South Carolina Electric & Gas Company

NND-13-0537

Enclosure 5

Virgil C. Summer Nuclear Station (VCSNS) Units 2 and 3

APP-OCS-GEH-522, "AP1000 Plant Startup Human Factors Engineering Design Verification Plan" Revision 2

(LAR 13-19)

Westinghouse

Westinghouse Non-Proprietary Class 3

AP1000

Plant Startup Human Factors Engineering Design Verification Plan

APP-OCS-GEH-522,
Rev. 2

August 2013

APPROVALS

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REVISION HISTORY

RECORD OF CHANGES

Revision	Author	Description	Completed
A	Ruiqi Ma	Preliminary Issue	05/2009
B	Ruiqi Ma	Added scope under Section 1.2.2. Added clarification on the responsibility of potential identified issues or discrepancies during the plant startup HFE design verification under Section 2. Made minor changes on the revision of the references. Added proprietary markings.	06/2010
0	Zhonghai Li	Incorporation of APP-GW-GEE-4259, Rev. 0. Numerous updates to the References and Bibliography in accordance with latest documents and revisions. "Glossary of Terms": Changed definition of Independent Verifier. Subsection 1.1.3, "Process Strategy": Clarified that verification may begin once plant construction is complete and equipment is installed, although some activities will need testing and preparations for plant startup to be underway. Subsection 1.2.2, "List of Design Features Requiring Verification": In item 1, deleted TSC and Radioactive Waste Control Area, plus changed local control stations to local control areas. In item 2, clarified that the scope is as defined by the scope of the HFE V&V activities. In item 3, changed "HFE design issue tracking database" to "Human Factors Tracking System" (and in other sections). In item 4, added the local risk-important action to deactivate the PMS division involved in the fire, and added a reference to APP-OCS-GLR-001, "AP1000 Post-Accident Risk-Important Human Actions Summary Report." Section 2, "Verification Process": Changed the wording for HED resolution in the last paragraph and moved the last sentence to the beginning of Section 3.1.	03/2013

REVISION HISTORY (cont.)

RECORD OF CHANGES (cont.)

Revision	Author	Description	Completed
0 (cont.)	Zhonghai Li	Section 3.1, "Personnel Requirements and Techniques": Changed "HFE verifier" to "HFE specialist" to be line with current organizational structure. Clarified that the scope covers design, operating procedures and training information.	03/2013
1	Zhonghai Li	Incorporation of APP-OCS-GEF-061, Rev. 0. Corrected a typographical error in Section 1.1.3. Note: An alternate document number is APP-OCS-GEH-520 (proprietary version)	5/2013
2	Zhonghai Li	Incorporation of APP-GW-GEE-4523, Rev. 0. Updated document revision numbers in the Bibliography. Section 1.2.3, "Limitation of Scope": Clarified that the Technical Support Center (TSC) and Emergency Operations Facility (EOF) are not within the scope of plant startup HFE design verification. Note: An alternate document number is APP-OCS-GEH-520 (proprietary version)	See EDMS

DOCUMENT TRACEABILITY & COMPLIANCE

Created to Support the Following Document(s)	Document Number	Revision
AP1000 Human Factors Engineering Program Plan	APP-OCS-GBH-001	1

OPEN ITEMS

Item	Description	Status
None.		

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ACRONYMS AND TRADEMARKS

Acronyms used in the document are defined in APP-GW-J9Y-001 (WNA-PS-00016-GEN), "Standard Acronyms and Definitions" (Reference 1), or included below to ensure unambiguous understanding of their use within this document.

Acronym	Definition
HF	Human Factors
MTIS	Maintenance, Test, Inspection and Surveillance
PMS	Protection and Safety Monitoring System

GLOSSARY OF TERMS

Standard terms used in the document are defined in APP-GW-J9Y-001, "Standard Acronyms and Definitions" (Reference 1), or included below to ensure unambiguous understanding of their use within this document.

Term	Definitions
Historical Review	Historical review is most useful for evaluating issues related to system effectiveness in the real setting where the system performance can be evaluated during testing, startup and operation. This technique involves the examination of historical records related to the performance of systems that are identical or similar to the system under evaluation.
Human Engineering Discrepancy	A departure of the AP1000® design from Human Factors Engineering (HFE) design guidance and/or human performance criteria as identified during the execution of HFE verification and validation activities.
Independent Verifier	Any competent individual(s) or group(s) other than those who performed the original design work, but who may be from the same organization or group.
Physical Measurement Techniques	Where appropriate control room environments exist, physical measurements can be taken in relation to key features, including lighting, thermal conditions, acoustics, etc. These measurements are then compared to environment and design specifications.
Walk-Through/Talk-Through	The walk-through/talk-through technique is the most widely used observation technique. The technique consists of having potential users of the system under test "walking and talking through" (in the sense of physically showing and verbally describing) one or more of the tasks that will be done using the system when it is operational.

REFERENCES

Following is a list of references used throughout this document.

1. APP-GW-J9Y-001, Rev. 0 (WNA-PS-00016-GEN, Rev. 5), "Standard Acronyms and Definitions," Westinghouse Electric Company LLC. (Proprietary)

2. APP-OCS-GBH-001, Rev. 1, "AP1000 Human Factors Engineering Program Plan," Westinghouse Electric Company LLC. (Proprietary)

3. APP-OCS-GEH-020, Rev. 2 (WCAP-15860), "Programmatic Level Description of the AP1000 Human Factors Verification and Validation Plan," Westinghouse Electric Company LLC.

4. NUREG-0711, Rev. 2, "Human Factors Engineering Program Review Model," U.S. Nuclear Regulatory Commission.

5. ISO 11064-7, First Edition, "Ergonomic Design of Control Centers, Part 7: Principles for the Evaluation of Control Centers," International Organization for Standardization.

BIBLIOGRAPHY

Following is a list of sources that were considered in preparing this document, or that provide additional information.

1. APP-OCS-J1-002, Rev. 2, "AP1000 Human System Interface Design Guidelines," Westinghouse Electric Company LLC. (Proprietary)

2. APP-GW-GRP-001, Rev. 1, "AP1000 Local Panels and Maintainability Human Factors Design Guidelines," Westinghouse Electric Company LLC. (Proprietary)

3. APP-OCS-GEH-120, Rev. 1, "AP1000 Human Factors Engineering Design Verification Plan," Westinghouse Electric Company LLC. (Proprietary)

4. APP-OCS-GEH-220, Rev. 1, "AP1000 Human Factors Engineering Task Support Verification Plan," Westinghouse Electric Company LLC. (Proprietary)

5. APP-OCS-GEH-320, Rev. 3, "AP1000 Human Factors Engineering Integrated System Validation Plan," Westinghouse Electric Company LLC. (Proprietary)

6. APP-OCS-GEH-420, Rev. 2, "AP1000 Human Factors Engineering Discrepancy Resolution Process," Westinghouse Electric Company LLC. (Proprietary)

7. APP-GW-GL-011, Rev. 0, "AP1000 Identification of Critical Human Actions and Risk Important Tasks," Westinghouse Electric Company LLC.

8. APP-OCS-GLR-001, Rev. 0, "AP1000 Post-Accident Risk-Important Human Actions Summary Report," Westinghouse Electric Company LLC. (Proprietary)

9. APP-OCS-GGR-110, Rev. 1, "AP1000 Technical Support Center and Emergency Operations Facility Workshop," Westinghouse Electric Company LLC. (Proprietary)

10. NUREG-0654, Rev. 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," U.S. Nuclear Regulatory Commission, March 2002.

11. NUREG-0696, "Functional Criteria for Emergency Response Facilities," U.S. Nuclear Regulatory Commission, February 1981.

12. NUREG-0700, Rev. 2, "Human-System Interface Design Review Guidelines," U.S. Nuclear Regulatory Commission.

13. WEC 3.3.1, Rev. 5, "Design Reviews," Westinghouse Electric Company LLC, effective February 18, 2013.

BIBLIOGRAPHY (cont.)

14. WEC 6.1, Rev. 4.1, "Document Control," Westinghouse Electric Company LLC, effective February 18, 2013.

15. WEC 3.3.3, Rev. 0.0, "Design Verification," Westinghouse Electric Company LLC, effective March 26, 2013.

16. APP-GW-GJP-100, Rev. 0, "Writer's Guideline for Operating Procedures," Westinghouse Electric Company LLC. (Proprietary)

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SECTION 1
INTRODUCTION

1.1 OVERVIEW

1.1.1 Purpose

The purpose of this document is to define the Human Factors Engineering (HFE) design verification plan at plant startup for the AP1000® plant. This document is part of the AP1000 HFE verification and validation (V&V) assessments.

The function of the HFE V&V assessments is to demonstrate that the AP1000 design attains a high standard of human factors adequacy and that it conforms to the human factors principles and guidance as specified in APP-OCS-GBH-001, "AP1000 Human Factors Engineering Program Plan" (Reference 2); APP-OCS-GEH-020 (WCAP-15860), "Programmatic Level Description of the AP1000 Human Factors Verification and Validation Plan" (Reference 3); NUREG-0711, "Human Factors Engineering Program Review Model" (Reference 4); and ISO 11064-7, "Ergonomic Design of Control Centers, Part 7: Principles for the Evaluation of Control Centers" (Reference 5).

1.1.2 Prerequisite

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1.1.3 Process Strategy

Formal HFE V&V assessments are an integral part of the overall HFE design process. These assessments include the following implementation plans and results reports as defined in the HFE Program Plan (Reference 2):

- APP-OCS-GEH-120, "AP1000 Human Factors Engineering Design Verification Plan" (Bibliog 3)
- APP-OCS-GER-120, "AP1000 Human Factors Engineering Design Verification Report" [LATER]
- APP-OCS-GEH-220, "AP1000 Human Factors Engineering Task Support Verification Plan" (Bibliog 4)
- APP-OCS-GER-220, "AP1000 Human Factors Engineering Task Support Verification Report" [LATER]
- APP-OCS-GEH-320, "AP1000 Human Factors Engineering Integrated System Validation Plan" (Bibliog 5)

- APP-OCS-GER-320, "AP1000 Human Factors Engineering Integrated System Validation Report" [LATER]
- APP-OCS-GEH-420, "AP1000 Human Factors Engineering Discrepancy Resolution Process" (Bibliog 6)
- APP-OCS-GER-420, "AP1000 Human Factors Engineering Resolution Verification Report" [LATER]
- APP-OCS-GER-520, "AP1000 Plant Startup Human Factors Engineering Design Verification Report" [LATER].

These HFE V&V assessments are a check of the adequacy of the Human System Interface (HSI) resources and Operation and Control Centers Systems (OCS). [

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1.2 SCOPE

1.2.1 Applicability

This document is applicable to the AP1000 HSI resources and OCS as identified in subsection 1.2.2 of the document.

1.2.2 List of Design Features Requiring Verification

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1. HFE aspects of the design that could not be fully evaluated in HFE design verification or task support verification. [

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2. The as-built in the plant HSIs, procedures, and training as follows:

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3. All HFE-related issues (including human engineering discrepancies [HEDs]) documented in the Human Factors Tracking System will be verified to ensure they are adequately addressed or resolved.

4. HFE aspects of local actions in risk-important tasks, [

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1.2.3 Limitation of Scope

The Technical Support Center (TSC) and Emergency Operations Facility (EOF) are not included as part of the HFE design verification at plant startup. APP-OCS-GGR-110, "AP1000 Technical Support Center

and Emergency Operations Facility Workshop" (Bibliog 9) provides details regarding the division of responsibility between plant startup HFE design verification and the utilities in relation to the EOF and TSC. The HFE V&V scope of work is limited to the provision of data and displays from the AP1000 control system to support the TSC and EOF functions. This is addressed in Task Support Verification (see APP-OCS-GEH-220, "AP1000 Human Factors Engineering Task Support Verification Plan" Bibliog 4). The utilities are responsible for the remaining human factors V&V aspects of the TSC and EOF, and will be covered via drills and exercises in accordance with NUREG-0654 "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants" (Bibliog 10) and NUREG-0696 "Functional Criteria for Emergency Response Facilities" (Bibliog 11).

1.3 OBJECTIVE

The overall objective of the HFE V&V is to ensure that the AP1000 OCS/HSI design attains a high standard of human factors adequacy and thereby contributes to the safety, operability and maintainability of the plant.

The objectives of the plant startup HFE design verification are to:

- Confirm aspects of the OCS/HSI design features that could not be evaluated in other HFE V&V activities.
- Confirm that the as-built in the plant HSIs, procedures, and training conform to the design that resulted from the HFE program.
- Confirm that all HFE-related issues (including HEDs) documented in the Human Factors Tracking System are verified as adequately addressed or resolved.
- Confirm the HFE adequacy for risk-important human actions in local plant, including the ability for the tasks to be completed within the time windows according to the Probabilistic Risk Assessment (PRA).

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SECTION 2
VERIFICATION PROCESS

In general, 1) the specific design features (e.g., control room lighting and noise) are evaluated against HF guidelines (i.e., APP-OCS-J1-002, "AP1000 Human System Interface Design Guidelines" (Bibliog 1), and APP-GW-GRP-001, "AP1000 Local Panels and Maintainability Human Factors Design Guidelines" (Bibliog 2)) by an independent verifier; 2) the as-built in the plant HSI resources are evaluated against the design that resulted from the HFE program by an independent verifier; and 3) all HFE-related issues (including HEDs) documented in the HFE issue tracking system are evaluated by an independent verifier to confirm they have been adequately addressed or resolved.

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The results of the Plant Startup HFE Design Verification will be formally documented in the associated report. [

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SECTION 3
METHODOLOGY AND MEASUREMENTS

3.1 PERSONNEL REQUIREMENTS AND TECHNIQUES

The Human Factors Manager is responsible for the plant startup HFE design verification activity, including the identification of Human Factors (HF) independent verifiers. To provide an independent and unbiased review, the plant startup HFE design verification process is performed by the designated HF independent verifiers. The independent verification will be conducted in accordance with the appropriate quality assurance policies and procedures. [

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The independent verifiers will document the results of the verification in APP-OCS-GER-520, "AP1000 Plant Startup HFE Design Verification Report."

3.2 DELIVERABLES

The deliverables are defined in Section 5.9, "Verification and Validation" of Reference 2.

The results of the plant startup HFE design verification assessment are documented in APP-OCS-GER-520, "AP1000 Plant Startup HFE Design Verification Report." The purpose of this report is to document the results of the plant startup HFE design verification process. [

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