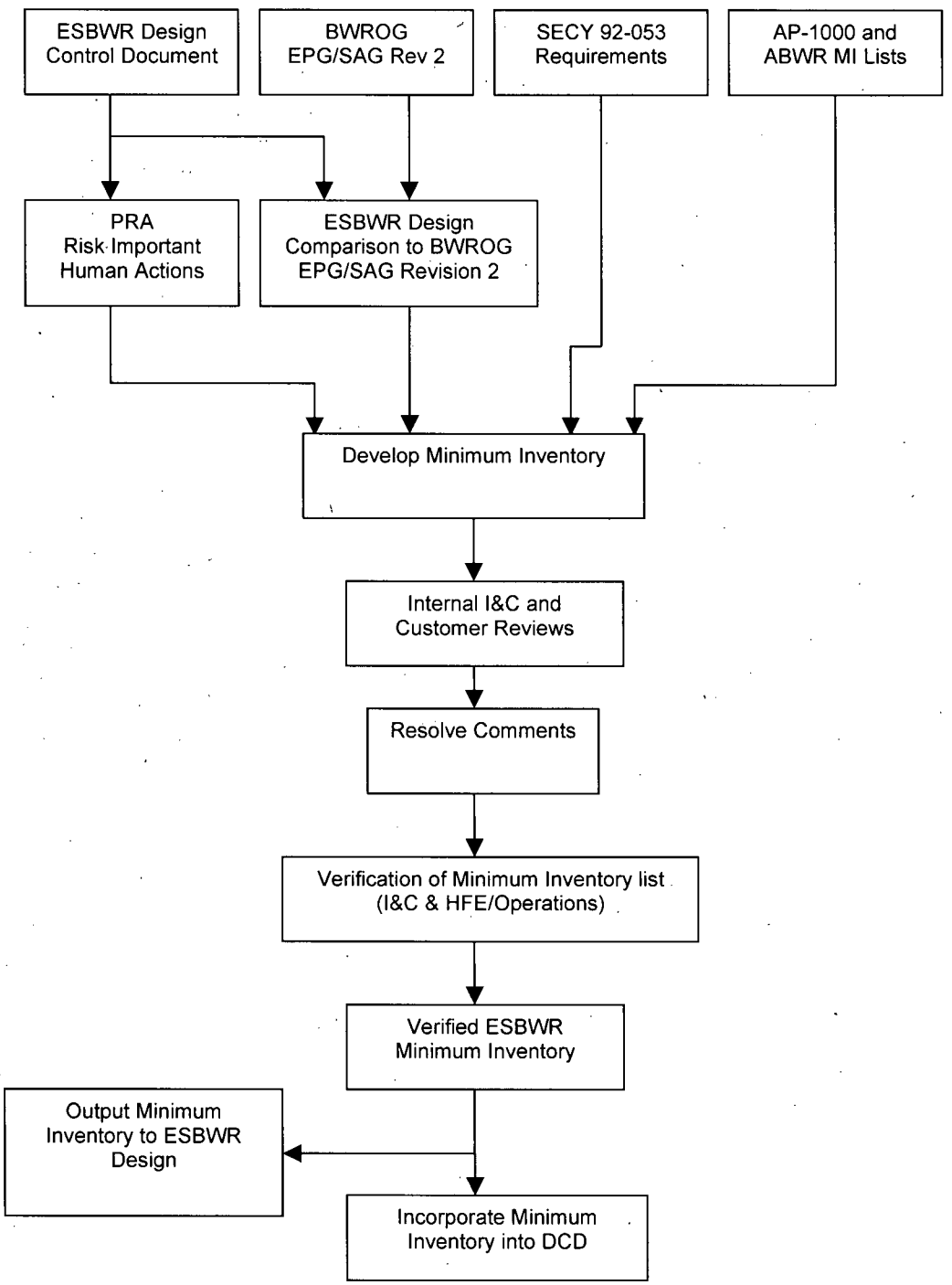
The ESBWR minimum inventory development process produces the ESBWR minimum inventory of alarms, displays, and controls document.

ESBWR Minimum Inventory of Fixed Alarms, Displays, and Controls

This document presents the ESBWR "minimum inventory of fixed alarms, displays, and controls necessary for the operators to implement the emergency operating procedures, and to carry out those human actions shown to be important from the applicant's PRA"(SECY 92-053). Additionally, it presents the minimum inventory of alarms, displays, and controls that must be incorporated into the RSS to support achieving and maintaining safe, stable shutdown following design basis MCR evacuation. The document is presented in a table format and provides a brief descriptor for each variable and identifies if an alarm, display, and/or control is required.

Attachment A

Figure 1: ESBWR Minimum Inventory Development Process



Attachment B

Minimum Inventory of MCR Alarms, Displays, and Controls

Description	Alarm	Display	Control
Reactor Power	X	X	
Reactor Pressure	X	X	
Reactor Water Level	X	X	
Containment Water Level		X	
Suppression Pool Level	X	X	
Average Drywell Temperature	X	X	
Suppression Pool Bulk Average Temperature	X	X	
Drywell Pressure	X	X	
Wetwell Pressure		X	
Containment Isolation Valves		X	X
Containment Radiation		X	
Drywell Hydrogen Concentration	X	X	
Wetwell Hydrogen Concentration	X	X	
Drywell Oxygen Concentration	X	X	
Wetwell Oxygen Concentration	X	X	
Isolation Condenser Valves		X	X
Isolation Condenser Pool Level	X	X	
Shutdown Cooling Initiation			X
Passive Containment Cooling Pool Level	X	X	
Gravity Driven Cooling Pool Level		X	
Gravity Driven Cooling Injection Valves		X	X
Gravity Driven Cooling Equalization Valves		X	X
Reactor Scram	X	X	X
Main Steam Isolation	X	X	X
Main Steam Relief Valves		X	X
Standby Liquid Control Accumulator Level		X	
Standby Liquid Control Initiation			X
Standby Liquid Control Accumulator Isolation Valves	X	X	X
Automatic Depressurization System Inhibit	X		X
Depressurization Valves (DPV)		X	X

Attachment B

Minimum Inventory of MCR Alarms, Displays, and Controls

Description	Alarm	Display	Control
Containment High Pressure Nitrogen Status	X		
Reactor Building Area Temperature High	X		
Reactor Building Ventilation Exhaust Radiation High	X	X	
Reactor Building Area Radiation High	X		
Reactor Building Area Water Level High	X		
Reactor Building Ventilation Isolation		X	X