

December 9, 2016

Sarah DiTommaso, Manager  
AP1000 Instrumentation & Control Licensing  
Westinghouse Electric Company  
5000 Ericsson Dr.  
Warrendale, PA 15086

SUBJECT: NUCLEAR REGULATORY COMMISSION INSPECTION OF WESTINGHOUSE  
ELECTRIC COMPANY REPORT NUMBER 99900404/2016-206

Dear Ms. DiTommaso:

On October 25 to October 27, 2016, the U.S. Nuclear Regulatory Commission (NRC) staff conducted an inspection at the Westinghouse Electric Company (WEC) facility in Cranberry Township, PA. The purpose of the limited-scope inspection was to assess WEC's implementation of aspects of the WEC Human Factors Engineering (HFE) program to determine if it adequately complies with the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," and Part 50, "Domestic Licensing of Production and Utilization Facilities."

This inspection specifically evaluated WEC's implementation of aspects of the HFE program associated with the HFE verification and validation activities including: Human-System Interface (HSI) Task Support Verification (TSV) and Integrated System Validation (ISV). These activities include inspections, tests, analyses, and acceptance criteria (ITAAC) from Appendix C from the Combined License for Vogtle Units 3 and 4 and V.C. Summer Units 2 and 3. Specifically, these activities were associated with ITAAC 3.2.00.01a (Index No. 739), 3.2.00.01c.i (Index No. 741), 3.2.00.01c.ii (Index No. 742), and 3.2.00.01d (Index No. 743).

The enclosed report presents the results of this inspection.

Within the scope of this inspection, no violations or non-conformances were identified. The NRC inspectors did not identify any findings associated with the ITAAC contained in Section 4 of the attachment to this report.

In accordance with 10 CFR 2.390, "Public Inspections, Exemptions, Requests for Withholding," of the NRC's Rules of Practice, a copy of this letter, its enclosures, and your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's document system, Agencywide Documents Access and Management System, which is accessible from the NRC Web site at <http://www.nrc.gov/readingrm/adams.html>. To the extent possible, your response (if applicable), should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request that such material is withheld from public disclosure, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for

your claim (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If safeguards information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Sincerely,

*/RA/*

Terry W. Jackson, Chief  
Quality Assurance Vendor Inspection Branch-1  
Division of Construction Inspection  
and Operational Programs  
Office of New Reactors

Docket No.: 99900404

Enclosure:  
Inspection Report No. 99900404/2016-206  
and Attachment

your claim (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If safeguards information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Sincerely,

**/RA/**

Terry W. Jackson, Chief  
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**U.S. NUCLEAR REGULATORY COMMISSION  
OFFICE OF NEW REACTORS  
DIVISION OF CONSTRUCTION INSPECTION AND OPERATIONAL PROGRAMS  
VENDOR INSPECTION REPORT**

Docket No.: 99900404

Report No.: 99900404/2016-206

Vendor: Westinghouse Electric Company  
5000 Ericsson Dr.  
Warrendale, PA 15086

Vendor Contact: Sarah DiTommaso, Manager  
AP1000 Instrumentation & Control Licensing  
Westinghouse Electric Company  
Email: ditomms@westinghouse.com

Nuclear Industry Activity: Westinghouse Electric Company, LLC, located at 5000 Ericsson Drive, Suite 517, Warrendale, PA 15086, whose scope of supply includes but is not limited to safety-related design, fabrication, testing, and delivery of HFE design for the current US AP1000 plants under construction.

Inspection Dates: October 25-27, 2016

Inspection Team Leader: Greg Galletti, NRO/DCIP/QVIB-1

Inspectors: Lauren Kent, NRO/DCIP/HOIB  
Paul Pieringer, NRO/DCIP/HOIB  
Brian Green, NRO/DCIP/HOIB  
Lisa Castelli, NRO/DE/ICE1

Approved by: Terry W. Jackson, Chief  
Quality Assurance Vendor Inspection Branch-1  
Division of Construction Inspection  
and Operational Programs  
Office of New Reactors

Enclosure

## **EXECUTIVE SUMMARY**

Westinghouse Electric Company  
99900404/2016-206

The U.S. Nuclear Regulatory Commission (NRC) staff conducted this vendor inspection to verify that Westinghouse Electric Company, LLC (hereafter referred to as WEC), implemented an adequate Human Factors Engineering (HFE) program that complies with the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," and Part 50, "Domestic Licensing of Production and Utilization Facilities." The inspectors conducted this inspection at the WEC facility in Cranberry Township, PA, on October 25-27, 2016.

This inspection specifically evaluated WEC's implementation of aspects of the HFE program associated with the HFE verification and validation activities including Human System Interface (HSI) Task Support Verification (TSV) and Integrated System Validation (ISV). These HFE V&V activities are associated with Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) 3.2.00.01a (Index No. 739), 3.2.00.01c.i (Index No. 741), 3.2.00.01c.ii (Index No. 742), and 3.2.00.01d (Index No. 743), which are listed in the combined licenses for V.C. Summer Units 2 and 3 and Vogtle Units 3 and 4.

The following regulations served as the bases for this NRC inspection:

- 10 CFR 52.47
- 10 CFR 50.34(f)

The inspectors used Inspection Procedure (IP) 43002, "Routine Inspections of Nuclear Vendors," dated July 15, 2013, and IP 65001.23, "Inspection of Human Factors Engineering Verification and Validation ITAAC," dated December 22, 2014.

The information below summarizes the results of this inspection.

### **ITAAC 3.2.00.01a (Index No. 739), Task Support Verification**

The inspectors performed a direct inspection of activities associated with ITAAC 3.2.00.01a (Index No. 739), HSI TSV. The inspectors used NRC Vendor Inspection Report Number 9990404/2015-201 dated April 5, 2016 (ADAMS Accession No. ML16091A462) to inform the inspection. NRC Vendor Inspection Report Number 999004042015-201 documents that the inspectors reviewed APP-OCS-GER-220, "AP1000 Human Factors Engineering Task Support Verification Summary Report" (GER-220), Revision 0, and concluded (1) TSV activities were conducted in conformance with the implementation plan, and (2) GER-220 includes verification that the information and controls provided by the HSI match the display and control requirements generated by the function-based task analyses and the operational sequence analyses. During this inspection, the inspectors found that GER-220 had been revised in June 2016. The inspectors reviewed GER-220, Revision 1, and found that the scope of the revision consisted of editorial changes that did not change the conclusions documented in the April 2016 inspection report. No findings of significance were identified.

#### ITAAC 3.2.00.01c.i (Index No. 741), ISV Implementation

The inspectors determined deficiencies were appropriately identified as required by APP-OCS-GEH-320, "AP1000 Human Factors Engineering Integrated System Validation Plan" (GEH-320). APP-OCS-GER-320, "AP1000 Human Factors Engineering Integrated System Validation Report" (GER-320), acceptably describes the implementation and results of the ISV. Based on these conclusions, ITAAC 3.2.00.01c.i (Index No. 741) has been satisfactorily addressed. Resolution of the deficiencies identified in the verification and validation activities are tracked under ITAAC 3.2.00.1d (Index No. 743). No findings of significance were identified.

#### ITAAC 3.2.00.01c.ii (Index No. 742), Demonstrate Capability to Manage Evolutions and Events

The inspectors determined that the process for resolving Human Engineering Discrepancies (HEDs) and the retesting of the corrective actions that derive from these resolutions is in progress. Specifically, corrective actions need to be implemented and appropriate retest requirements met in order to conclude that the test and analysis results demonstrate that the main control room (MCR) operators can perform the plant operations described. Completion of resolution plans and retesting of the resultant corrective actions is needed to support closure of ITAAC 3.2.00.01c.ii (Index No. 742). The work completed so far conforms to the control procedures. No findings of significance were identified.

#### ITAAC 3.2.00.01d (Index No. 743), HFE Design Issue Resolution Verification

The inspectors determined WEC performed HED prioritization as required by APP-OCS-GEH-420, "AP1000 Human Factors Engineering Discrepancy Resolution Process" (GEH-420). The inspectors also determined that the implementation of WEC's cumulative effects analysis was thorough, of high quality and conformed to programmatic requirements contained in GEH-420.

Additionally, the inspectors determined issue resolution plan development and issue resolution tracking were being conducted consistent with their administrative control, the requirements in GEH-420, and their licensing commitments. When WEC completes the HFE discrepancy resolution report, the inspectors identified the following items as requiring additional inspection to verify issues have been adequately addressed in the final design: (1) WEC's issue resolution implementation, (2) WEC's implementation of the retesting requirements of GEH-420 and GEH-320, and (3) the results of the retesting. No findings of significance were identified.

## REPORT DETAILS

### 1. ITAAC 3.2.00.01a (Index No. 739), Task Support Verification

#### a. Inspection Scope

The inspectors performed a direct inspection of activities associated with ITAAC 3.2.00.01a (Index No. 739), Human-System Interface (HSI) Task Support Verification (TSV). The inspectors used NRC Vendor Inspection Report Number 9990404/2015-201 dated April 5, 2016 (ADAMS Accession No. ML16091A462), to inform the inspection. NRC Vendor Inspection Report Number 9990404/2015-201 states that the inspectors reviewed APP-OCS-GER-220, "AP1000 Human Factors Engineering Task Support Verification" (GER-220), Revision 0, and concluded TSV was conducted in conformance with the implementation plan, APP-OCS-GEH-220, "AP1000 Human Factors Engineering Task Support Verification Plan." The April 2016 inspection report also states the inspectors confirmed that the report included verification that the information and controls provided by the HSI match the display and control requirements generated by the function-based task analyses and the operational sequence analyses.

During this inspection, the inspectors found that GER-220 had been revised in June 2016. The inspectors reviewed GER-220, Revision 1, and found that the scope of the revision was limited to editorial changes that did not change the conclusions documented in the April 2016 inspection report.

#### b. Observations and Findings

No findings of significance were identified.

#### c. Conclusion

The inspectors determined that the revision to GER-220 did not change the conclusion that TSV activities were conducted in conformance with the implementation plan and included verification that the information and controls provided by the HSI match the display and control requirements generated by the function-based task analyses and the operational sequence analyses. No findings of significance were identified.

### 2. ITAAC 3.2.00.01c.i (Index No. 741), Integrated System Validation (ISV) Implementation

#### a. Inspection Scope

GER-320 describes the scenarios used in the ISV and the deficiencies identified as each scenario was completed. As stated in NRC Vendor Inspection Report Number 9990404/2015-201, the inspectors selected a sample of ISV scenarios to observe based on maximizing the observation of scenarios containing important human actions and/or complex operational challenges while still providing a diverse set of scenarios including a plant startup. The inspectors determined that the implementation of the ISV performance testing including scenario adequacy and completeness; simulator fidelity; and ISV team performance; were adequately controlled throughout the performance of the ISV testing.

As stated in NRC Vendor Inspection Report Number 9990404/2015-201, the inspectors reviewed GER-320, Revision 0, and verified WEC identified Human Engineering Discrepancies (HEDs) when the acceptance criteria associated with ISV performance measures were not satisfied. The documentation of HEDs was determined to be complete and supports closure of ITAAC 3.2.00.01c.i (Index No. 741).

During this inspection, the inspectors found GER-320 had been revised in October 2016. The inspectors reviewed GER-320, Revision 2, and found that the changes made to GER-320 did not change the conclusions documented in the April 2016 inspection report about the adequacy of WEC's implementation of the ISV.

b. Observations and Findings

No findings were identified in this area.

c. Conclusions

The inspectors determined deficiencies were appropriately identified as required by GEH-320. GER-320 acceptably describes the implementation and results of the ISV. Based on these conclusions, ITAAC 3.2.00.01c.i (741) has been satisfactorily addressed. Resolution of the deficiencies identified in the verification and validation activities are tracked under ITAAC 3.2.00.1d (743). No findings were identified in this area.

3. ITAAC 3.2.00.01c.ii (Index No. 742), Demonstrate Capability to Manage Evolutions and Events

a. Inspection Scope

One of the primary objectives of the ISV is to demonstrate that the main control room operators can safely operate the plant. This is accomplished by using a simulator to run a series of scenarios that include a wide variety of operational conditions the plant could experience. These scenarios have pass/fail criteria associated with them to distinguish when major challenges in operating safely might exist. These challenges are evaluated to determine underlying problems, and then corrective actions are taken. The corrective actions are then retested to verify the scenarios can be successfully performed. This process is defined by GEH-320 and GEH-420.

GER-320 contains a conclusion that the test and analysis results demonstrate that the MCR operators can perform the following:

- Heat up and start up the plant to 100% power
- Shut down and cool down the plant to cold shutdown
- Bring the plant to safe shutdown following the specified transients:
  - Reactor Trip
  - Turbine Trip
- Bring the plant to a safe, stable state following the specified accidents:
  - Small-break Loss of Coolant Accident (LOCA)
  - Large-break LOCA
  - Steam line break



- Feedwater line break
- Steam generator tube rupture

The report then concludes with a note that, “Exceptions are noted in the list of HEDs provided in section 5.”

ITAAC 3.2.00.01c.ii (Index No. 742) verifies that operators can perform these evolutions. In reviewing the ISV results in GER-320 and interviewing WEC personnel, the inspectors determined that five scenarios, including a plant startup scenario, did not pass their pass/fail criteria for at least one or more of the scenario trials, and corrective actions are still ongoing. The inspectors concluded that the ISV successfully identified challenges to operating safely, but those challenges must be resolved before the more general conclusion on the ability to safely operate the plant can be made. Therefore, the HFE design process as approved in the AP1000 safety evaluation has not been completed, and ITAAC 3.2.00.01c.ii (Index No. 742) cannot be closed until the HFE design process is completed. Specifically, corrective actions (i.e., HED resolution plans) need to be implemented and appropriate retest requirements met in order to conclude that the test and analysis results demonstrate that the MCR operators can perform the plant operations described.

b. Observations and Findings

No findings of significance were identified.

c. Conclusions

The inspectors determined that the process for resolving HEDs and the retesting of the corrective actions that derive from these resolutions are in progress. Specifically, corrective actions need to be implemented and appropriate retest requirements met in order to conclude that the test and analysis results demonstrate that the MCR operators can perform the plant operations described. Completion of resolution plans and retesting of the resultant corrective actions is needed to support closure of ITAAC 3.2.00.01c.ii (Index No. 742). The work completed so far conforms to the control procedures. No findings of significance were identified.

4. ITAAC 3.2.00.01d (Index No. 743), HFE Design Issue Resolution Verification

Prioritizing, Analyzing and Resolving HEDs

a. Inspection Scope

The inspectors reviewed WNA-WI-00411-WAPP, “Human Engineering Discrepancy Resolution Process Work Instruction,” Revision 2, dated August 2015, which contains WEC’s procedures for prioritizing, analyzing, and resolving HEDs identified during TSV, Design Verification (DV) and ISV. The inspectors found it implements the requirements of GEH-420 for prioritizing, analyzing, and resolving HEDs.

The inspectors reviewed APP-OCS-GLR-320, “Human Factors Engineering - HED Resolution Report” (GLR-320), Revision 0, dated October 2016, to verify that the prioritization, analysis, and resolution of HEDs conform to GEH-420 and WEC’s procedures. The inspectors found GLR-320, Attachment 1,

“APP-OCS-GLR-320\_420\_HED Processing.xlsx,” documented the results of WEC’s prioritization process as well as HED analysis and HED resolution plans.

The inspectors confirmed that GLR-320, Attachment 1, included each HED identified during the V&V activities, which are documented in GER-120, GER-220 and GER-320. The inspectors verified GLR-320, Attachment 1 identified a Priority level for each HED as required by GEH-420. The inspectors also confirmed GLR-320, Attachment 1, included a resolution plan for each Priority 1 and 2 HED as required by GEH-420. The inspectors found WEC also developed resolution plans for each of the Priority 3 HEDs.

The inspectors found that all of the Priority 1 HEDs were addressed with a resolution plan that includes modifying one or more aspects of the integrated system (i.e., no Priority 1 HEDs were justified to remain as-is in the final design). In some cases, the inspectors found the resolution plans were still under development. For example, resolution plans for Priority 1 HEDs associated with the alarm presentation system described actions that were taken to identify modifications to the final design that will be required to resolve the HEDs. However, these resolution plans did not yet identify the specific modifications that will be implemented. Further inspection in this area will be required once the resolution process described in GEH-420 is complete. Other resolution plans for Priority 1 HEDs identified the specific modifications that will be performed to address the issue in the final design.

The inspectors found that all the Priority 2 and 3 HEDs were addressed with either a resolution plan that includes modifying one or more aspects of the integrated system or a justification. The inspectors selected a sample of resolution plans and justifications for Priority 2 and 3 HEDs associated with the alarm presentation system (APS), feedwater control system, rod control system, diverse actuation system, and passive core cooling system because these systems were either associated with a relatively large number of HEDs and/or documented instances where test personnel consistently struggled to operate the system during the ISV.

The inspectors reviewed the justifications for the Priority 2 and 3 HEDs sampled, and the inspectors also discussed the technical bases for the justifications with WEC personnel. The inspectors determined that HEDs were justified when the discrepancy either (1) occurred only once during the multiple scenarios conducted as part of the ISV and was not repeatable, (2) did not result in any significant consequences that affected plant safety, performance or efficiency during the ISV scenarios, (3) was determined after further analysis not to be valid, or (4) was determined to be an enhancement to an aspect of the integrated system. The inspectors determined the bases for the justifications were reasonable and conformed to the requirements of GEH-420. Additionally, the inspectors noted that WEC personnel exercised a conservative determination of Priority for the Priority 2 and 3 HEDs sampled.

The inspectors reviewed the resolution plans for the Priority 2 and 3 HEDs sampled and, in some cases, found the resolution plans were still under development. For example, resolution plans for Priority 2 HEDs associated with the alarm presentation system described actions that were taken to identify modifications to the final design that will be required to resolve the HEDs. However, like the resolution plans for Priority 1 HEDs associated with the alarm presentation system, these resolution plans did not yet identify the specific modifications that will be implemented. Further inspection in this area will be required once the resolution process described in GEH-420 is complete. Other

resolution plans for Priority 2 and 3 HEDs identified the specific modifications that will be performed to address the issue in the final design.

b. Observations and Findings

No findings of significance were identified.

c. Conclusions

The inspectors determined WEC's implementation of their procedures for prioritizing HEDs had been adequately implemented in accordance with the requirements of GEH-420. The inspectors concluded that justifications for HEDs that will remain in the final design as-is were appropriate. Further inspection of the HED resolution plans will be required once the resolution process described in GEH-420 is complete. No findings of significance were identified.

Tracking HEDs

a. Inspection Scope

The inspectors reviewed WNA-WI-00411-WAPP, "Human Engineering Discrepancy Resolution Process Work Instruction," Revision 2, which contains WEC's procedure for tracking HEDs identified during TSV, DV and the ISV and found that it implements the requirements of GEH-420 for tracking HEDs in the Human Factors Tracking System.

To verify that all TSV, DV, and ISV HEDs were tracked in the Human Factors Tracking System, the inspectors compared the list of HEDs documented in GLR-320, Attachment 1, to the Human Factors Tracking System. The inspectors found the HED number and description as documented in GLR-320, Attachment 1, was entered in the Human Factors Tracking System for each HED. The inspectors also observed the Human Factors Tracking System assigned each HED a unique tracking number, which was also documented in GLR-320, Attachment 1. The inspectors observed that WEC personnel were in the process of updating the Human Factors Tracking System with additional information required by WEC's procedure (e.g., a description of the issue resolution).

The inspectors also observed that WEC's procedure contains an additional requirement to track each of the individual HED issues in the Replacement and Automation Services (RRAS) Issue Tracking System (RITS). For a sample of TSV, DV, and ISV HEDs, the inspectors compared GLR-320, Attachment 1, to the RITS and found they were being tracked by the RITS in accordance with WEC's procedure.

b. Observations and Findings

No findings of significance were identified.

c. Conclusions

The inspectors determined the HEDs have been entered in the Human Factors Tracking System and assigned a unique tracking number, and therefore the HEDs are being tracked. When WEC completes the HFE discrepancy resolution report, additional

inspection will be performed to verify the Human Factors Tracking System contains all of the information required by GEH-420. No findings of significance were identified.

### Categorizing and Analyzing the Cumulative Effects of HEDs

#### a. Inspection Scope

As noted in NRC Vendor Inspection Report Number 9990404/2015-201, the inspectors determined convergence analysis (i.e., an evaluation of whether multiple measures support the existence of a deficiency) was used effectively to reinforce the existence of a problem identified during ISV as required by GEH-320. The inspectors found that HEDs ranged from a single significant problem, such as failure of to meet a pass/fail criteria for an ISV scenario, to HEDs that documented the impact of multiple individual issues contributing to the more significant problem identified in the HED. The inspectors noted that the HEDs identified by the ISV provided substantial evidence that a detailed analysis was completed of the aggregate impact of the individual issues.

During this inspection, the inspectors reviewed WNA-WI-00411-WAPP, "Human Engineering Discrepancy Resolution Process Work Instruction," Revision 2, which contains WEC's procedure for categorizing and analyzing the cumulative effects of HEDs identified during TSV, DV and ISV. The inspectors found it implements the requirements of GEH-420. The inspectors reviewed the results of WEC's cumulative effects analysis documented in GLR-320 and also discussed the cumulative effects analysis methodology with WEC personnel to verify the extent of condition was well understood and the analysis was used effectively to identify the impact of multiple HEDs on a particular aspect of the control room design, HSI design, procedures, training, staffing or work organization.

The inspectors found that subsequent to identifying and prioritizing all of the DV, TSV, and ISV HEDs, WEC categorized each HED in accordance with the requirements of WEC's procedure and GEH-420. The inspectors found that WEC sorted and grouped all of the DV, TSV, and ISV HEDs by the various categories to evaluate the impact of multiple HEDs on a particular aspect of the control room design, procedures, training, or work organization. Although GEH-420 requires only Priority 1 and 2 HEDs to be included in the cumulative effects analysis, the inspectors noted that all Priority 3 issues were also included.

The documentation in GLR-320, Attachment 1, clearly identified how the lower Priority issues rolled up into higher Priority, more generic issues and cumulative effects. The inspectors determined WEC's method for performing the cumulative effects analysis provided for a structured approach for associating similarities between HEDs, which in turn supported the objectives of identifying generic issues among the larger number of specific issues and identifying whether there were impacts on an aspect of the integrated system as a result of multiple HEDs identified during the V&V evaluations. The inspectors found the analysis performed by WEC personnel to be thorough, well-informed on operational impact, and demonstrated a conservative determination of both specific issue extent of condition, generic issues, and the most appropriate overall resolution.

The inspectors noted that the generic issues identified by the cumulative effects analysis had not been entered into the tracking system as documented in the WNA-WI-00411-WAPP, "Human Engineering Discrepancy Resolution Process Work Instruction." Westinghouse initiated CAPAL #100424942, "Issuance of HFE HEDs and Tracking," dated October 26, 2016, to address the issue.

b. Observations and Findings

No findings of significance were identified.

c. Conclusions

The inspectors determined WEC's implementation of the cumulative effects analysis was thorough; of high quality; provided an adequate rollup of HEDs into higher level, generic HEDs; and conformed to the requirements of GEH-420. No findings of significance were identified.

HFE Design Issue Resolution Verification Conclusions

The inspectors determined WEC performed HED prioritization and the cumulative effects analysis as required by GEH-420. Additionally, the inspectors determined issue resolution plan development and issue resolution tracking were being conducted consistent with their administrative control, the requirements in GEH-420, and their licensing commitments. When WEC completes the HFE discrepancy resolution report, the inspectors identified the following items as requiring additional inspection to verify issues have been adequately addressed in the final design: (1) WEC's issue resolution implementation, (2) WEC's implementation of the retesting requirements of GEH-420 and GEH-320, and (3) the results of the retesting. No findings of significance were identified.

Entrance and Exit Meetings

On October 25, 2016, the inspectors presented the inspection scope during an entrance meeting with Mr. Jan Dudiak, Director, Automation and Field Services (WEC-AFS), of WEC, and other WEC personnel. On October 27, 2016, the inspectors presented the inspection results during an exit meeting with Mr. Jan Dudiak, Director, WEC-AFS, and other WEC personnel.

## ATTACHMENT

1. PERSONS CONTACTED AND NRC STAFF INVOLVED:

Name	Affiliation	Entrance	Exit	Interviewed
Jan Dudiak	WEC-AFS	X	X	
Michael Moser	WEC		X	
Chuck Lease	WEC-AFS	X	X	X
Sarah DiTommaso	WEC	X	X	X
Bob Hirmanpour	SNC	X	X	X
Robert Fuld	WEC	X		
Robert Lane	WEC	X	X	
Peter LeRoy	WEC	X	X	
Jim Vazzann	WEC	X		
Rick Paese	WEC	X		X
Brock Wilbanks	SNC	X	X	
Jason Weathersby	SCE&G	X	X	
Greg Cesare	WEC	X	X	
David Hawes	SNC	X	X	
Thomas Rubenstein	WEC		X	
Paul Russ	WEC		X	
April Rice	SCE&G		X	
Garrett Sanders	SCE&G		X	
Christopher Landon	WEC	X		
Greg Galletti	NRC	X	X	
Lisa Castelli	NRC	X	X	
Lauren Kent	NRC	X	X	
Brian Green	NRC	X	X	
Paul Pieringer	NRC	X	X	

2. INSPECTION PROCEDURES USED:

IP 43002, "Routine Inspections of Nuclear Vendors," dated July 15, 2013

IP 65001.23, "Inspection of Human Factors Engineering Verification and Validation ITAAC," dated December 22, 2014.

3. LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED:

Item Number	Status	Type	Description	Applicable ITAAC
None				

#### 4. INSPECTIONS, TESTS, ANALYSES, AND ACCEPTANCE CRITERIA:

The U.S. Nuclear Regulatory Commission (NRC) inspectors identified the following ITAAC related to components being designed, manufactured, and tested at WEC. At the time of the inspection, WEC was involved in certain engineering analysis activities related to the ISV for the AP1000 reactor control room and remote shutdown panel design. For the ITAAC listed below, the inspectors reviewed WEC's QA controls and implementation of the aspects of the WEC Human Factors Engineering Program Plan in the areas of TSV and ISV. The ITAAC design commitments referenced below are for future use by the NRC staff during the ITAAC closure process; the listing of these ITAAC design commitments does not constitute that they have been met and/or closed. The inspectors did not identify any findings associated with these ITAAC during this inspection.

This section of the inspection report focuses on the vendor's implementation of aspects of their programs for HFE analysis activities associated with TSV and ISV. This included a review of on-going HFE program plan documentation addressing AP1000 ITAAC 3.2.00.01a (Index No. 739), 3.2.00.01c.i (Index No. 741), 3.2.00.01c.ii (Index No. 742), and 3.2.00.01d (Index No. 743). Specifically the inspectors reviewed the implementation of the TSV and ISV to verify consistency with the design commitments and the acceptance criteria of the ITAACs. The goal of these inspection activities is to examine the governing documents and samples of engineering activities that demonstrate the implementation of the design commitments and design attributes in order to provide a comprehensive inspection of specific aspects of the HFE program plan as stated in the ITAAC design commitments.

<b>ITAAC Index No.</b>	<b>ITAAC Section No.</b>	<b>Design Commitment</b>	<b>Inspections, Tests, Analyses</b>	<b>Acceptance Criteria</b>
739	3.2.00.01a	1. The HFE verification and validation program is performed in accordance with the HFE verification and validation implementation plan and includes the following activities: a) HSI Task support verification	a) An evaluation of the implementation of the HSI task support verification will be performed.	a) A report exists and concludes that: Task support verification was conducted in conformance with the implementation plan and includes verification that the information and controls provided by the HSI match the display and control requirements generated by the function-based task analyses and the operational sequence analyses.
741	3.2.00.01c.i	1. The HFE verification and validation program is performed in accordance with the HFE verification and validation implementation plan and includes the following activities: c) Integrated system validation	c) (i) An evaluation of the implementation of the integrated system validation will be performed.	c) (i) A report exists and concludes that: The test scenarios listed in the implementation plan for integrated system validation were executed in conformance with the plan and noted human deficiencies were addressed.
742	3.2.00.01c.ii	1. The HFE verification and validation program is performed in accordance with the HFE verification and validation implementation plan and includes the following activities: c) Integrated system validation	c) (ii) Tests and analyses of the following plant evolutions and transients, using a facility that physically represents the MCR configuration and dynamically represents the MCR HSI and the operating characteristics and responses of the AP1000 design, will be performed:	c) (ii) A report exists and concludes that: The test and analysis results demonstrate that the MCR operators can perform the following: – Heat up and start up the plant to 100% power – Shut down and cool down the plant to cold shutdown – Bring the plant to safe shutdown following the specified transients



<b>ITAAC Index No.</b>	<b>ITAAC Section No.</b>	<b>Design Commitment</b>	<b>Inspections, Tests, Analyses</b>	<b>Acceptance Criteria</b>
			<ul style="list-style-type: none"> <li>– Normal plant heatup and startup to 100% power</li> <li>– Normal plant shutdown and cooldown to cold shutdown</li> <li>– Transients: reactor trip and turbine trip</li> <li>– Accidents: <ul style="list-style-type: none"> <li>- Small-break LOCA</li> <li>- Large-break LOCA</li> <li>- Steam line break</li> <li>- Feedwater line break</li> <li>- Steam generator tube rupture</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>– Bring the plant to a safe, stable state following the specified accidents</li> </ul>
743	3.2.00.01d	<p>1. The HFE verification and validation program is performed in accordance with the HFE verification and validation implementation plan and includes the following activities:</p> <p>d) Issue resolution verification</p>	<p>d) An evaluation of the implementation of the HFE design issue resolution verification will be performed.</p>	<p>d) A report exists and concludes that: HFE design issue resolution verification was conducted in conformance with the implementation plan and includes verification that human factors issues documented in the design issues tracking system have been addressed in the final design.</p>

5. DOCUMENTS REVIEWED:

- APP-OCS-GEH-320, "AP1000 Human Factors Engineering Integrated System Validation Plan," Revision 6, January 2015
- APP-OCS-GEH-420, "AP1000 Human Factors Engineering Discrepancy Resolution Process," Revision 2, December 2014
- APP-OCS-GLR-320, "AP1000 Human Factors Engineering - HED Resolution Report," Revision 0, October 2016
- APP-OCS-GER-120, "AP1000 HFE Design Verification Report," Revision 1, September 2015
- APP-OCS-GER-220, "AP1000 Human Factors Engineering Task Support Verification Summary Report," Revision 1, June 2016
- APP-OCS-GER-320, "AP1000 Human Factors Engineering Integrated System Validation Report," Revision 0, October 2015
- APP-OCS-GER-320, "AP1000 Human Factors Engineering Integrated System Validation Report," Revision 2, October 2016
- WNA-WI-00411-WAPP, "Human Engineering Discrepancy Resolution Process Work Instruction," Revision 2, August 2015

6. ACRONYMS USED:

ADAMS	Agencywide Documents Access and Management System
CAPAL	Corrective Action Program and Learning system
CFR	Code of Federal Regulations
DAC	Design Acceptance Criteria
DCIP	Division of Construction Inspection and Operational Programs
DV	Design Verification
QVIB-1	Quality Assurance Vendor Inspection Branch 1
HED	Human Engineering Discrepancies
HFE	Human Factors Engineering
HSI	Human-System Interface
IP	Inspection Procedure
ISV	Integrated System Validation
ITAAC	Inspections, tests, analyses, and acceptance criteria
LOCA	Loss of Coolant Accident
MCR	Main Control Room
NRC	(U.S.) Nuclear Regulatory Commission
NRO	Office of New Reactors
OCS	Operation and Control Centers
RITS	Replacement and Automation Services (RRAS) Issue Tracking System
RRAS	Replacement and Automation Services
TSV	Task Support Verification
U.S.	United States (of America)
V&V	Verification and Validation
WEC	Westinghouse Electric Company
WEC-AFS	Automation Field Services